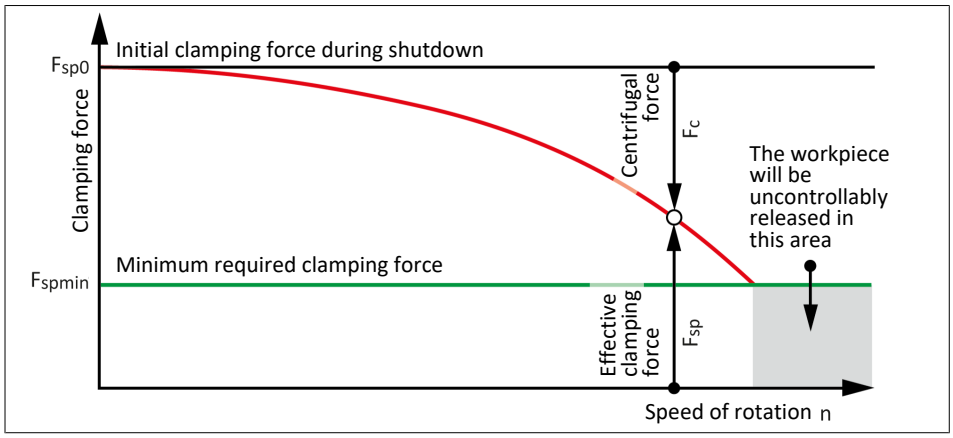


Reduction in effective clamping force by the magnitude of the total centrifugal force, for gripping from the outside inwards.

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: **$S_z \geq 1.5$.**

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

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

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

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

NOTICE

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 [🗋 16]

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.

NOTICE

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:

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

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

$$M_C = m_B \cdot r_S \text{ [kgm]}$$

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 $\mathbf{M_{cGB}}$** and the **centrifugal torque of the top jaws $\mathbf{M_{cAB}}$** need to be added:

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

The centrifugal torque of the base jaws M_{cGB} can be found in the table "Lathe chuck data"▸ 3.1 [🗋 16]. The centrifugal torque of the top jaws M_{cAB} is calculated as per:

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

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:

$$F_c = \sum M_c \cdot (\frac{\pi \cdot n}{30})^2$$

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:

M_{cGB} = 0.319 kgm

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

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

Centrifugal torque for one jaw:

$M_c = 0.319 + 0.571 \Rightarrow$ **M_c = 0.89 kgm**

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

$\sum M_c = 3 \cdot M_c = 3 \cdot 0.889 \Rightarrow$ **$\sum M_c$ = 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:

$F_{sp0} = S_{sp} \cdot (F_{sp} + F_c) = 1.5 \cdot (4500 + 42131) \Rightarrow$ **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:

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

NOTICE

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 [🗋 16]).

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 DIN ISO 21940-11

The ROTA-S flex in ungreased state without T-nuts and top 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 top 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 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
Admissible torque M_A (Nm)	16	30	50	70	130	150	220	450

4.2 Mounting in general

4.2.1 Pre-assembly measures

Carefully lift the product (e.g. using suitable lifting gear) from the packaging.

⚠ 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.

Check the delivery for completeness and for transport damage.

In order to achieve high run-out accuracy of the chuck, the machine side must be aligned before mounting the chuck. To do this, check the mounting surfaces for radial and axial run-out using a dial indicator.

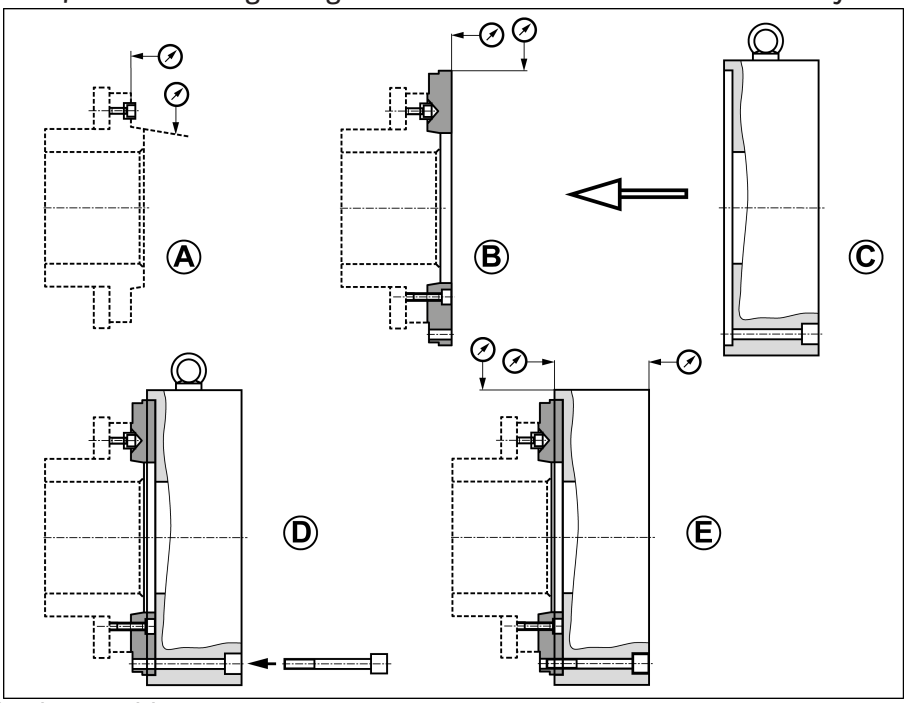
A maximum concentricity error of 0.01 mm should be ensured for the centring of the mount and a maximum axial run-out error of 0.01 mm for the contact surfaces. In addition, the flat surface must be checked for evenness using a straight edge (flat surface deburred and clean at the bore holes).

Radial and axial run-out tolerances of the chuck:

Chuck size [mm]	Max. Radial run-out tolerance [mm]	Max. Axial run-out tolerance [mm]
≤ 315	0.02	0.02
≤ 400	0.03	0.03
≤ 800	0.04	0.04
≤ 1200	0.05	0.05
≤ 1600	0.06	0.06

4.2.2 Chuck assembly options

If the interface of the machine spindle and chuck is identical, assembly is carried out without assembly preparation. If the interface of the machine spindle deviates from the interface of the chuck, a connecting flange must be installed before assembly.



Chuck assembly

- Direct assembly of the chuck to the machine spindle
- Assembly of the chuck with connecting flange
  - Direkt flange (insert ring)
  - Reduction flange
  - Expansion flange

NOTICE

When mounting with the connecting flange, never allow the outer rim of the chuck body to make contact. The flange must support on the entire surface.

NOTICE

Use a crane to install the chuck. Fasten the chuck to the eye bolt provided for this purpose (see Fig. "Chuck assembly" – C) The eye bolt must be removed prior to commissioning.

4.3 Assembly of the entire manual chuck

NOTICE

Follow the assembly and operating instructions for the centring chuck (**ROTA-S plus** or **ROTA-S plus 2.0**).

Insert the T-nuts (item 15) into the grooves provided in the machine table. Then lift the toolholder and supplied eye bolts onto the machine table. Align centrally with the centering pins (item 8) and radially with the location bolts (item 21) on the manual lathe chuck. Then fasten the chuck according to the specified torque using a torque wrench with the screws (item 14) and the T-nuts. To protect the counterbore holes against contamination, fit the caps (items 9, 10).

⚠ WARNING

Risk of injury from mounting screw brass caps (items 9 and 10) being flung out when chuck turns.

The mounting screw brass caps (items 9 and 10) must only be applied for stationary use of the chuck.

5 Function

The manual chuck can be operated in two different modes:

- With guideway extensions and long base jaws.
- Without guideway extensions and with short base jaws (corresponds to the basic manual chucks **ROTA-S plus** or **ROTA-S plus 2.0**)

5.1 Handling

NOTICE

Follow the assembly and operating instructions for the centring chuck (**ROTA-S plus** or **ROTA-S plus 2.0**).

When fitting the cover (item 4) to close the bore, ensure that the base jaws are mounted first. Then screw the cover (item 4) with the O-ring (item 18) onto the chuck face using the screws (item 11).

The base jaws must always move under the cover so as to keep the toolholder through bore sealed. However, the base jaws must only be moved inwards to the extent that the first tongue and groove of the base jaws does not move onto the cover (item 4) in the course of clamping.

If standard jaws are used on the toolholder, the cover (item 4) cannot be mounted.

With the ROTA-S flex 1000 size, ensure that the indicator pin is not covered by the cover when screwing on the cover (item 4) - observe recess in cover!

Fitting the guideway extensions

The guideway extensions are aligned with the baseplate using the feather keys (item 19) and screwed to the baseplate using the screws (item 12).

⚠ WARNING

Risk of injury (danger to life and limb) for the operating personnel and risk of considerable material damage if the guideway extensions (item 3) are not mounted correctly.

The guideway extensions (item 3) must be screwed to the bracket (item 2) using the feather keys (item 19) and **all** the mounting screws (item 12).

To protect the counterbore holes against contamination, fit the caps (item 10). Then push in the base jaws (item 6, 7).

NOTICE

Follow the assembly and operating instructions for the centring chuck (**ROTA-S plus** or **ROTA-S plus 2.0**).

⚠ WARNING

Risk of injury from mounting screw brass caps (items 9 and 10) being flung out when chuck turns.

The mounting screw brass caps (items 9 and 10) must only be applied for stationary use of the chuck.

6 Maintenance

NOTICE

Follow the assembly and operating instructions for the centring chuck (**ROTA-S plus** or **ROTA-S plus 2.0**).

To maintain the safe functioning and high quality of the chuck, it must be lubricated regularly at all lubrication points. For optimum grease distribution, the chuck must be lubricated in the lubricating position.

Depending on the operating conditions, the function and clamping force must be checked after a certain period of operation. Only perform the clamping force test with a calibrated clamping force tester (SCHUNK IFT). If the chuck is used over several clamping cycles in the short stroke range (< 50% clamping stroke), it is recommended to perform a empty stroke regularly to maintain the clamping force at a consistently high level.

Lubricate the chuck evenly in order to avoid large imbalances.

⚠ WARNING

Risk of injury through contact with lubricants!

Skin or eye contact with lubricants can cause irritation and allergic reactions.

- Avoid skin or eye contact with lubricants.
- Wear safety goggles and protective gloves.

6.1 Disassembling and assembling the chuck

Remove the base jaws from the chuck as described in chapter "Handling and jaw change" ▶ 5.1 [🗋 28]

Unscrew the screws (item 33) and remove the guideway extension (item 4). Screw out the screws (item 33) and undo the ROTA-S flex from the baseplate (item 3), taking it off to the front.

For further disassembly and assembly of the chuck, see the **ROTA-S plus** or **ROTA-S plus 2.0** Assembly and Operating Manual.

⚠ WARNING

Risk of injury due to dropping the manual chuck during transport, installation or removal

During transport and when installing or detaching the manual chuck, ensure it does not fall off.

7 Storage

When storing the product for a longer period of time, observe the following points:

- Clean the product and lubricate it lightly.
- Store the product in a suitable transport container.
- Only store the product in dry rooms.
- Protect the product from major temperature fluctuations.

NOTE: Before recommissioning, clean the product and all attachments, check for damage, functionality and leaks.

8 Part lists

When ordering spare parts, it is essential to specify the type, size and, above all, the serial number of the chuck. **Seals, sealing elements, screw connections, springs, bearings, screws and wiper strips as well as parts that come into contact with the workpiece are not covered by the warranty.**

8.1 ROTA-S flex Part list

Item	Designation	Quantity	Note
	ROTA -S plus 2.0 200 centering chuck (complete)	1	550
	ROTA -S plus 2.0 315 centering chuck (complete)	1	700
	ROTA -S plus 400 centering chuck (complete)	1	1000
	ROTA -S plus 500 centering chuck (complete)	1	1200
	ROTA -S plus 630 centering chuck (complete)	1	1400
20	Spanner wrench	1	
40	Short base jaw	3	
60	Base plate	1	
61	Guideway extension	3	
62	Cover	1	
63	Long base jaw	3	
64	Pressure bolt	3	
65/83	Ratchet with adapter	1	
66	Cover (bore cover)	15	
67	Locking screw	1	
68/69	Centering pin	2	
70	Cylindrical screws	15	
71	Countersunk screws	3	
72	Mounting bolts	1	
73	Nut for T-slot	13	
74	Cylindrical screws	13	
75	Cylindrical screws	3	
76	Cylindrical screws	2	
77	Feather keys	6	
78	Cylindrical screws	12	
79	Wiper	3	
80	O-ring	1	
85	Cover (bore cover)	13	

8.2 ROTA-S plus Part list

Size 400 (ROTA-S flex 1200)

Size 500 (ROTA-S flex 1200)

Size 630 (ROTA-S flex 1400)

Item	Designation	Quantity	Note
1	Chuck body	1	
2	Cover	1	
3	Drive ring	1	
4	Base jaws	3	
5	Wedge bar with thread	1	
6	Wedge bar	1	
7	Sliding block	3	
8	Spindle	1	
9	Wedge bar without thread	2	
10	Safety bolt	2	
13	Seat of bearing with bore hole	1	
15	Seat of bearing	1	
17	Indicator pin	1	
18	Ball	1	
19	Cartridge	3	
20	Bushing	3	
21	Control pin	3	
22	Ball	6	
23	Compression spring	3	
24	2nd plunger pin	3	
25	Plunger pin	3	
26	Washer	3	
27	Compression spring for plunger pin	3	
28	Compression spring for indicator pin	1	
29	Compression spring for safety bolt	2	
30	Clamping sleeve	2	
31	Screw for plunger pin	3	
32	Lubrication nipple for spindle	1	

Item	Designation	Quantity	Note
33	Lubrication nipple for chuck body	3	400 / 500
34	Screw 10.9 (cover)	3	
35	Screw 10.9	3	
36	Screw 10.9	3	
39	Safety disk	3	
40	Compression spring	3	
41	Set-screw	3	
42	Circlip	3	
	Screw 10.9	3	630
44	Lubrication nipple	3	
	Lubrication nipple	6	630
	Screw	6	630
52	Scraper left	3	630
53	Scraper right	3	630
54	Flat-head screw	24	630
61	Eye-bolt	1	
90	O-ring	3	
95	Sleeve	3	630
102	O-ring	3	630
103	O-ring	3	630
105	Compression spring	3	630

8.3 ROTA-S plus 2.0 Part list

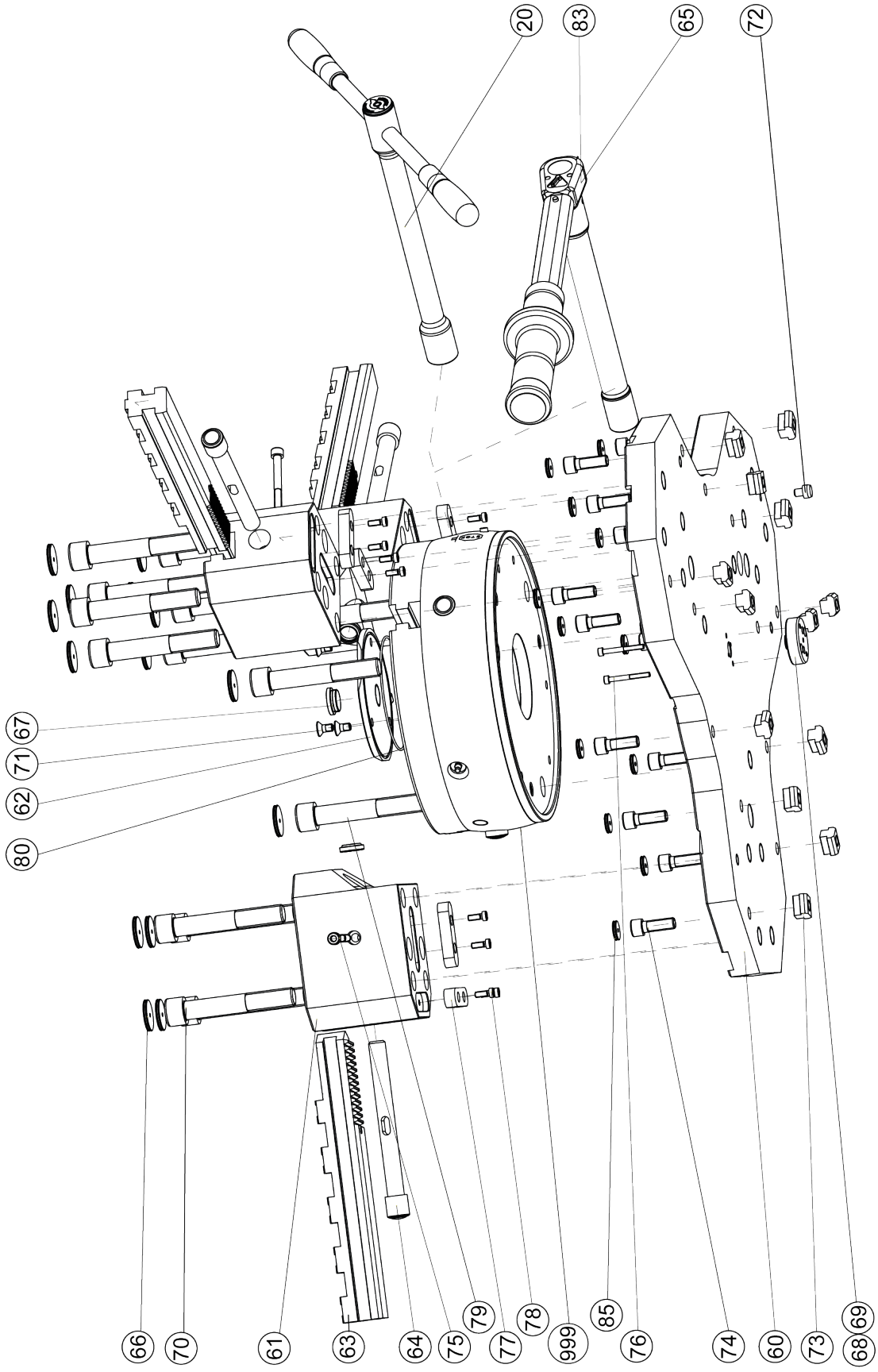
Size 200 (ROTA-S flex 550)

Size 315 (ROTA-S flex 700)

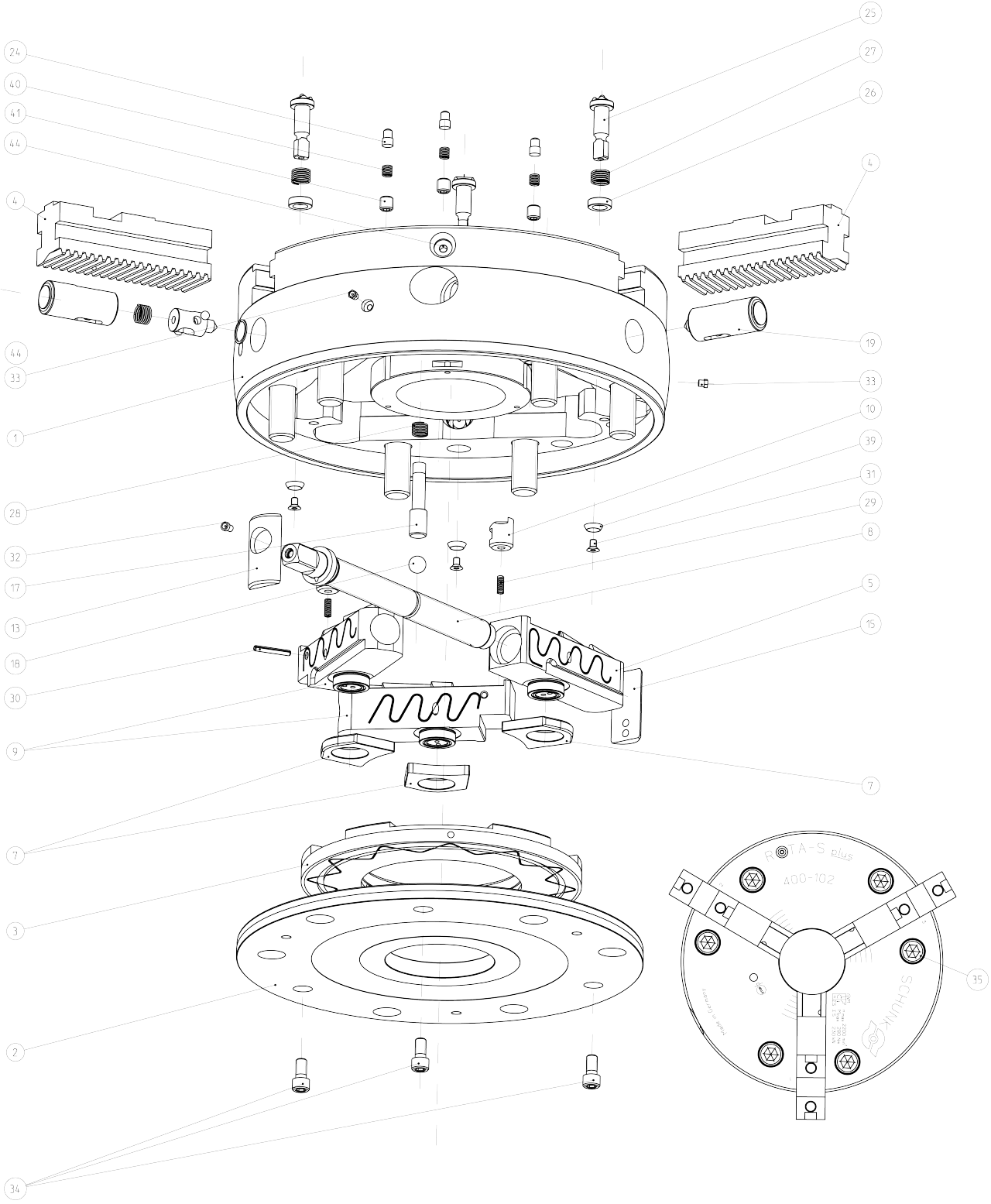
Item	Designation	Quantity
1	Chuck body	1
2	Cover	1
3	Drive ring	1
4	Base jaw	3
5	Wedge bar with thread	1
6	Wedge bar	2
7	Sliding block	3
8	Spindle	1
9	Spindle nut	1
10	Seat of bearing	1
11	Wiper (starting for size 200)	3
12	Slide	3
13	Locking slide	3
14	Pressure bolt	3
15	Traverse slide	3
17	Indicator pin	1
30	Cylindrical pin	1
31	Compression spring for thrust bolt	3
32	Compression spring for locking slide	3
33	Spring-loaded pressure piece	3
34	Cylindrical screw	3
35	Cylindrical screw	3
36	Flat lens head screw (starting from size 200)	12
37	Lubrication nipples	2
38	Compression spring for indicator pin	1
39	O-ring	3
45	Cylindrical pin	3
50	Eye bolt (starting from size 250)	1
55	Insert	3
99	Assembly key	1

9 Assembly drawings

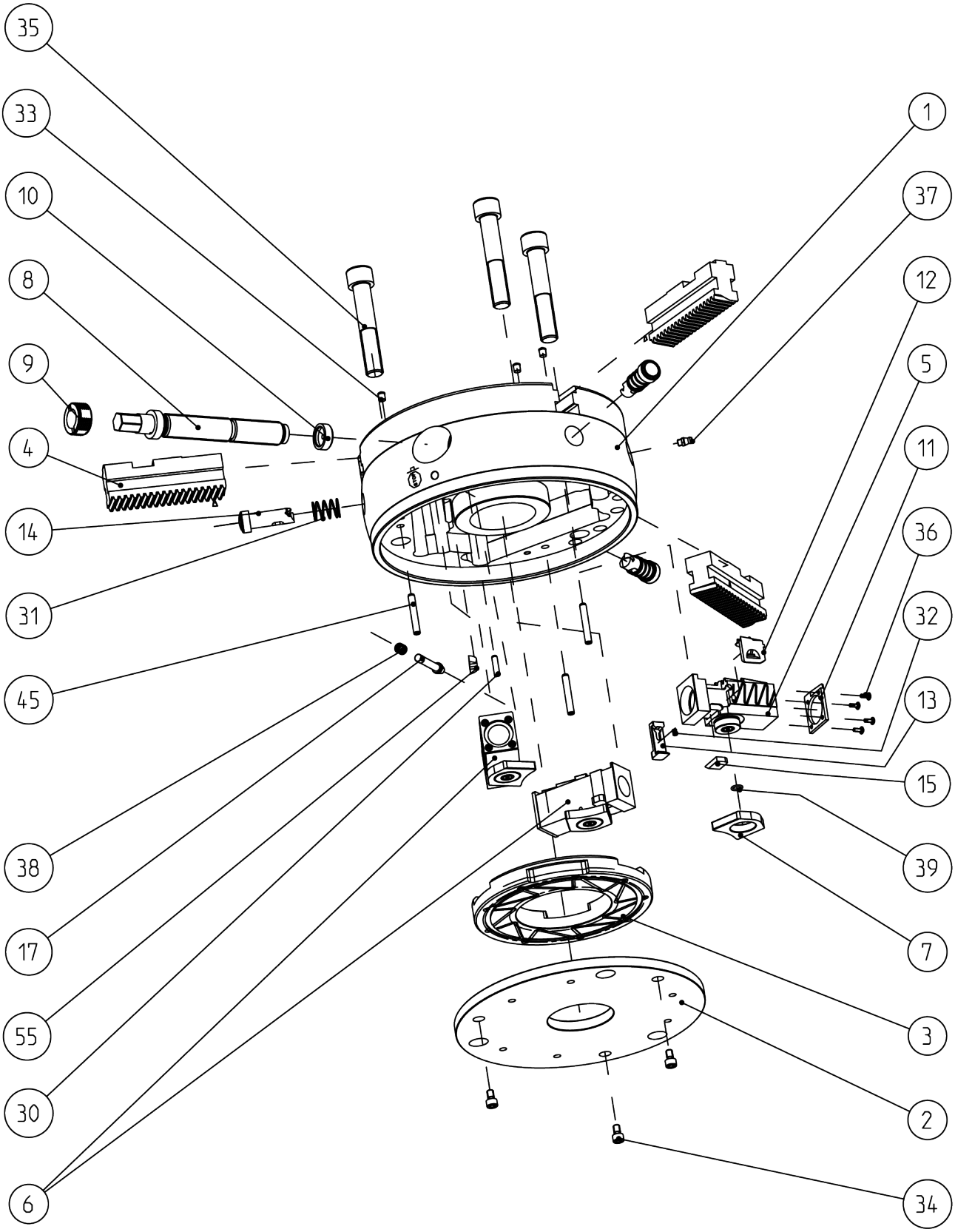
9.1 ROTA-S flex Assembly drawing



9.2 ROTA-S plus Assembly drawing



9.3 ROTA-S plus 2.0 Assembly drawing



10 Manufacturer certificate

Manufacturer / Distributor:	H.-D. SCHUNK GmbH & Co. Spanntechnik KG Lothringer Str. 23 D-88512 Mengen
Product:	Lathe chuck
Designation:	ROTA
Type designation:	M-flex 2+2, S-flex, SPK, ROTA-G, ROTA-S, Vario-M

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 proper 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 "Breakage during operation" in compliance with the parameters, limitations, ambient conditions, characteristic values and maintenance intervals, etc., specified in the operating manual.

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 702-2:2010-04** Machine tools – Connecting dimensions of spindle noses and lathe chucks – Part 2: front short-taper mount with camlock mounting
- **ISO 702-3:2010-04** Machine tools – Connecting dimensions of spindle noses and lathe chucks – Part 3: front short-taper mount with bayonet mounting
- **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, 25th of April 2023

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