Power chuck
ROTA NCR-A
Assembly and Operating Manual

Translation of Original Operating Manual

Hand in hand for tomorrow

Imprint

Technical changes:
We reserve the right to make alterations for the purpose of technical improvement.

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Dear Customer,

Thank you for trusting our products and our family-owned company, the leading technology supplier of robots and production machines.

Our team is always available to answer any questions on this product and other solutions. Ask us questions and challenge us. We will find a solution!

Best regards,

Your SCHUNK team

Customer Management

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Please read the operating manual in full and keep it close to the product.

Table of Contents

1 General

1.1 About this manual

This manual contains important information for a safe and appropriate use of the product.

This manual is an integral part of the product and must be kept accessible for the personnel at all times.

Before starting work, the personnel must have read and understood this operating manual. Prerequisite for safe working is the observance of all safety instructions in this manual.

In addition to these instructions, the documents listed under ▸ 1.1.2 [🗋 6] are applicable.

NOTE: The illustrations in this manual are intended to provide a basic understanding and may deviate from the actual version.

1.1.1 Presentation of Warning Labels

To make risks clear, the following signal words and symbols are used for safety notes.

⚠ DANGER

Dangers for persons!

Non-observance will inevitably cause irreversible injury or death.

⚠ WARNING

Dangers for persons!

Non-observance can lead to irreversible injury and even death.

⚠ CAUTION

Dangers for persons!

Non-observance can cause minor injuries.

CAUTION

Material damage!

Information about avoiding material damage.

1.1.2 Applicable documents

- General terms of business *
- Catalog data sheet of the purchased product *
- Calculation of the jaw centrifugal forces, "Technology" chapter in the lathe chuck catalog *

The documents labeled with an asterisk (*) can be downloaded from **schunk.com**.

1.1.3 Sizes

This operating manual applies to the following sizes:

- ROTA NCR-A
  190; 225; 250; 315; 400; 500; 630; 800; 1000
- ROTA NCR-A-F
  225; 250; 315; 400; 500; 630

1.2 Warranty

If the product is used as intended, the warranty is valid for 24 months from the date of delivery from the production facility or 500 000 cycles* under the following conditions:

- Observe the applicable documents, ▸ 1.1.2 [🗋 6]
- Observe the ambient conditions and operating conditions, ▸ 2.6 [🗋 9]
- Observe the specified maintenance and lubrication intervals, ▸ 6 [🗋 35]

Parts touching the workpiece and wear parts are not included in the warranty.

* A cycle consists of a complete clamping process ("Open" and "Close").

1.3 Scope of delivery

1	**Power Chuck**
3	**Fastening screws** (up to size 400)
6	**Fastening screws** (from size 500 on)
12	**T-nuts** for fine serration
12	**Screws** for tongue and groove
1	**Eye bolt** from size 250 and up
1	**Operating manual**

2 Basic safety notes

2.1 Intended use

This product is intended for clamping workpieces on machine tools and other suitable technical devices.

- The product may only be used within the scope of its technical data, ▸ 3 [🗋 17].
- The product is intended for industrial and industry-oriented use.
- Appropriate use of the product includes compliance with all instructions in this manual.
- The maximum RPM of the chuck and the required clamping force must be determined by the user for the respective clamping task based on the applicable standards and technical specifications of the manufacturer.
  (See also "Calculations for clamping force and RPM" in the chapter "Technical data"). ▸ 3 [🗋 17]

2.2 Not intended use

A not intended use of the product is for example:

- It is used as a press, a punch, a toolholder, a load-handling device or as lifting equipment.
- the product is used for unintended machines or workpieces.
- the technical data is exceeded when using the product. ▸ 3 [🗋 17]
- if workpieces are not clamped properly, paying particular attention to the clamping forces specified by the manufacturer.
- if it is used in working environments that are not permissible.
- if the product is operated without a protective cover.

2.3 Constructional changes

Implementation of structural changes

By conversions, changes, and reworking, e.g. additional threads, holes, or safety devices can impair the functioning or safety of the product or damage it.

- Structural changes should only be made with the written approval of SCHUNK.

2.4 Spare parts

Use of unauthorized spare parts

Using unauthorized spare parts can endanger personnel and damage the product or cause it to malfunction.

- Use only original spare parts or spares authorized by SCHUNK.

2.5 Chuck jaws

Requirements of the chuck jaws

Stored energy can make the product unsafe and poses the danger of serious injuries and considerable material damage.

- Only change chuck jaws if no residual energy can be released.
- Do not use welded jaws.
- The chuck jaws should be designed to be as light and as low as possible. The clamping point must be as close as possible to the chuck face (clamping points at a greater distance lead to greater surface pressure in the jaw guidance and can significantly reduce the clamping force).
- If for constructional reasons the special chuck jaws are heavier than the top jaws assigned to the lathe chuck, greater centrifugal forces must be accounted for when defining the required clamping force and the recommended speed.
- The maximum recommended speed may only be operated in conjunction with maximum actuating force and only with the lathe chuck in optimum, fully functioning condition.
- After a collision, the lathe chuck and the chuck jaws must be subjected to a crack test before being used again. Damaged parts must be replaced with original SCHUNK spare parts.
- Renew the chuck jaw mounting screws if there are signs of wear or damage. Only use screws with a quality of 12.9.
- Screw the jaw mounting screws into the bore holes furthest apart.

2.6 Environmental and operating conditions

Required ambient conditions and operating conditions

Incorrect ambient and operating conditions can make the product unsafe, leading to the risk of serious injuries, considerable material damage and/or a significant reduction to the product's life span.

- Make sure that the product is used only in the context of its defined application parameters, ▸ 3 [🗋 17].
- Make sure that the product is a sufficient size for the application.
- Only use high-quality cooling emulsions with anti-corrosive additives during processing.

Clamping force measurement

Depending on the operating conditions, the function and clamping force must be checked after a certain period of operation ▸ 6.2 [🗋 35].

With the smallest possible actuating pressure (hydraulic cylinder), the base jaws should move evenly. This method only provides a limited indication and is not a substitute for measuring the clamping force.

If the clamping force has dropped too much or if the base jaws and piston no longer move properly, the chuck must be disassembled, cleaned, and relubricated ▸ 6 [🗋 35].

2.7 Personnel qualification

Inadequate qualifications of the personnel

If the personnel working with the product is not sufficiently qualified, the result may be serious injuries and significant property damage.

- All work may only be performed by qualified personnel.
- Before working with the product, the personnel must have read and understood the complete assembly and operating manual.
- Observe the national safety regulations and rules and general safety instructions.

The following personal qualifications are necessary for the various activities related to the product:

Trained electrician Due to their technical training, knowledge and experience, trained electricians are able to work on electrical systems, recognize and avoid possible dangers and know the relevant standards and regulations.

Qualified personnel Due to its technical training, knowledge and experience, qualified personnel is able to perform the delegated tasks, recognize and avoid possible dangers and knows the relevant standards and regulations.

Instructed person Instructed persons were instructed by the operator about the delegated tasks and possible dangers due to improper behaviour.

Service personnel of the manufacturer Due to its technical training, knowledge and experience, service personnel of the manufacturer is able to perform the delegated tasks and to recognize and avoid possible dangers.

2.8 Personal protective equipment

Use of personal protective equipment

Personal protective equipment serves to protect staff against danger which may interfere with their health or safety at work.

- When working on and with the product, observe the occupational health and safety regulations and wear the required personal protective equipment.
- Observe the valid safety and accident prevention regulations.
- Wear protective gloves to guard against sharp edges and corners or rough surfaces.
- Wear heat-resistant protective gloves when handling hot surfaces.
- Wear protective gloves and safety goggles when handling hazardous substances.
- Wear close-fitting protective clothing and also wear long hair in a hairnet when dealing with moving components.

2.9 Notes on safe operation

Incorrect handling of the personnel

Incorrect handling and assembly may impair the product's safety and cause serious injuries and considerable material damage.

- Avoid any manner of working that may interfere with the function and operational safety of the product.
- Use the product as intended.
- Observe the safety notes and assembly instructions.
- Do not expose the product to any corrosive media. This does not apply to products that are designed for special environments.
- Eliminate any malfunction immediately.
- Observe the care and maintenance instructions.
- Observe the current safety, accident prevention and environmental protection regulations regarding the product's application field.

2.10 Transport

Handling during transport

Incorrect handling during transport may impair the product's safety and cause serious injuries and considerable material damage.

- When handling heavy weights, use lifting equipment to lift the product and transport it by appropriate means.
- Secure the product against falling during transportation and handling.
- Stand clear of suspended loads.

2.11 Malfunctions

Behavior in case of malfunctions

- Immediately remove the product from operation and report the malfunction to the responsible departments/persons.
- Order appropriately trained personnel to rectify the malfunction.
- Do not recommission the product until the malfunction has been rectified.
- Test the product after a malfunction to establish whether it still functions properly and no increased risks have arisen.

2.12 Disposal

Handling of disposal

The incorrect handling of disposal may impair the product's safety and cause serious injuries as well as considerable material and environmental harm.

- Follow local regulations on dispatching product components for recycling or proper disposal.

2.13 Fundamental dangers

General

- Observe safety distances.
- Never deactivate safety devices.
- Before commissioning the product, take appropriate protective measures to secure the danger zone.
- Disconnect power sources before installation, modification, maintenance, or calibration. Ensure that no residual energy remains in the system.
- If the energy supply is connected, do not move any parts by hand.
- Do not reach into the open mechanism or movement area of the product during operation.

2.13.1 Protection during handling and assembly

Incorrect handling and assembly

Incorrect handling and assembly may impair the product's safety and cause serious injuries and considerable material damage.

- Have all work carried out by appropriately qualified personnel.
- For all work, secure the product against accidental operation.
- Observe the relevant accident prevention rules.
- Use suitable assembly and transport equipment and take precautions to prevent jamming and crushing.

Incorrect lifting of loads

Falling loads may cause serious injuries and even death.

- Stand clear of suspended loads and do not step into their swiveling range.
- Never move loads without supervision.
- Do not leave suspended loads unattended.

2.13.2 Protection during commissioning and operation

Falling or violently ejected components

Falling and violently ejected components can cause serious injuries and even death.

- Take appropriate protective measures to secure the danger zone.
- Never step into the danger zone during operation.

2.13.3 Protection against dangerous movements

Unexpected movements

Residual energy in the system may cause serious injuries while working with the product.

- Switch off the energy supply, ensure that no residual energy remains and secure against inadvertent reactivation.
- Never rely solely on the response of the monitoring function to avert danger. Until the installed monitors become effective, it must be assumed that the drive movement is faulty, with its action being dependent on the control unit and the current operating condition of the drive. Perform maintenance work, modifications, and attachments outside the danger zone defined by the movement range.
- To avoid accidents and/or material damage, human access to the movement range of the machine must be restricted. Limit/prevent accidental access for people in this area due through technical safety measures. The protective cover and protective fence must be rigid enough to withstand the maximum possible movement energy. EMERGENCY STOP switches must be easily and quickly accessible. Before starting up the machine or automated system, check that the EMERGENCY STOP system is working. Prevent operation of the machine if this protective equipment does not function correctly.

2.13.4 Notes on particular risks

⚠ DANGER

Risk of fatal injury from suspended loads!

Falling loads can cause serious injuries and even death.

- Stand clear of suspended loads and do not step within their swiveling range.
- Never move loads without supervision.
- Do not leave suspended loads unattended.
- Wear suitable protective equipment.

⚠ DANGER

Risk of fatal injury to operating personnel due to the workpiece falling down or being flung out in the event of a power failure.

In the event of a power failure, the lathe chuck's clamping force may fail immediately and the workpiece may be released in an uncontrolled manner. This poses a risk of death or injury to the operating personnel and can result in serious damage to the system.

- The machine manufacturer and the operator of the machine must carry out and document a hazard assessment and risk analysis to ensure that suitable measures are taken to maintain the lathe chuck's clamping force until the machine comes to a standstill and the workpiece can be secured (e.g. using a crane or suitable lifting equipment).
- The machines and equipment must fulfill the minimum requirements of the EC Machinery Directive; specifically, they must have effective technical measures to protect against potential mechanical hazards.
- Perform regular maintenance.

⚠ DANGER

Possible risk of fatal injury to operating personnel if a jaw breaks or if the lathe chuck fails because the technical data have been exceeded and a workpiece is released or parts fly off

- The technical data specified by the manufacturer for using the lathe chuck must never be exceeded.
- The lathe chuck may only be used on machines and facilities that fulfill the minimum requirements of the EC Machinery Directive; specifically, they must have effective technical measures to protect against possible mechanical hazards.

⚠ DANGER

Possible risk of fatal injury to operating personnel from clothing or hair being caught on the lathe chuck and being dragged into the machine

Loose clothing or long hair may become caught on projecting parts of the lathe chuck and be drawn into the machine.

- The machines and equipment must fulfill the minimum requirements of the EC Machinery Directive; specifically, they must have effective technical measures to protect against potential mechanical hazards.
- Always wear tight-fitting clothing and a hairnet when working on the machine and the lathe chuck.

⚠ CAUTION

Danger of slipping and falling in case of dirty environment where the chuck is used (e.g. by cooling lubricants or oil).

- Ensure that the working environment is clean before starting assembly and installation work.
- Wear suitable safety shoes.
- Follow the safety and accident-prevention regulations when operating the chuck, especially when working with machine tools and other technical equipment.

⚠ CAUTION

Danger of limbs being crushed by opening and closing of the chuck jaws during manual loading and unloading or when replacing moving parts.

- Do not reach between the chuck jaws.
- Automatic loading is preferred.
- If manual loading is used, adjust the jaw position so that the opening gap between the jaw and the workpiece is less than 4 mm.
- Wear protective gloves.
- Observe the safety and accident prevention regulations during operation of the chuck, especially in connection with machining centers and other technical equipment.

⚠ CAUTION

Risk of burns due to workpieces with high temperatures.

- Wear protective gloves when removing the workpieces.
- Automatic loading is preferred.

⚠ CAUTION

Risk of damage due to incorrect choice of clamping position for chuck jaws on workpiece.

If an incorrect clamping position is chosen for the chuck jaws on workpiece, the base and top jaws may become damaged.

- The T-nuts for connecting the top jaws to the base jaws must not protrude beyond the base jaws in the radial direction.
- The diameter of the workpiece may not be bigger than the chuck diameter.

⚠ CAUTION

Hazard from vibration due to imbalanced rotating parts and noise generation.

Physical and mental strains due to imbalanced workpieces and noise during the machining process on the clamped and rotating workpiece.

- Ensure the chuck's axial and concentric runout.
- Check options for remedying imbalances on special top jaws and workpieces.
- Reduce the speed.
- Wear hearing protection.

3 Technical data

3.1 Chuck data

ROTA NCR-A	190	225	250	315	400	500	630	800	1000
Max. actuating force [kN]	20	28	38	40	54	65	80	80	150
Max. clamping force [kN]	36	50	64	80	100	125	160	160	300
Max. speed [RPM]	4000	3500	3000	2500	1400	1200	1000	700	600
Stroke per jaw [mm]	6	6	8	8	12	12	16	16	25
Piston stroke [mm]	13.5	15.0	18.5	20.0	30.0	30.0	40.0	40.0	60.0
Pendular compensation	1+1	1+1	2+2	2+2	2.5+2.5	2.5+2.5	3.5+3.5	3.5+3.5	6+6
Moment of inertia [kgm²]	0.055	0.11	0.31	0.71	2.4	5.6	19.1	31.7	143
Weight [kg]	13.5	19.5	35	54	118	175	375	480	1250
Centrifugal force of the base jaw M_{cGB} [kgm]	0.015	0.023	0.041	0.063	0.216	0.338	0.935	1.491	3.360
Max. jaw eccentricity of center of gravity in axial direction a_{max} [mm]	12	24	24	24	32	32	32	32	40

Sizes 1200 to 2500 on request

The maximum RPM stated is only valid with the maximum clamping force and when using the hard standard chuck jaws that go with the chuck.

If unhardened top jaws or special chuck jaws are used, ensure that the jaws weigh as little as possible.
For soft top jaws or special chuck jaws the speed permitted for the cutting task must be calculated in accordance with VDI 3106 whereby the max. recommended speed may not be exceeded. The calculated values must be checked by dynamic measurement. Function monitoring (piston movement and actuating pressure) must be performed in accordance with the guidelines of the Berufsgenossenschaft (employers' mutual insurance association).

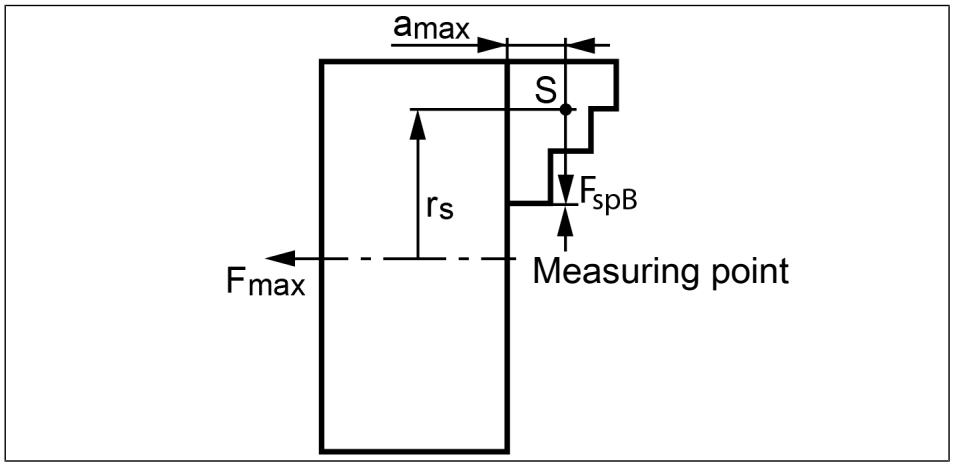
3.2 Clamping force / speed diagrams

Clamping force/RPM curves have been determined by using hard jaws. In the determination process, the maximum actuating force was applied and the jaws were set flush with the outer diameter of the chuck jaws.

The chuck is in perfect condition and lubricated with SCHUNK LINOMAX plus special grease.

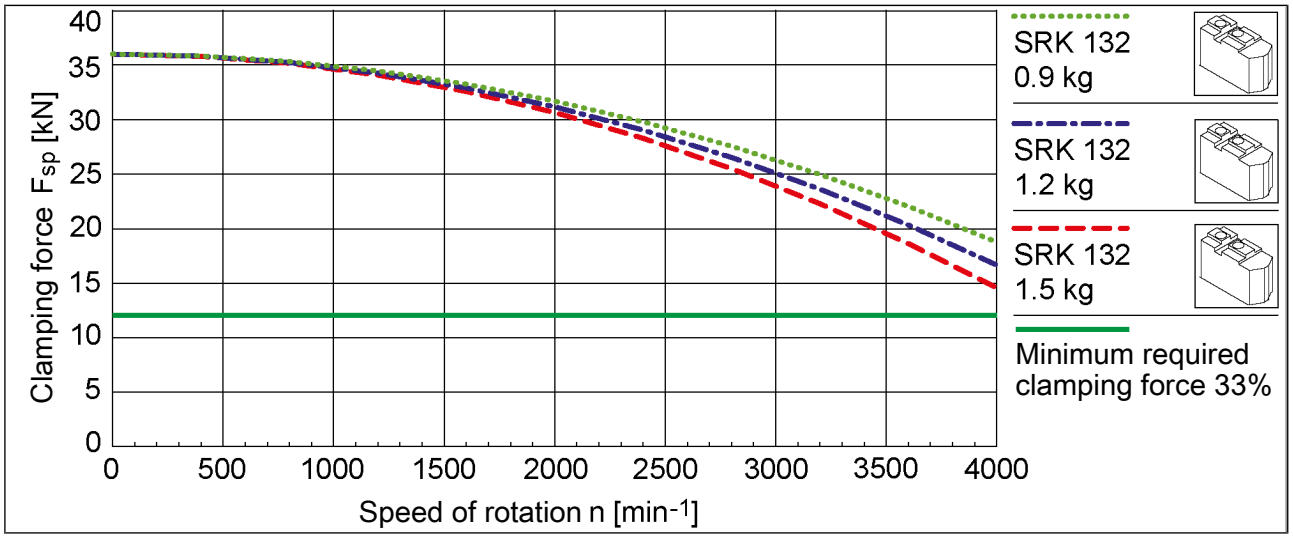
If one or more of these prerequisites is modified, the graphs will no longer be valid.

Chuck setup for clamping force/RPM graph

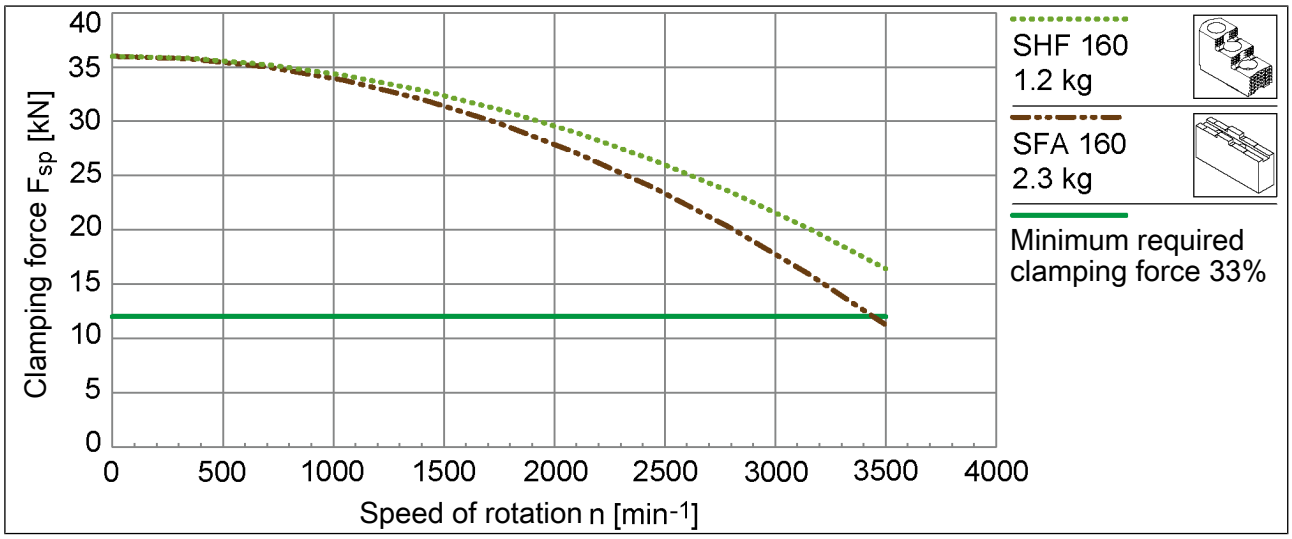


F_{spB}	Jaw clamping force	S	Center of gravity
r_s	Radius of center	a_{max}	Max. jaw eccentricity of center of gravity in axial direction
F_{max}	Max. actuating force		

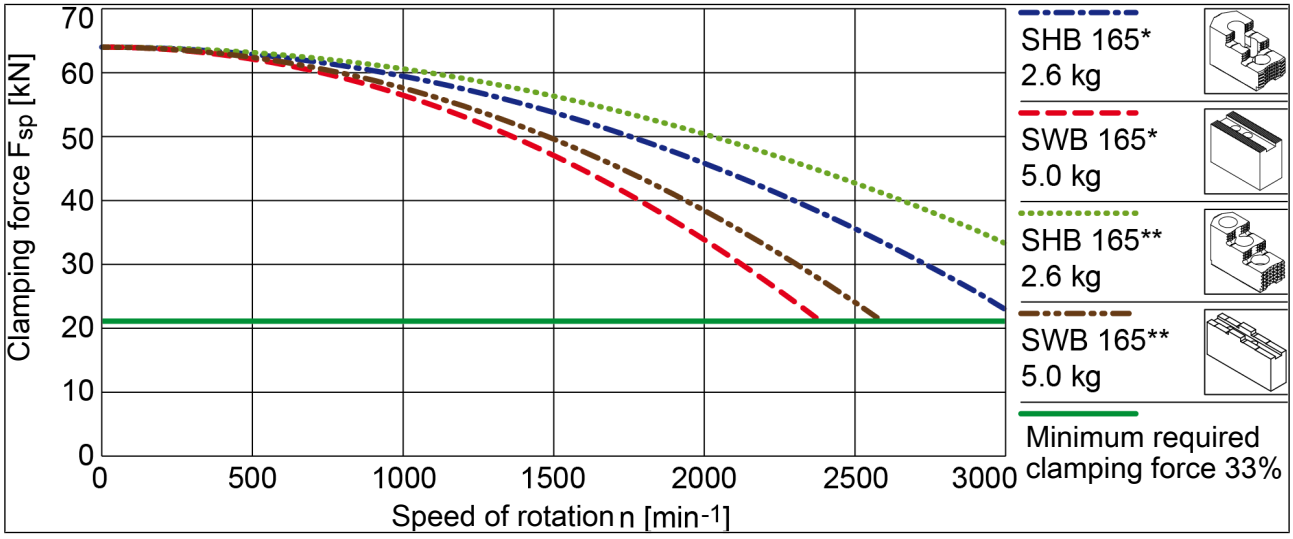
Clamping force/RPM graph for ROTA NCR-A 190



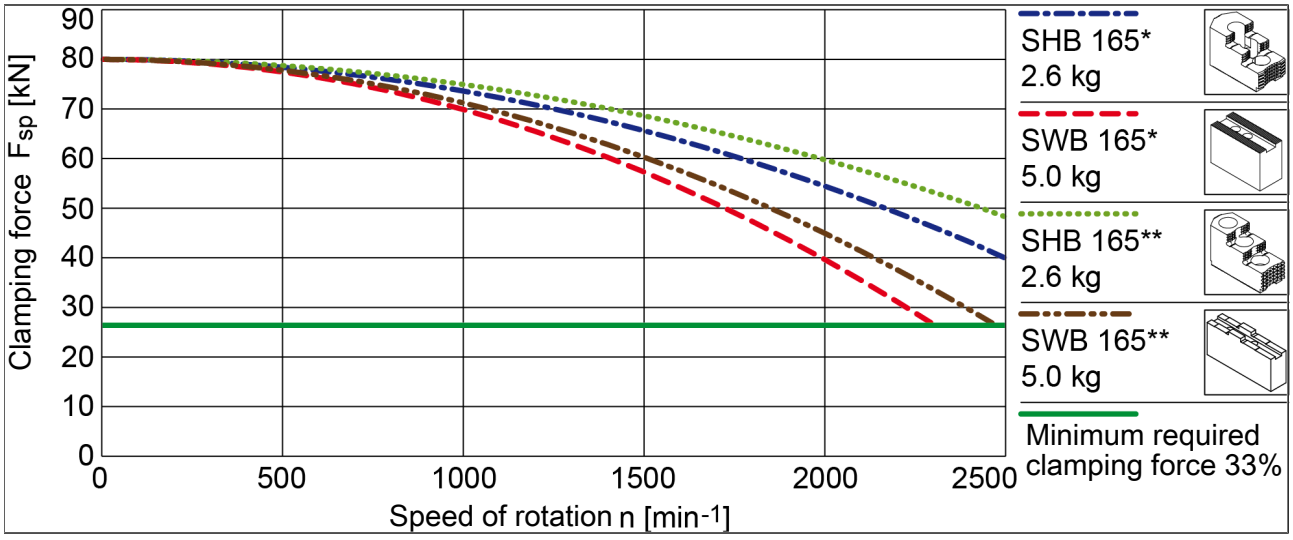
Clamping force/RPM graph for ROTA NCR-A 225



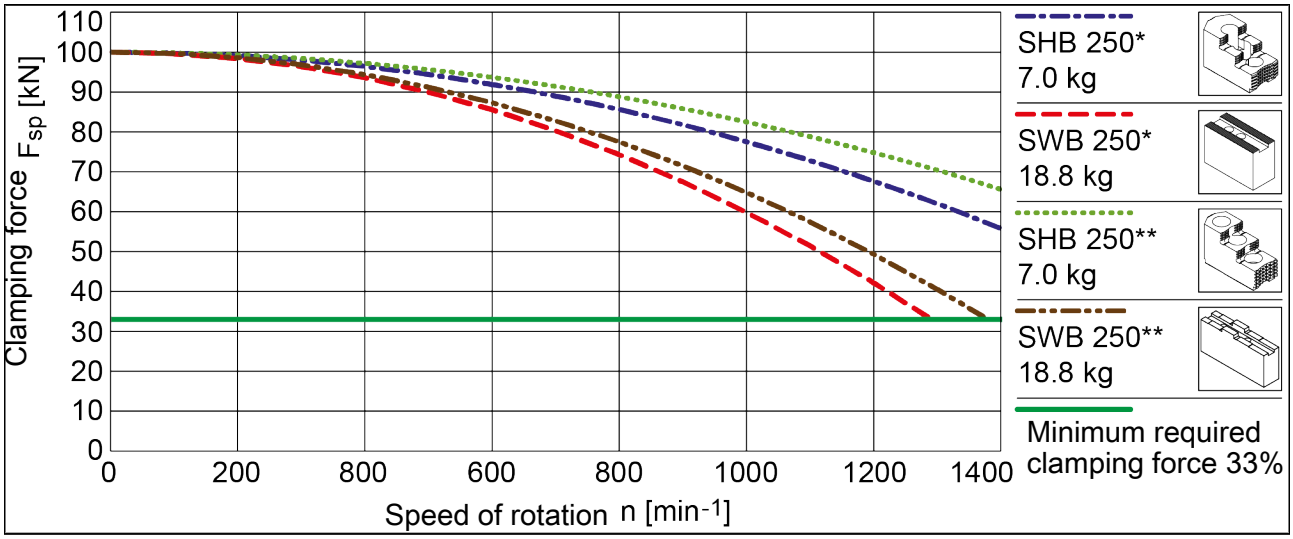
Clamping force/RPM graph for ROTA NCR-A 250



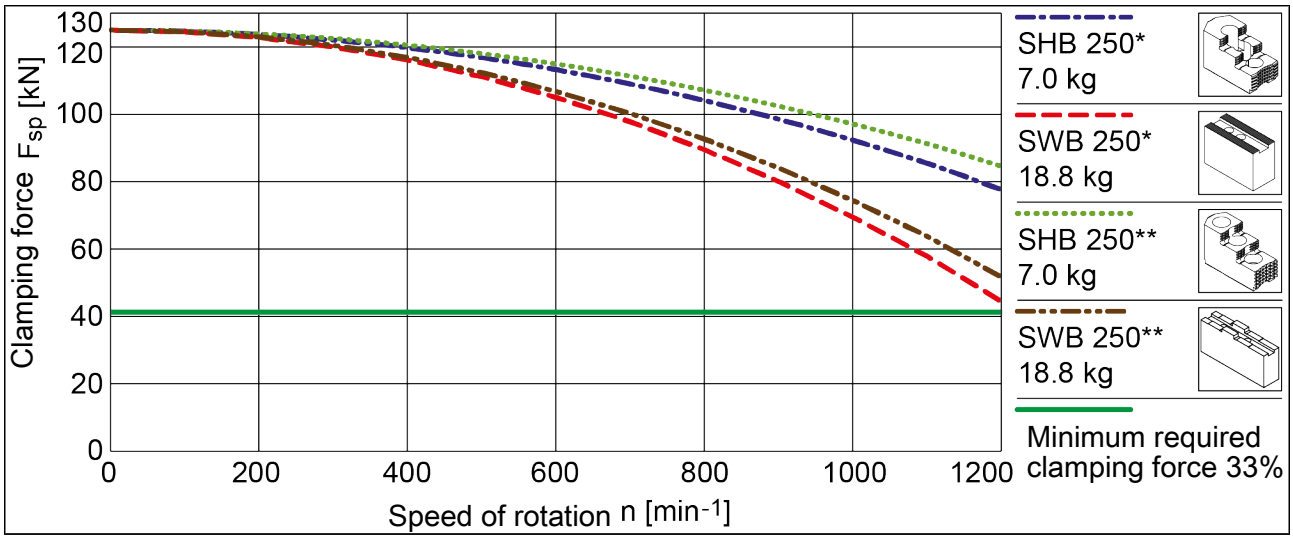
Clamping force/RPM graph for ROTA NCR-A 315



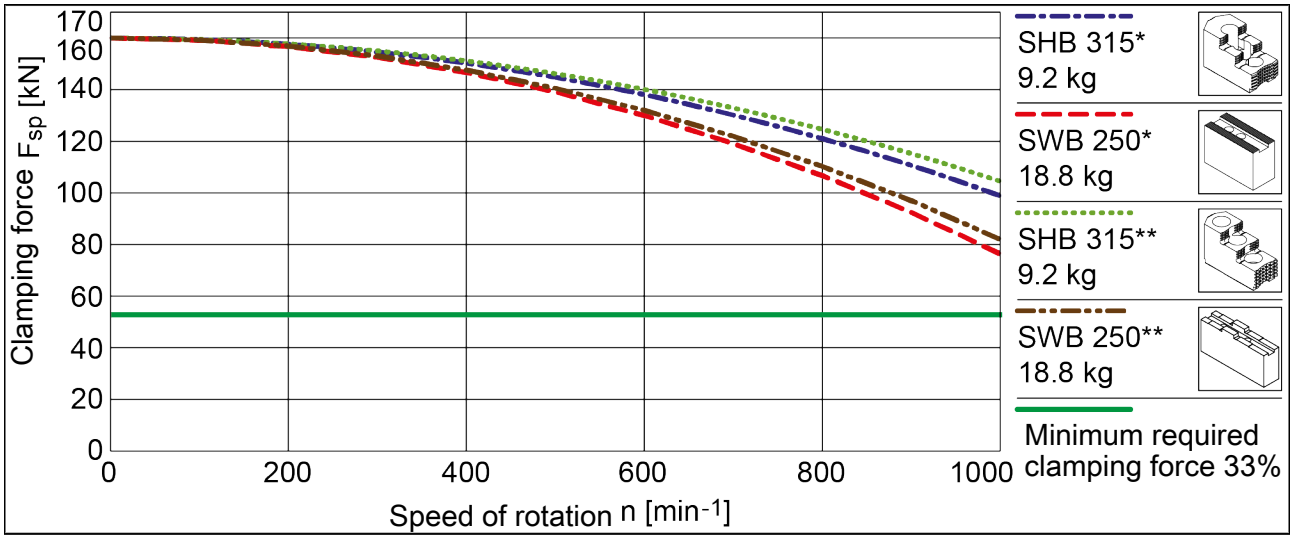
Clamping force/RPM graph for ROTA NCR-A 400



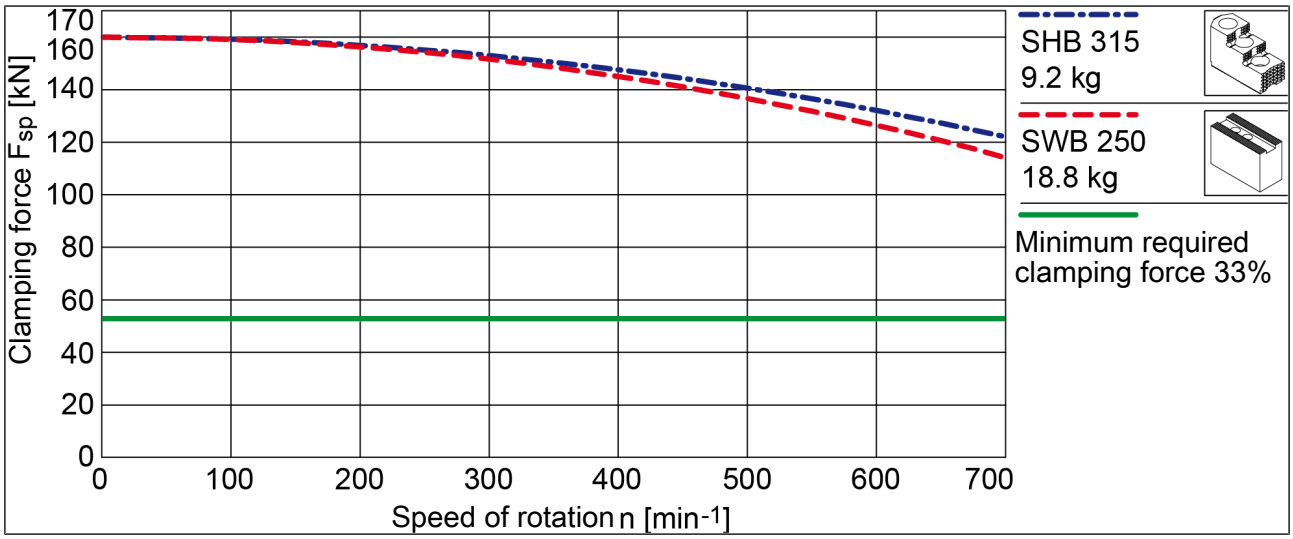
Clamping force/RPM graph for ROTA NCR-A 500



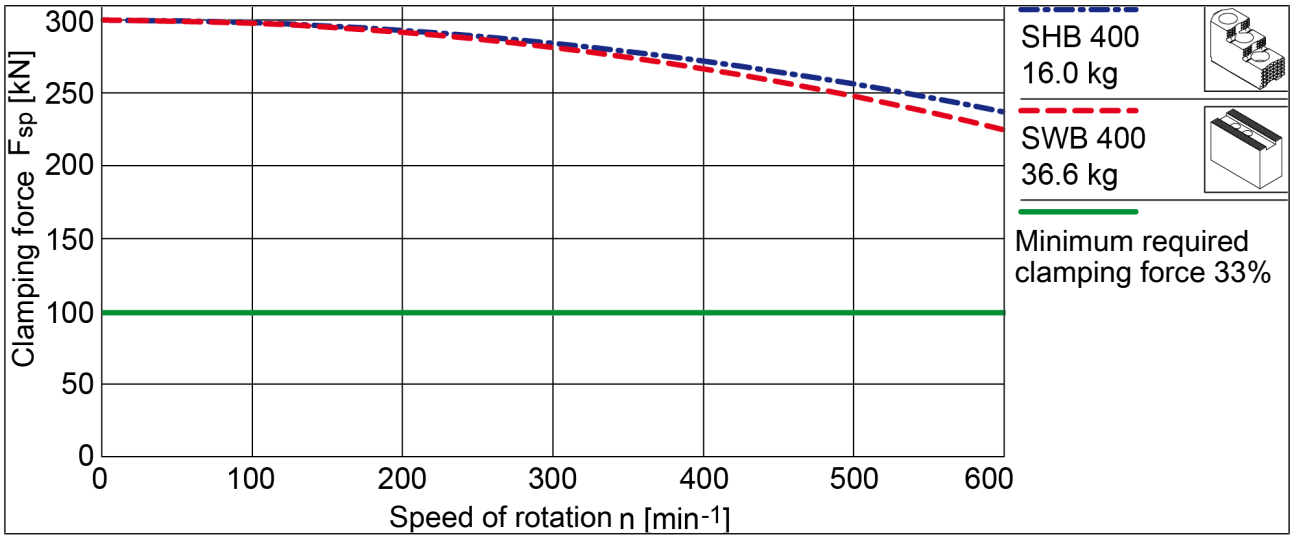
Clamping force/RPM graph for ROTA NCR-A 630



Clamping force/RPM graph for ROTA NCR-A 800



Clamping force/RPM graph for ROTA NCR-A 1000



* without centrifugal force compensation ** with centrifugal force compensation

3.3 Calculations for clamping force and speed

Missing information or specifications can be requested from the manufacturer.

Legend			
F_c	Total centrifugal force [N]	M_{cAB}	Centrifugal torque of top jaws [Kgm]
F_{sp}	Effective clamping force [N]	M_{cGB}	Centrifugal torque of base jaws [Kgm]
F_{spmin}	minimum required clamping force [N]	n	Speed of rotation [RPM]
F_{sp0}	Initial clamping force [N]	r_s	Center of gravity radius [mm]
F_{spz}	Cutting force [N]	r_{sAB}	Center of gravity radius of top jaw [mm]
m_{AB}	Mass of one top jaw [kg]	s_{sp}	Safety factor for clamping force
m_B	Mass of chuck jaw set [kg]	s_z	Safety factor for machining
M_c	Centrifugal torque [kgm]	Σ_s	Max. clamping force of lathe chuck [N]
kgm × 9.81 = Nm			

3.3.1 Calculation of the required clamping force in case of a given rpm

The initial clamping force F_{sp0} is the total force impacting radially on the workpiece via the jaws due to actuation of the lathe chuck during shutdown. Under the influence of rotation, the jaw mass generates an additional centrifugal force. The centrifugal force reduces or increases the initial clamping force depending on whether gripping is from the outside inwards or from the inside outwards.
The sum of the initial clamping force **F_{sp0}** and the **total centrifugal force F_c** is **the effective clamping force F_{sp}**.

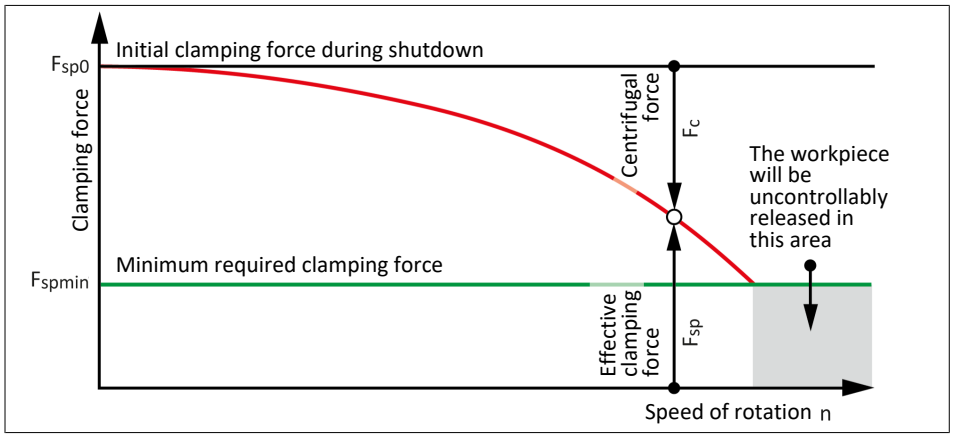
$$F_{sp} = F_{sp0} \mp F_c \text{ [N]}$$

(–) for gripping from the outside inwards
(+) for gripping from the inside outwards

⚠ DANGER

Risk to life and limb of the operating personnel and significant property damage when the RPM limit is exceeded! With gripping from the outside inwards, and with increasing RPM, the effective clamping force is reduced by the magnitude of the increasing centrifugal force (the forces are opposed). When the RPM limit is exceeded, the clamping force drops below the required minimum clamping force F_{spmin}. Consequently, the workpiece is released spontaneously.

- Do not exceed the calculated RPM.
- Do not fall below the necessary minimum clamping force.



Reduction in effective clamping force by the magnitude of the total centrifugal force, for gripping from the outside inwards.

The required effective clamping force for machining F_{sp} is calculated from the product of the **machining force F_{spZ}** and the **safety factor S_z**. This factor takes into account uncertainties in the calculation of the machining force. According to VDI 3106:
$S_z \geq 1.5$.

$F_{sp} = F_{spz} \cdot S_z$ [N]

From this we can derive the calculation of the initial clamping force during shutdown:

$F_{sp0} = S_{sp} \cdot (F_{sp} \pm F_c)$ [N]

(+) for gripping from the outside inwards
(–) for gripping from the inside outwards

CAUTION

This calculated force must not be larger than the maximum clamping force ΣS engraved on the lathe chuck.

See also "Lathe chuck data" table ▶ 3.1 [🗋 17]

From the above formula it is evident that the sum of the effective clamping force F_{sp} and the total centrifugal force F_c is multiplied by the **safety factor for the clamping force S_{sp}**. According to VDI 3106, the following also applies here: **$S_{sp} \geq 1.5$.**
The **total centrifugal force F_c** is dependent on both the sum of the masses of all jaws and on the center of gravity radius and the rpm.

CAUTION

For safety reasons, in accordance with DIN EN 1550, the centrifugal force may be a maximum of 67% of the initial clamping force.

The formula for the calculation of the total centrifugal force F_c is:

$$F_C = \sum(m_B \cdot r_s) \cdot \left(\frac{\pi \cdot n}{30}\right)^2 = \sum M_C \cdot \left(\frac{\pi \cdot n}{30}\right)^2 \text{ [N]}$$

For this, **n is the given speed of rotation** in RPM. The product **$m_B \cdot r_s$ is referred to as the centrifugal torque M_c.**

$M_C = m_B \cdot r_S$ [kgm]

In case of toolholders with split chuck jaws, i.e., with base jaws and top jaws, for which the base jaws change their radial position only by the stroke amount, the **centrifugal torque of the base jaws M_{cGB}** and the **centrifugal torque of the top jaws M_{cAB}** need to be added:

$M_C = M_{cGB} + M_{cAB}$ [kgm]

The centrifugal torque of the base jaws M_{cGB} can be found in the table "Lathe chuck data"▶ 3.1 [🗋 17]. The centrifugal torque of the top jaws M_{cAB} is calculated as per:

$M_{cAB} = m_{AB} \cdot r_{sAB}$ [kgm]

3.3.2 Calculation example: required initial clamping force for a given speed

Required initial clamping force F_{sp0} for a given RPM n

The following data is known for the machining job:

- Gripping from the outside in (application-specific)
- Machining force F_{spz} = 3000 N (application-specific)
- max. RPM n_{max} = 3200 RPM ("Lathe chuck data" table)
- RPM n = 1200 RPM (application-specific)
- Mass of one (!) top jaw m_{AB} = 5.33 kg (application-specific)
- Center of gravity radius of top jaw r_{sAB} = 0.107 m (application-specific)
- Safety factor S_z = 1.5 (according to VDI 3106)
- Safety factor S_{sp} = 1.5 (according to VDI 3106)

Note: Masses of the jaw mounting screws and T-nuts are not taken into account.

First the required effective clamping force F_{sp} is calculated using the machining force stated:

$F_{sp} = F_{spz} \cdot S_z = 3000 \cdot 1.5 \Rightarrow \mathbf{F_{sp} = 4500\ N}$

Initial clamping force during shutdown:

$F_{sp0} = S_{sp} \cdot (F_{sp} + F_C)$

Calculation of total centrifugal force:

$$F_C = \sum M_C \cdot \left(\frac{\pi \cdot n}{30}\right)^2$$

For two-part chuck jaws, the following applies:

$M_C = M_{cGB} + M_{cAB}$

Take the centrifugal torque of the base jaw and top jaw specified from the "Lathe chuck data" table:

$\mathbf{M_{cGB} = 0.319\ kgm}$

For the centrifugal torque of the top jaw, the following applies:

$M_{cAB} = m_{AB} \cdot r_{sAB} = 5.33 \cdot 0.107 \Rightarrow \mathbf{M_{cAB} = 0.57\ kgm}$

Centrifugal torque for one jaw:

$M_C = 0.319 + 0.571 \Rightarrow \mathbf{M_C = 0.89\ kgm}$

The chuck has 3 jaws, the total centrifugal torque is:

$\sum M_C = 3 \cdot M_C = 3 \cdot 0.889 \Rightarrow \mathbf{\sum M_C = 2.667\ kgm}$

The total centrifugal force can now be calculated:

$$F_c = \sum M_c \cdot (\frac{\pi \cdot n}{30})^2 = 2.668 \cdot (\frac{\pi \cdot 1200}{30})^2 \Rightarrow \mathbf{F_c = 42131\ N}$$

Initial clamping force during shutdown that was sought:

$$F_{sp0} = S_{sp} \cdot (F_{sp} + F_c) = 1.5 \cdot (4500 + 42131) \Rightarrow \mathbf{F_{sp0} = 69947\ N}$$

3.3.3 Calculation of the permissible speed in case of a given initial clamping force

Calculation of the permissible RPM n_{perm} in case of a given initial clamping force F_{sp0}

The following formula can be used to calculate the permissible RPM for a given initial clamping force during shutdown:

$$n_{zul} = \frac{30}{\pi} \cdot \sqrt{\frac{F_{sp0} - (F_{spz} \cdot S_z)}{\sum M_c}}\ [min^{-1}]$$

CAUTION

For safety reasons, the calculated permissible RPM may not exceed the maximum RPM inscribed on the lathe chuck!

Example of calculation: Permissible RPM for a given effective clamping force

The following data is known from previous calculations:

- Initial clamping force during shutdown F_{sp0} = 17723 N
- Machining force for machining job F_{spz} 3000 N (application-specific)
- Total centrifugal torque of all jaws ΣM_c = 2,668 kgm
- Safety factor S_z = 1.5 (according to VDI 3106)
- Safety factor S_{sp} = 1.5 (according to VDI 3106)

NOTE:

Masses of the jaw mounting screws and T-nuts are not taken into account.

Identifying the permissible RPM:

$$n_{zul} = \frac{30}{\pi} \cdot \sqrt{\frac{F_{sp0} - (F_{spz} \cdot S_z)}{\sum M_c}} = \frac{30}{\pi} \cdot \sqrt{\frac{69947 - (3000 \cdot 1.5)}{2.668}} \Rightarrow \mathbf{n_{zul} = 1495\ min^{-1}}$$

The calculated RPM n_{perm} = 1495 RPM is smaller than the maximum permissible RPM of the lathe chuck n_{max} = 3200 RPM (see "Lathe chuck data" table ▶ 3.1 [🗋 17]).

This calculated RPM may be used.

3.4 Grades of Accuracy

Tolerances for radial and axial run-out accuracy correspond to the Technical Supply Terms for lathe chucks as per DIN ISO 3442-3.

3.5 Permissible imbalance

The ROTA NCR-A in ungreased state without chuck jaws corresponds to the balancing quality class 6.3 (according to DIN ISO 21940-11). Residual imbalance risks may arise due to insufficient rotation compensation being achieved (see DIN EN 1550 6.2 e). This applies particularly to high speeds, asymmetrical workpieces or the use of various chuck jaws, as well as uneven application of lubricants. In order to prevent damage resulting from these residual risks, the entire rotor is to be dynamically balanced in accordance with DIN ISO 21940-11.

4 Mounting

4.1 Installing and connecting

⚠ WARNING

Risk of injury due to unexpected movements!

If the power supply is switched on or residual energy remains in the system, components can move unexpectedly and cause serious injuries.

- Before starting any work on the product: Switch off the power supply and secure against restarting.
- Make sure, that no residual energy remains in the system.

⚠ CAUTION

Danger of injury due to sharp edges and rough or slippery surfaces

- Wear personal protective equipment, particularly protective gloves.

1. Checking the chuck mount ▸ 4.3 [🗋 28]
2. Mounting of the chuck ▸ 4 [🗋 27]
3. Check the function ▸ 5.2 [🗋 34]

4.2 Torques per screw

Tightening torques for mounting screws used to clamp the chuck on lathes or other suitable technical equipment (screw quality 10.9)

Screw size	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30
Admissible torque M_A (Nm)	13	28	50	88	120	160	200	290	400	500	1050	1500

Tightening torques for mounting screws used to attach top jaws onto the chuck (screw quality 12.9)

Screw size	M6	M8	M10	M12	M14	M16	M20	M24
Max. admissible torque M_A (Nm)	16	30	50	70	130	150	220	450

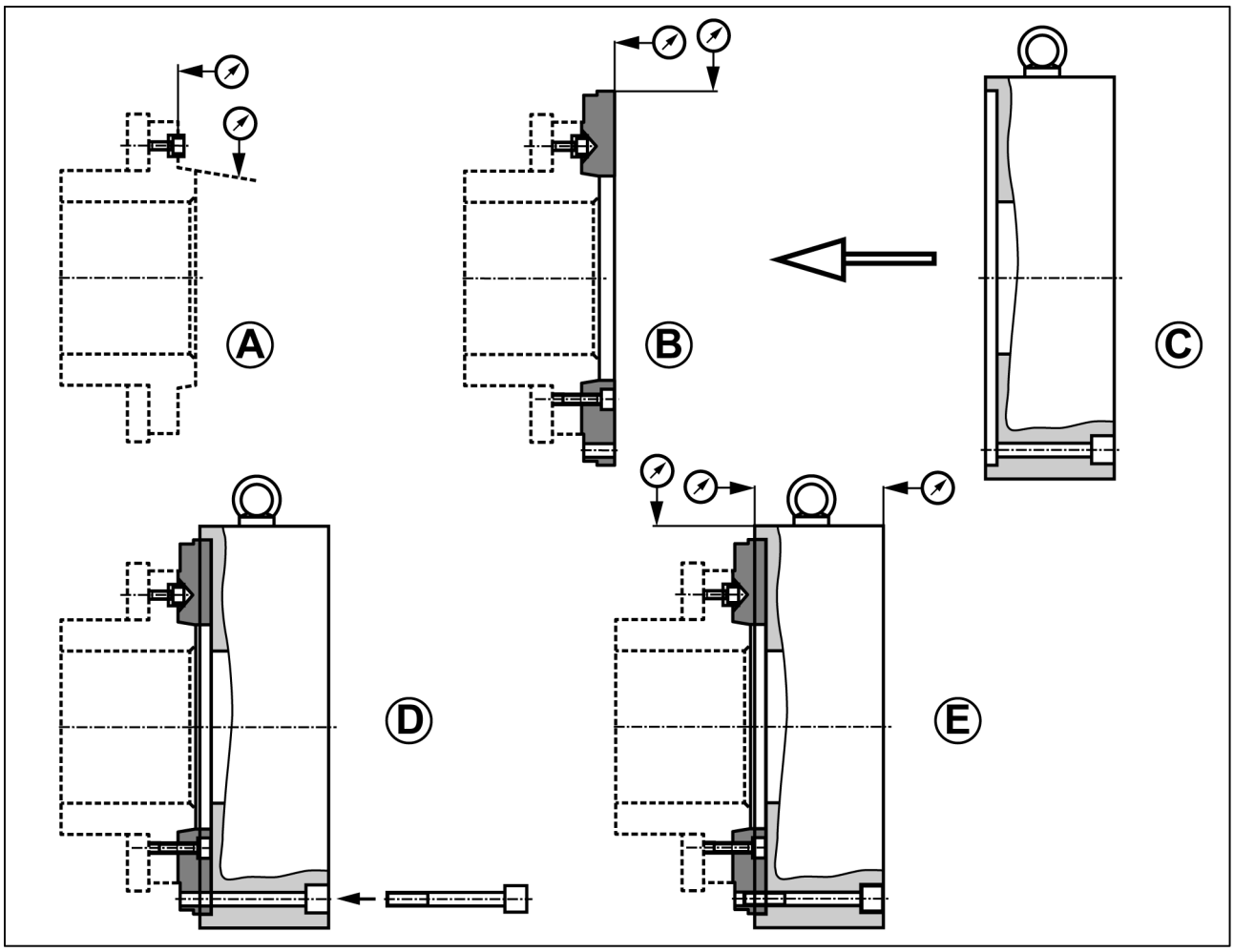
4.3 Checking the chuck mounting

Checking the spindle nose for mounting the chuck flange

The machine side has to be aligned prior to the flange being installed in order to achieve high true running accuracy for the chuck. To do this, check the contact surfaces on the spindle for axial and concentric run-out using a dial indicator (see Fig. "Chuck assembly" - A).

There should be a maximum concentricity error in the centering of the mount of 0.005 mm and a maximum axial run-out error in the contact surfaces of 0.005 mm. The flat surface of the spindle must also be checked for flatness using a straight edge.

Make sure that the surface area of the flat surface is deburred at the bore holes and is clean.



Chuck assembly

4.4 Assembly of the chuck on the machine

The item numbers specified for the corresponding individual components relate to the chapter Drawings, ▶ 8 [🗋 41].

Chucks in sizes 190 and 225

The screws (item 10) cannot be inserted into the piston (item 3) and rotated.

- Fully screw the chuck into the drawbar.
- Fasten the chuck with the mounting screws supplied (item 60) to the spindle nose. Tighten the chuck mounting screws (item 60) alternately.
- Check radial and axial run-out at the checking edge.
- Check the jaw stroke of the base jaws and that these can move easily.
- Attach top jaws according to the marking to the base jaws.

Chuck from size 250

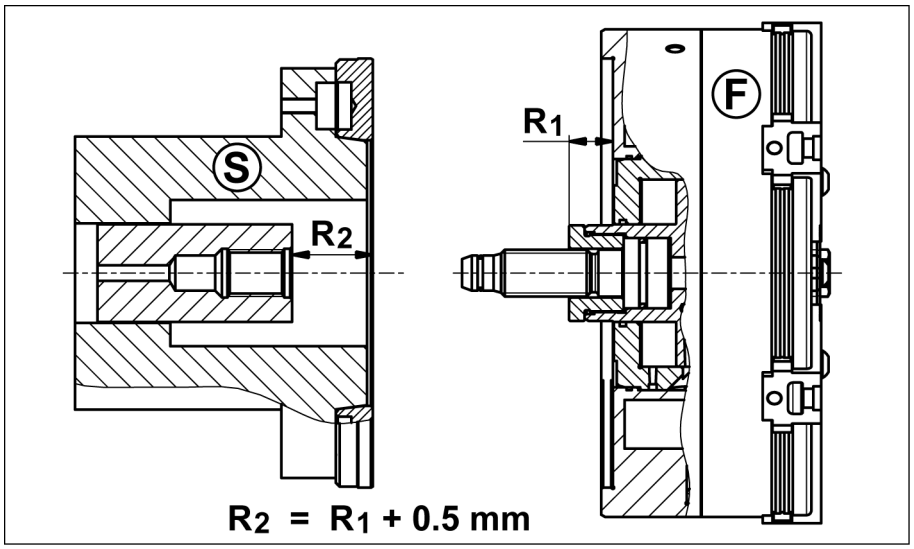
- Remove screws (item 39) and take off cover (item 34).
- Screw the screw (item 33) fully into the piston.
- Disassemble the three stop pins (item 40). (The pins can be unscrewed on the 2-edge).
- Completely unscrew screw (item 33) from the piston.
  Caution: Secure loose pins (item 31) separately.
- The rotatable screw (item 10) can only be actuated directly using an Allen key.
- Lift the chuck using lifting equipment on the eye bolt so that it is flush with the center of the spindle.
- Screw the rotatable screw (item 10) onto the draw tube using the assembly key as far as this will go.
- Tighten the chuck mounting screws (item 60) alternately.
- Check radial and axial run-out at the checking edge.
- Check the jaw stroke of the base jaws and that these can move easily.
- Screw screws (item 33) together with pins (item 31) into the piston (item 3) as far as it will go (pendulum locking is active).
- Assemble the three stop pins (item 40).
- Place cover on (item 34) and tighten with screws (item 39).
- Attach top jaws according to the marking to the base jaws.

The spindle is disassembled in the same way but in the reverse order.

The following must be taken into account during chuck assembly:

The attachment of the chuck to the machine spindle must be designed in such a way so that when the chuck is open, a safety distance between the piston (item 3) and cover (item 34) or from size 400 between the piston (item 3) and the chuck body (item 1) of $0.5^{+0.5}$ mm is adhered to.

The stop when opening the chuck must take place via the activation cylinder and may not take place in the chuck!



S	Spindle nose	**F**	Chuck

Cylinder piston in foremost position

R1 = Push the chuck piston to its foremost position and measure with a depth gauge.

R2 = Draw bar in foremost position. Measure with a depth gauge.

4.4.1 Mounting the chuck with a reduction or extension flange

If the chuck is screwed on with an intermediate flange, the following points must be observed:

- For mounting the chuck on the machine spindle with a short taper by means of a reduction or extension flange, a corresponding chuck flange is attached on the spindle nose.
- Before installing the chuck flange, remove any dirt or swarf from the machine spindle and from the centring mount and the contact surface of the flange.
- A chuck flange made by the user himself must be finished machining on the machine spindle and must be balanced before the chuck is mounted.
- After mounting, it must be ensured that the flange is fitted tightly on the entire surface.

- Then check the run-out accuracy and true running as described in "Measures before starting assembly" (see Fig. "Assembly of the chuck" – B)

The chuck is mounted after the flange has been aligned. During this, it must be ensured that any contaminations on the flange and on the chuck contact surfaces are removed.

⚠ WARNING

Risk of injury from falling of the unit during transport and assembly!

The use of a crane is necessary for assembling the lathe chuck. This can be fastened on the eye bolt provided (see Fig. "Assembly of the chuck" – C). The eye bolt is in all deliveries from chuck size 250 and up included.

Before commissioning the lathe chuck, the eye-bolt has to be removed.

- Push the chuck onto the intermediate flange. During this, it must be ensured that the through-holes for attaching the chuck coincide with the threaded holes of the flange (see Fig. "Assembly of the chuck" – D).
- Next, turn in the fastening screws and tighten them slightly. Check the chuck for radial and axial run-out (see figure "Assembly of the chuck" – E) and align with slight blows with a hammer on the outer diameter if necessary. Next, screw the chuck tightly onto the chuck flange by means of the fastening screws using a torque wrench. During this, pay attention to the specified maximum tightening torques ▸ 4.2 [🗋 27]. Next, check the radial and axial run-out again as described in figure (see figure "Assembly of the chuck" – E).

4.4.2 Mounting the chuck by means of a direct mount

When mounting the chuck by means of a direct mount with a through screw connection, the flange is first attached to the chuck and subsequently mounted on the spindle.

- Before mounting the chuck flange on the cylindrical recess of the chuck, dirt and swarf must be removed from the centring mount and contact surface of the flange.
- The flange must be slightly tightened on the chuck by means of the supplied screws and aligned towards the chuck body. The radial and axial run-out must be checked.
- Next, the screws must be tightened with the specified torque ▸ 4.2 [🗋 27].

- After mounting, it must be ensured that the flange is fitted tightly on the entire surface. Check radial and axial run-out.

After mounting the flange on the chuck, the chuck must be mounted on the machine spindle.

- Push the chuck onto the intermediate flange. During this, it must be ensured that the through-holes for attaching the chuck coincide with the threaded holes of the flange (see Fig. "Assembly of the chuck" - D).
- Then screw in the mounting screws and tighten slightly. Then check the chuck for radial and axial runout (see Fig. "Assembly of the chuck" - E). Tighten the mounting screws on the chuck flange with a torque wrench. During this, pay attention to the specified maximum tightening torques ▸ 4.2 [🗋 27]. Then check again for radial and axial runout (see Fig. "Assembly of the chuck" - E).

The target radial and axial run-out accuracies depend on the outer diameter of the chuck.
The following table shows the maximum attainable radial and axial run-out tolerances:

Chuck size	190	225	250	315	400	500	630	800	1000
max. radial run-out error [mm]	0.02	0.02	0.03	0.03	0.04	0.05	0.06	0.08	0.10
max. axial run-out error [mm]	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.06

4.5 Replacement of jaws

When changing the top jaws, the serration must be cleaned.

Chuck jaws for maximum clamping repeat accuracy must be turned or ground in the lathe chuck under clamping pressure.

When turning or grinding, ensure that the turning ring or turning pin is clamped **by the top jaws** and not by the base jaws.
Tighten jaw mounting screws (screw quality 12.9) to specified torque (see "Screw torques" chapter" ▸ 4.2 [🗋 27]).

Tighten the mounting screws of the top jaws with a torque wrench. Never tighten the Allen key with an extension pipe or by hitting it with a hammer.

⚠ WARNING

If the workpiece is clamped at the end of the base jaw stroke, this poses the risk that the entire clamping force is not transferred onto the workpiece.

Risk of injury due to loss of workpiece.

- **Always clamp the workpiece at the middle of the base jaw stroke.**

4.6 Switching the compensating clamping on and off

The item numbers specified for the corresponding individual components relate to the chapter Drawings, ▸ 8 [🗋 41].

With the bolts (item 31), the oscillating clamp blocks the oscillation of the pendulum bodies (item 5) installed in the piston. The bolts (item 31) are moved by screwing in or unscrewing the screw (item 33).

Tightening torques for oscillating clamping (Pos. 33)

Size	190	225	250	315	400	500	630	800	1000
Tightening torque [Nm]	10,0	10,0	20,0	20,0	35,0	35,0	50,0	50,0	50,0

Switching on the oscillating clamp:

The chuck must not be in the open position.

- Remove the screw (item 35).
- Fully screw in the screw (item 33) as far as it will go into the piston (item 3).
- Screw in the screw (item 35).

Switching off the oscillating clamp:

Piston position or jaw position freely selectable.

- Remove the screw (item 35).
- Fully unscrew the screw (item 33) until the stop on the stop pins (item 40).
  Observe the maximum permissible torque. The stop pin (item 40) may be damaged.
- Screw in the screw (item 35).

5 Function

5.1 Function and handling

The lever chuck is actuated using a rotating solid or through-hole cylinder. The axial tension and pressure forces are diverted into the radial clamping force via lever action.

The clamping and opening path of the chuck jaws is determined by the clamping cylinder. The serration of the base jaws can be used to standard jaws as well as mount customized chuck jaws for complicated workpiece shapes. The top jaws are moved or changed in the open clamping position.

The 6-jaw compensation chuck has paired pendulum chuck jaws that clamp concentrically. Two base jaws are always connected with a compensation piece. The result is workpiece centering between six points of contact, which are averaged in pairs. Even raw parts can be centered without distortion of the workpiece.

For special applications, the pendulum compensation can be disabled and all jaws simultaneously clamp concentrically. ▸ 4.6 [🗋 33]

5.2 Functional testing

Functional test

After installation of the chuck, its function must be checked prior to start-up.

Two important points are:

- **Clamping Force!** The clamping force of the chuck must be achieved at max. operating force/pressure.
- **Stroke control!** The stroke of the clamping piston must allow a safety zone at the front and rear end position. The machine spindle may only be started when the clamping piston has passed through the safety zone. Only limit switches that meet the requirements for safety limit switches specified in DIN EN 60204-1 may be used.

When determining the necessary clamping force to machine a workpiece, take the centrifugal force acting on the chuck jaws into account (according to VDI 3106).
If the chuck jaws are changed, adjust the stroke control to the new situation.

Speed of rotation

⚠ DANGER

Risk of fatal injury to operating personnel if the top speed is exceeded, resulting in workpiece loss and parts flying off!

- A reliable speed limiter must be installed in the machine tool or technical equipment and proof must be provided that the speed limiter is effective!

6 Maintenance

6.1 Lubrication

To maintain the safe function and high quality of the power chuck it is important to lubricate it regularly at the greese nipples (item 90).

Lubricate the chuck without a workpiece, with the base jaws in the fully closed position.

For optimum grease distribution, the clamping piston must travel the entire clamping stroke several times after lubrication.

Chuck size	190	225	250	315	400	500	630	800	1000
No. of grease-gun strokes	6	8	10	12	16	20	25	30	30

Operating Conditions

Depending on operating conditions, check the function and the clamping force after a certain time of operation (see chapter "Maintenance intervals" ▶ 6.2 [🗋 35]). Measure the clamping force only by using a calibrated Grip Force Tester (SCHUNK IFT).

Technical Condition

The base jaws must move evenly at the smallest possible operating pressure (cylinder). This method is only to some extend expressive and cannot replace clamping force measurement.

If clamping force has dropped too low, or if base jaws and piston cannot be moved perfectly, it is necessary to disassemble the chuck to clean it and to relubricate it.

Use original SCHUNK spare parts only when exchanging damaged parts.

6.2 Maintenance intervals

Lubricating the greasing areas:

Lubrication interval	Demands
every 100 hours	normal / use of coolant
every 25 hours	high / use of coolant
after 1200 hours or when needed	Full cleaning with disassembly of chuck depending on type of contamination and quantity

6.3 Disassembly and assembly of the Chuck

The item numbers specified for the corresponding individual components relate to the chapter Drawings, ▸ 8 [🗋 41].

The lathe chuck must only be disassembled once it has been uninstalled.
(See chapter "Mounting the chuck to the machine" ▸ 4 [🗋 27].)

For chuck sizes 190 / 225

- If present, remove top jaws.
- Remove screws (item 24) and take off the intermediate piece (item 14) connected to the base jaw including the sealing elements (items 17/22).
- Remove screws (item 39) and take off the cap (item 34). For this purpose, first move the piston to the "closed" position.
- Remove the screws (item 61) and take off the mount (item 7). The mount (item 7) can be pushed off the chuck body (item 1) from the rear with the suitable screws (screws not included in the scope of delivery).
- Remove the six levers (item 6) together with the bearing seat (item 8) from the chuck body. To do this, there is a bore hole on the side of the bearing seat in which a removal tool can be inserted.
- Push the six base jaws (item 2) radially outwards to the stop and push the piston (item 3) out of the chuck body (item 1).
- Slide the base jaws (item 2) radially inwards until they can be removed from the chuck body (item 1).

From chuck size 250:

- If present, remove top jaws.
- Remove screws (item 39) and take off the cover (item 34).
- Remove screws (item 58) and the covering strips (items 15/16).
- Take the seal (item 22) along the base jaw out of the groove.
- Remove the screws (item 61) and take off the mount (item 7). The mount (item 7) can be pushed off the chuck body (item 1) from the rear with the suitable screws (screws not included in the scope of delivery)
- Remove screws (item 20) and take the cover plates (item 18) out of the chuck body.
- Remove the seals (items 22/17)
- Remove the six levers (item 6) together with the bearing seat (item 8) from the chuck body. To do this, there is a bore hole on the side of the bearing seat in which a removal tool can be inserted.
- Remove the six base jaws (item 2) radially outwards (size 250: inwards) and push the piston (item 3) out of the chuck body (item 1).
- Degrease and clean all parts and check them for damage or wear.

Only use genuine SCHUNK spare parts when replacing damaged parts.

Before assembly, grease well with LINOMAX plus special grease paste.

The lathe chuck is assembled in the same way but in the reverse order.

During assembly, the following must be observed in particular:

- The piston has a point marking on the front side. This is assigned to base jaw guide 1 during assembly.
- The bore hole on the side of the bearing seat (item 8) must point in the direction of the mount.
- Scraper strips (items 15/16) may only be placed lightly on the base jaws (item 2). Free movement must be ensured.
- For mounting the seal along the base jaw, using the optional assembly tool (ID: 1384194) is recommended. The seal should not be stretched during the assembly process.

6.4 Disassembling and assembling the piston

The item numbers specified for the corresponding individual components relate to the chapter Drawings, ▶ 8 [🗋 41].

- **For chuck sizes 165 and 200** the screw (item 10) is screwed in directly to the piston (item 3) and secured using the pin (item 67). Items 9, 70 and 80 are no longer required.
- Unscrew the stop pins (item 40) from the piston.
- Unscrew and remove the screw (item 33) and take off the safety ring (item 38), then remove the thrust washer (item 32).
- Remove the screws (item 64), take off the plate (item 12), and pull the pendulum body (item 5) out of the piston (item 3).
- The screw (item 66) is glued into the pendulum body (item 5) such that the connecting member (item 11) is pivot-mounted with 0.2 mm axial play. Only remove the connecting member (item 11) if disassembly is required.
- Undo the securing screws (item 67) such that the flange (item 9) or the screw (item 10) can be removed from the piston (item 3).

Degrease and clean all parts and check them for damage or wear.

Only use genuine SCHUNK spare parts when replacing damaged parts.

Before assembly, grease well with LINOMAX plus special grease paste.

The piston is assembled in the same way but in the reverse order.

7 Spare parts

Item	Characterization	Quantity	Note
1	Chuck body	1	
2	Base jaws	6	
3	Piston	1	
5	Pendulum body	3	
6	Lever	6	
7	Mount	1	
8	Seat of bearing	12	
9	Nut	1	
10	Screw	1	
11	Connecting member	6	
12	Plate	3	
14	Intermediate piece	6	190 – 225
15 / 16	Scraper strips	12	250 – 1000
17	Base jaw seal	6	
18	Cover plate	6	250 – 1000
20	Cover plate screws	12	250 – 1000
21	Cover plate seal	6	250 – 1000
22	Base jaw seal	6	
23	Cover seal	1	
24	Screw	6	
25	Cover seal	6	
29	Screw	6	800 / 1000
31	Bolts	3	
32	Thrust washer	1	
33	Screw	1	
34	Cover	1	
35	Locking screw	1	
38	Safety ring	1	
39	Screws	*	
40	Stop pins	3	
56	Mounting position orientation	3	
57	Piston torque pin	3	400 – 1000
58	Mounting screws for scraper strips	*	250 – 1000
59	Mounting screws from front	6	800 / 1000
60	Mounting screw – DIN EN ISO 4762-10.9	*	

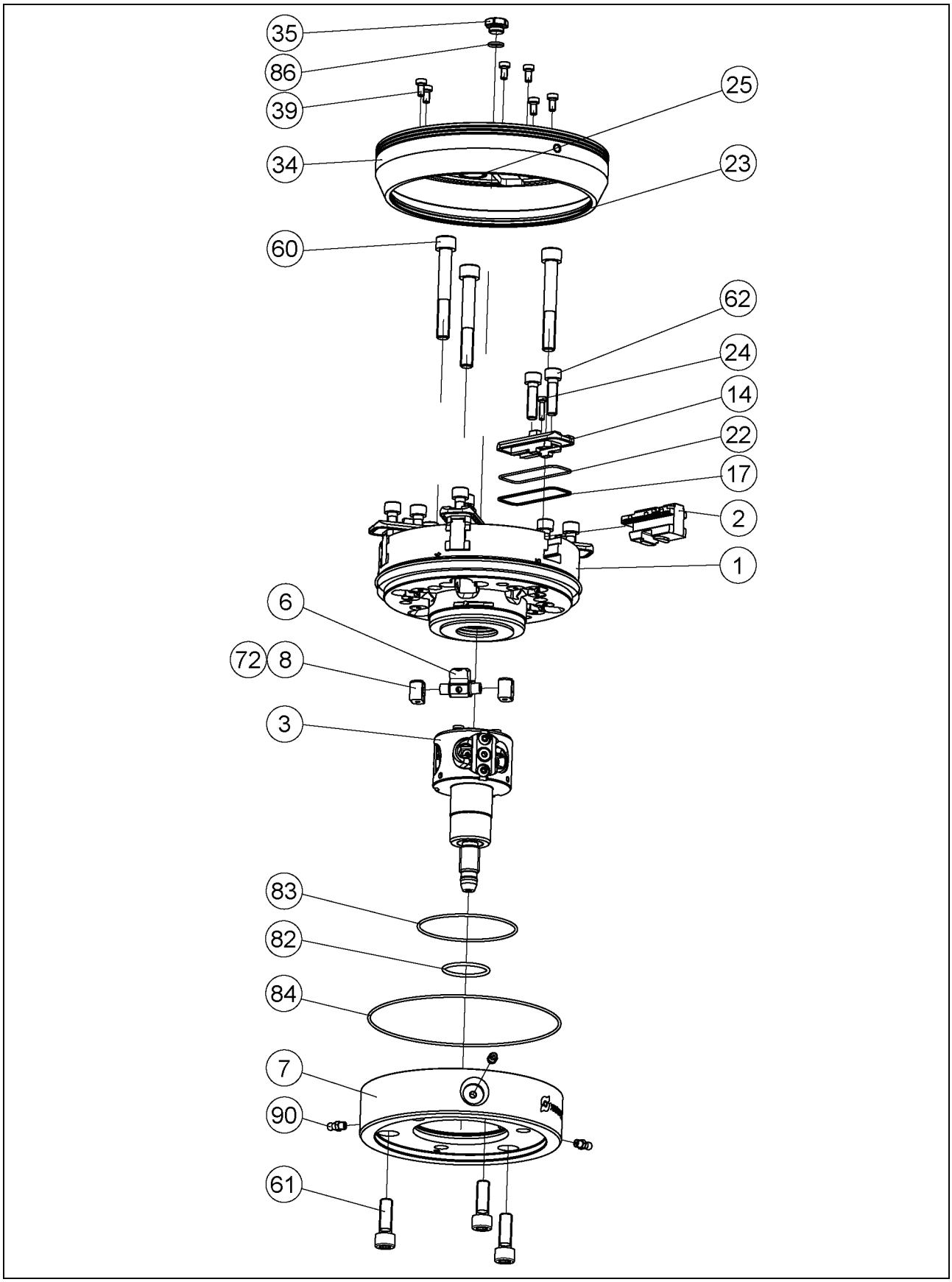
Item	Characterization	Quantity	Note
61	Mounting screw (machine from behind) – DIN EN ISO 4762-10.9	*	
64	Pan-head screw	6	
65	Set-screw	*	
66	Connecting member countersunk screw	6	
67	Piston set-screw	1	
69	Set-screw	*	
70	Plunger pin	2	
72	Seat of bearing torque pin	12	165 – 250
73	Screws	*	400 – 1000
78	Eye bolt	1	
80	Screw seal	1	
81	Adapter seal	1	
82	Piston seal	1	
83	Mounting seal	1	
84	Chuck body seal	1	
85	Pipe seal	1	
86	Locking screw seal	1	
88	Screw seal	1	
90	Conical lubrication nipple	*	
91	Piston set-screw	3	
92	Lever set-screw	6	
93	Lever set-screw	6	
94	Lever set-screw	*	
95	Set-screw	1	1000
*	The number of components varies with chuck size		

When ordering spare parts, it is imperative to specify the type, size and above all the serial no. of the chuck.

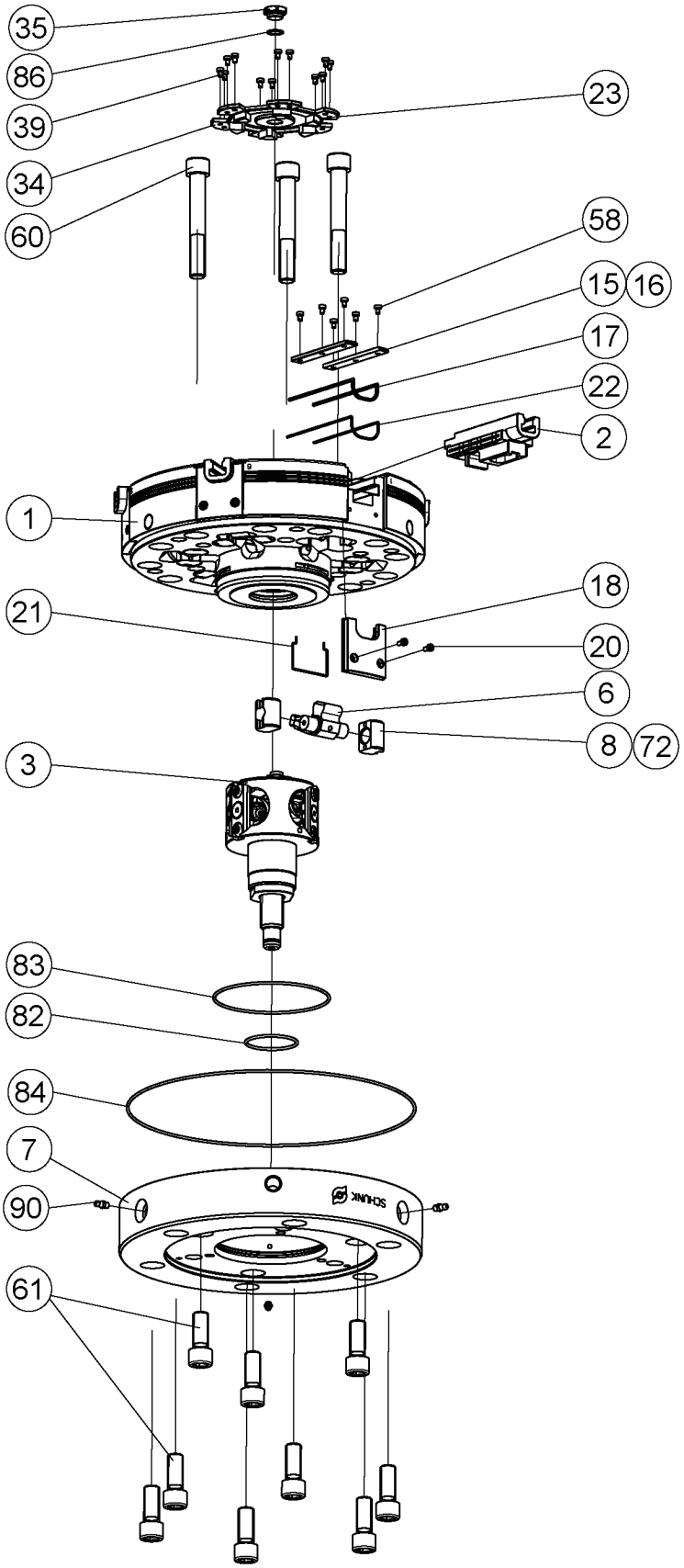
Seals, sealing elements, screw connections, springs, bearings, screws and wiper bars plus parts coming into contact with the workpiece are not covered by the warranty.

8 Assembly drawings

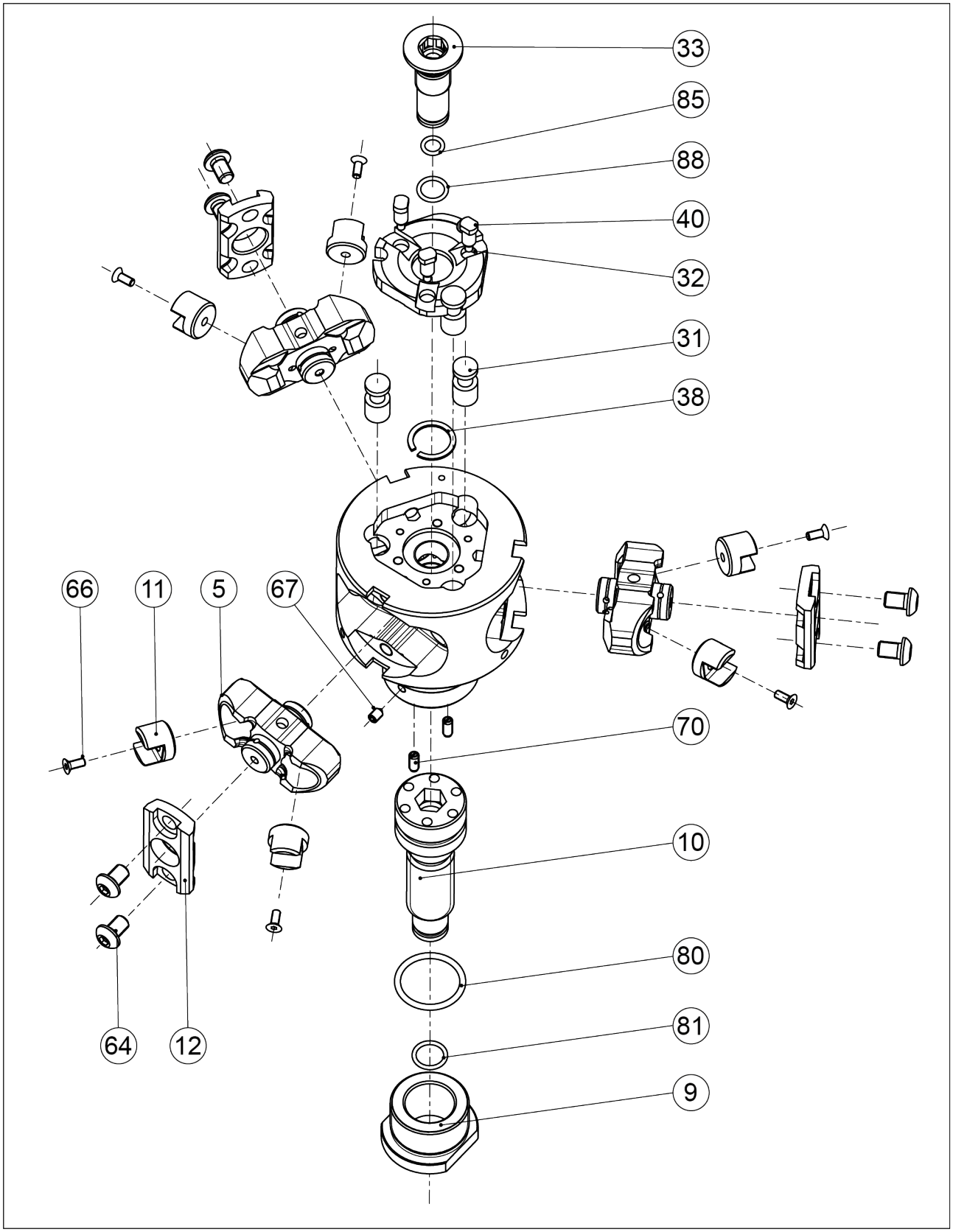
Size NCR-A-190/225



From size NCR-A-250



Piston from size NCR-A-250



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05.00 | ROTA NCR-A | Power chuck | en | 1341130

Manufacturer certificate

Manufacturer / Distributor:	Heinz-Dieter SCHUNK GmbH & Co. Spanntechnik KG. Lothringer Str. 23 D-88512 Mengen
Product:	**Lathe chuck**
Description:	**ROTA**
Type designation:	2B, NCA, NCD, NCE, NC, NCF, NCK, NCO, NCR, NCS, NCX, TH, THW

Heinz-Dieter SCHUNK GmbH & Co. Spanntechnik KG certifies that the above-mentioned products, when used as intended and in compliance with the operating manual and the warnings on the product, are safe according to the national regulations and:

- a **risk assessment** has been carried out in accordance with ISO 12100:2010.
- an **operating manual** for the assembly instructions has been created in accordance with the contents of the Machinery Directive 2006/42/EC Annex I No. 1.7.4.2. and the contents of the provisions of Annex VI of the Machinery Directive 2006/42/EC.
- the relevant basic and proven safety principles of the Annexes of **ISO 13849-2:2012**, taking into account the requirements of the documentation have been observed for the component. The parameters, limitations, ambient conditions, characteristic values, etc. for correct operation are defined in the operating manual.
- an $MTTF_D$ value of 150 years can be estimated for mechanical components using the informative procedure in Table C.1 of ISO 13849-1:2015.
- the **fault exclusion** against the fault "Unexpected release without pending release signal".
- the **fault exclusion** against the fault "Breakage during operation" in compliance with the parameters, limitations, ambient conditions, characteristic values and maintenance intervals, etc., specified in the operating manual.
- that internal bore diameters in the **pipe or control lines** are at least 2 mm for pneumatic clamping systems and at least 3 mm for hydraulic clamping systems

Harmonized standards applied:

- **ISO 12100:2010** Safety of machinery - General principles for design - Risk assessment and risk reduction
- **EN 1550:1997+A1:2008** Machine-tools safety – Safety requirements for the design and construction of lathe chucks for the workpiece mount

Other related technical standards and specifications:

- **ISO 702-1:2010-04** Machine tools – Connecting dimensions of spindle noses and lathe chucks – Part 1: front short-taper mount with screws
- **ISO 702-4:2010-04** Machine tools – Connecting dimensions of spindle noses and lathe chucks – Part 4: cylindrical mount
- **VDI 3106:2004-04:** Determination of permissible RPM of lathe chucks (jaw chucks)

Mengen, 25. Apr. 2023

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