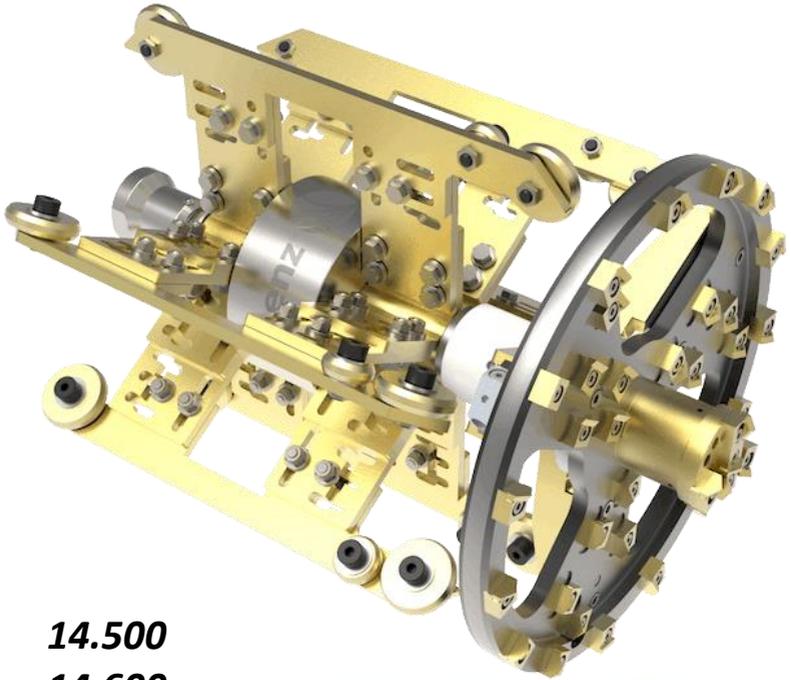


Impact Milling Cutters



14.100

14.120

14.150

14.400 14.500

14.450 14.600

Operating manual

English

November 20 | Version 3.1



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2.0	Created	Oct-16	mre
3.0	Revised and formatted in portrait format	Aug-20	fkr
3.1	Item No. cutting teeth updated	Nov-20	fkr

Preface

Dear customer

Thank you for the trust you have placed in us by the choice of our product. We would be more than pleased to receive any improvement suggestions and any constructive suggestions. We consider your cooperation as contribution to the optimum execution of our product and the corresponding documentation.

If you have any questions or suggestions, please contact our customer services directly:

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Person responsible for the documentation:

Fabian Krasniqi (Tech. Support / Head of QM)

Changes and enhancements due to technical progress as well as print errors are reserved.

Purpose of the document

These operating instructions serve to use our product in a comprehensive sense according to its intended use, correctly, effectively and safely. The users are informed about the risks, reasonably foreseeable misuse and residual risks.



Important!

Before using the product for the first time, read these original operating instructions, handle accordingly and keep them in a safe place for future reference.

Carefully read through the operating instructions before working with the cleaning tool. Make sure that it has been understood by all persons working with the product.

The operating instructions should be made available to the operating personnel at all times. It must be stored at an easily accessible location.

If the operating instructions are lost or have been destroyed, a copy can be requested from your local dealer or direct from the manufacturer.

1 Safety

1.1 Consequences when disregarding the safety instructions

Disregarding the safety instructions may lead to accidents with serious personal injury, property or environmental damage.

The manufacturer is not liable for damage that results from disregarding the safety instructions.

1.2 Target group

These operating instructions are intended for all persons that are involved in assembly, commissioning and operation of the pipe cleaning tool.

1.3 Requirements on the user

All persons that are involved in the assembly, commissioning and operation of the tool must ...

- be familiar with the cleaning work environment and have professional knowledge;
- be trained and instructed accordingly for the use of the product;
- have read and understood the operating instructions, in particular the chapter  **Safety**.

If the personnel do not have the necessary knowledge, this must be trained and instructed. If necessary, this can be carried out by the manufacturer of the pipe cleaning tool.

Only the maintenance and repair activities described in these operating instructions may be carried out by users who fulfil the requirements specified. All other maintenance and repair work may only be carried out by qualified personnel of the manufacturer.



Observe the instructions in the chapter "**Maintenance**"!

1.4 ⚠ Meaning of the general safety instructions

The general safety instructions in this chapter inform you about potential residual risks which, despite correct use of the product, may be permanently present or occur unexpectedly.

To avoid personal injury, property or environmental damage, it is essential that all persons working with the product observe the safety instructions. For these persons, it is therefore mandatory that this chapter is read and understood.

1.5 ⚠ Types of instructions in these operating instructions

	DANGER!
Designates dangers which, if disregarded, will result in death or severe injuries!	
	WARNING!
Designates dangers which, if disregarded, may result in death , severe injuries and / or invalidity!	
	CAUTION!
Designates dangers which, if disregarded, may result in injuries and significant property, financial or environmental damage!	
	Information for the technically correct and efficient use of the product.

1.6 Intended use

Due to the high pressures and temperatures, there is a risk of property damage as well as a risk of injury for the user and other persons. For the correct and intended use of the product, the following points must be observed:

-  The pipe cleaning tool may be used exclusively in pipes or pipe-like channels. In doing so, the profile to be cleaned must be closed and surrounded by material.
-  The product is suitable for use in cast steel, concrete and plastic pipes.
-  The product may only be operated with correct hose connections free of faults.
-  During operation including setup and clearing work, the cleaning area (shaft, feed, etc.) must be sufficiently secured.
-  During operation, **no** persons may remain in the pipes or at the ends of the pipes.
-  The max. pressure specified on the nozzle may **not** be exceeded.
-  The dirty water may **not** be directed into streams or rivers.
-  Before putting into operation each time, the correct state of the product must be checked.
-  Defects must be rectified before putting into operation.
-  Use only a correct tool. (For nuts, use only matching spanners)
-  Secure hose lines in such a way that they cannot be damaged during operation.
-  Only accessory parts provided and approved by **enz® technik ag** may be used.

1.7 Safety instructions for modifications

It is forbidden to carry out any conversions or modifications to the pipe cleaning tool. Only parts authorised by the manufacturer may be used. The manufacturer is not liable for damage that results in conjunction with conversions to the product made at your own authority.

1.8 ⚠ Protective equipment when working in shafts, pits and channels

The employer provides suitable protective equipment. They must ensure that their employees wear these during work.

The protective equipment prescribed by the SUVA (Switzerland) are described in the following.

See the leaflet for this purpose:

Safe access and working in shafts, pits and channels

Order number: 44062.d

Suva
Schweizerische Unfallversicherungsanstalt
Arbeitssicherheit
Postfach, 6002 Luzern, Switzerland
Information:
Tel. 041 419 51 11
Orders:
www.suva.ch/waswo
Fax 041 419 59 17
Tel. 041 419 58 51

	Isolation devices
	Isolation device (breathing apparatus) for remaining in dangerous atmospheres and for rescue operations.
	Isolation devices
	Isolation devices for self-rescue (self-contained open-circuit compressed air breathing apparatus and regenerative devices) for remaining in channels and for first supply of persons injured
	Rescue harness
	Rescue harness or safety clothing with sewn-in neck eyelet. During the rescue operation, the rescue rope is attached to the neck eyelet. Lifting the injured person is carried out, e.g. By means of a rescue lifting device with automatic load backstop.
	Suitable work clothing
	Closed work clothing protects against contamination of skin and possible infections. Visually noticeable work clothing should make the employees more visible for road users.
	Suitable shoes
	The safety shoes should, in particular, offer good support as well as be anti-slip and leak proof (e.g. Rubber boots).

	Gloves
	Suitable gloves protect against hand injuries and contact against substances hazardous to health and contaminated water.
	Hard hat
	The hat protects the persons head against falling objects as well as against knocking against fixed components and objects.
	Ear protection
	For noise which can damage hearing, e.g. ear protector capsules with integrated headset can be worn.
	Eye protection
	If there is a danger from splitters, splashing of hazardous substances, etc. eyes must be protected.
	Network-independent lighting
	For example, a splash-proof torch or a lamp fixed to a hard hat must be carried.

1.9 General safety instructions

Danger! | High-pressure water jets



Defective or incorrect operation of the product may generate dangers from splash water under pressure. Before operation, ensure the trouble-free state of the product. Powerful water jets may cause severe injuries or even sever limbs. Non-observance of the safety instructions may result in **death** or very serious injuries!

Danger! | Poisonous vapours



Channels may contain poisonous vapours. Wear the prescribed protective equipment such as gas masks, gas alarms and rescue harnesses. Inhaling poisonous vapours or air contaminated with particles may result in **death** or very serious injuries from the particles penetrating into the lungs!

Warning! | Parts falling down



In the area of open shafts, objects may fall into the shaft on top of persons working there. When inserting the product, never remain directly under the shaft opening. Secure the shaft access against parts that may fall down. Do not throw any tools or objects into the shaft. Never access shafts that are in danger of collapsing. Persons could be buried. Non-observance of safety instructions may result in **death** or very serious injuries!

Warning! | Chemical burns



Channels may contain unknown, corrosive or other harmful substances. Wear the respective protective clothing. Use the prescribed protective equipment. Chemical burns to skin and eyes as well as infections with pathogens may be the consequence.

Warning! | Risk of falling



In the area where work is carried out using the product, open shafts are to be expected. Open shafts must be indicated. Take care where you step. Persons falling may result in **death** or very serious injuries!

**Warning! | Hand injuries**

With a modification of the product, there is a risk of hand injuries from entrapment or abrasion. Wear gloves when working. Observe where you hold the product. Carry heavy devices with the assistance of a second person. This may result in crushing, abrasion up to the severing of limbs.

**Caution! | Tipped objects**

With a modification of the product, there is a risk of hand injuries from sharp edges. Wear gloves when working. Observe where you hold the product. This may result in cut injuries to hands and other body parts.

**Caution! | Risk of falling**

In the area where work is carried out with the product, lines and objects are to be expected on the ground. Take care where you step. Keep the operating area clean and tidy. Falling caused by tripping may result in injury.

2 Rights

2.1 Copyright

This manual may not be partially or completely copied, photocopied, reproduced, translated or converted in an electronically of machine-readable form without the prior written consent of **enz® technik ag**.

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All rights reserved.

2.2 Disclaimer

The manufacturer is not liable for damage that:

- has resulted in conjunction with modifications to the product carried out at your own authority.
- have resulted from disregarding the safety instructions.

2.3 Guarantee conditions

In line with our terms of sales and delivery, we issue a guarantee. However, the guarantee is omitted:

- When used under conditions stipulated otherwise by us.
- When using replacement or accessory parts that are not original from **enz® technik ag**.
- In event of damage caused by:
 - Incorrect handling
 - Non-observance of the operating instructions
 - Unsuitable operating material
 - Routing of the hose or pipelines incorrectly or inappropriately
 - Changes, modifications or conversions to the product at your own authority.

3 Environment

3.1 Disposal

Old devices have valuable recyclable materials that should be recycled. Thus, please dispose of the old device via appropriate collecting points.

3.2 Environmental protection

Please observe that surfaces can only be cleaned where the composition is known. Chemicals or other poisonous substances must never be released to the environment. Take care to avoid excessive use of water. In this way, you help to protect natural resources.

4 Technical Data

4.1 Introduction

The enz® impact milling cutters have been designed for the milling of extremely hard deposits in pipes. The impact milling cutter has a impact of 600 - 3,000 impacts per minute and up to 12 tons of impact force. Moreover, the head and hub are exchangeable and can be set in diverse diameters.

Depending on the hardness of the deposits, carbide or diamond teeth are used.

4.2 Area of application

The enz® impact milling cutters can be used in a range of Ø 100-600 mm and are well suited for the following deposits:

- calcareous layers
- concrete
- injection cement
- etc.

4.3 Legend for technical data

	Connecting thread [“]		Rotating nozzles / bore
	Weight [kg]		Thrust jet
	Mass		Area of application
	Maximum pressure		min. flow rate at 100 bar

Table 1: Legend for technical data

4.4 14.100

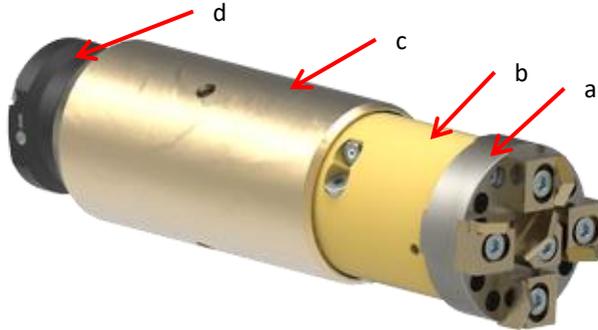


Figure 1: Designation of the parts (14.100)

4.4.1 Designation of the parts

- a: Cutter head
- b: Hub
- c: Cage
- d: Thrust part

4.4.2 Specifications

Order no.		14.100
		BSPP 1"
		3xM10
		3xM10
		12.0
	mm	100
	inch	3.9
ØxL	mm	89x345
	inch	3.5x13.6
	l/min	100
	US gpm	26.4
	bar	150
	psi	2,200

Table 2: Technical data 14.100

4.5 14.120

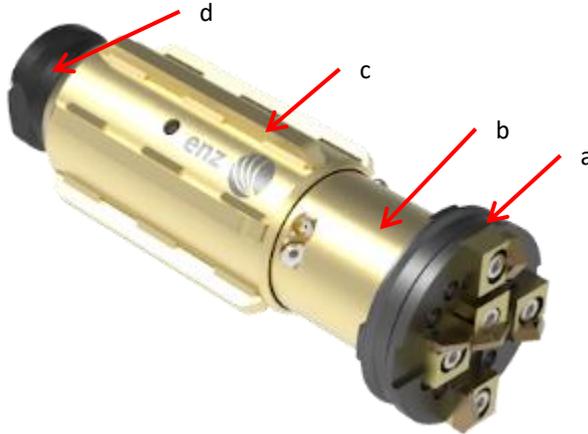


Figure 2: Designation of the parts (14.120)

4.5.1 Designation of the parts

- a: Cutter head
- b: Hub
- c: Cage
- d: Thrust part

4.5.2 Specifications

Order no.		14.120
		BSPP 1"
		3xM10
		3xM10
		13.7
	mm	120
	inch	4.7
ØxL	mm	109x345
	inch	4.3x13.6
	l/min	120
	US gpm	31.7
	bar	150
	psi	2,200

Table 3: Technical data 14.120

4.6 14.150

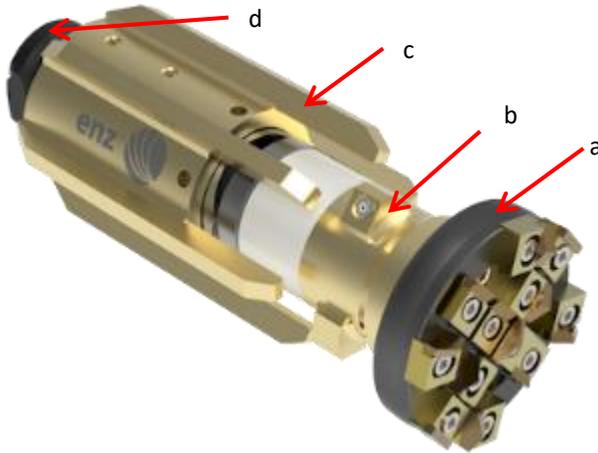


Figure 3: Designation of the parts (14.150)

4.6.1 Designation of the parts

- a: Cutter head
- b: Hub
- c: Cage
- d: Thrust part

4.6.2 Specifications

Order no.		14.150
		BSPP 1"
		3xM10
		3xM10
		21.4
	mm	150
	inch	5.9
ØxL	mm	138x390
	inch	5.4x15.4
	l/min	150
	US gpm	39.6
	bar	150
	psi	2,200

Table 4: Technical data 14.150

4.7 14.400-14.600

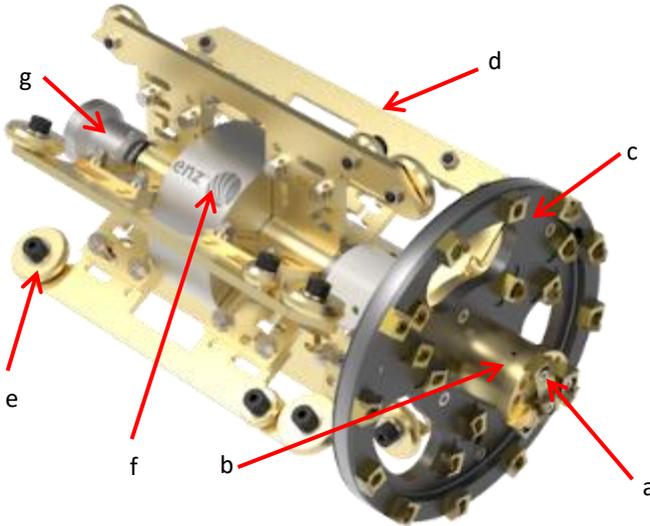


Figure 4: Designation of the parts (14.400-14.600)

4.7.1 Designation of the parts

- a: Centre cap
- b: Hub
- c: Cutter head
- d: Skid
- e: Roller
- f: Weight
- g: Swivel joint

4.7.2 Specifications

Order no.		14.400	14.450	14.500	14.600
		BSPP 1" and BSPP 1 1/4"			
		3xM10			
		3xM10			
		89.0	107.0	111.0	120.0
	mm	400	450	500	600
	inch	15.7	17.7	19.7	23.6
	mm	375x710	425x710	475x710	575x710
	inch	14.8x28.0	16.7x28.0	18.7x28.0	22.6x28.0
	l/min	300	400	450	500
	US gpm	79.3	105.7	118.9	132.1
	bar	150			
	psi	2,200			

Table 5: Technical data 14.400-14.600

4.8 Tightening torques of the screws

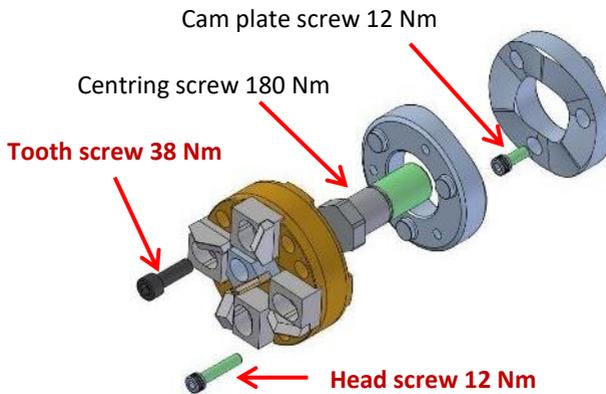


Figure 5: Tightening torques 14.100-14.150

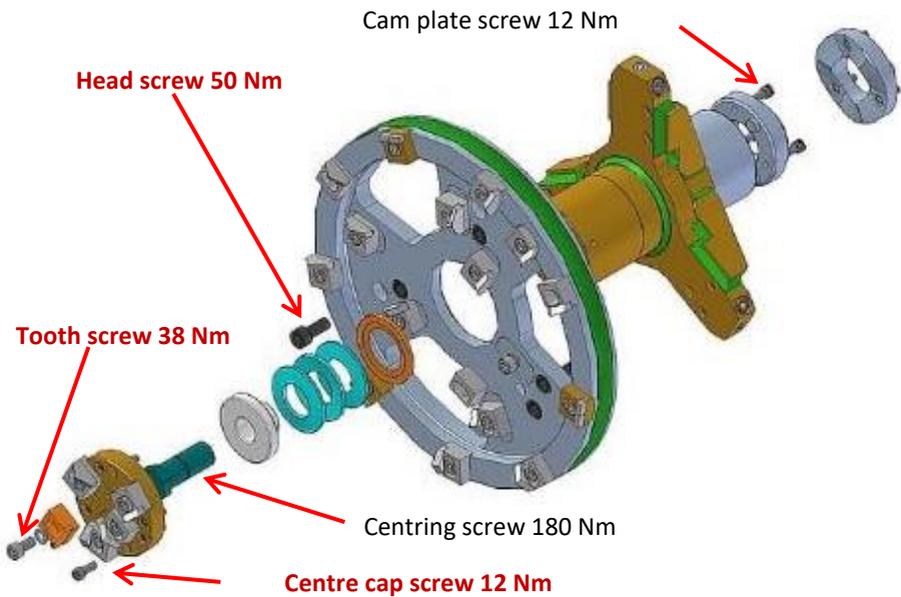


Figure 6: Tightening torques 14.400-14.600



CAUTION!

At the beginning, all tightening torques written in **red** must be checked with a torque wrench after two minutes, and then every hour. This may result in damage to the milling cutter or to parts flying around.

5 Cutting teeth

5.1 Overview of cutting teeth

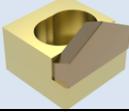
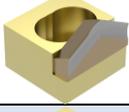
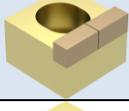
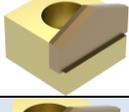
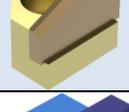
Figure	Article number	Area of application
	15.ZU	Calcareous layers
	15.ZU-GSL	Plastic
	15.ZHU	Calcareous layers
	15.Z1	Calcareous layers Concrete
	15.Z1-100	Calcareous layers Concrete
	15.ZD	Concrete

Table 6: Overview of cutting teeth

5.2 Cutting teeth on the centre cap

With the centre cap, take care that the outer carbide tooth 15.ZU are always offset to the outside and the inner carbide tooth 15.ZU is always mounted in the neutral position. The centre tooth 15.Z1 must be mounted precisely in the middle.

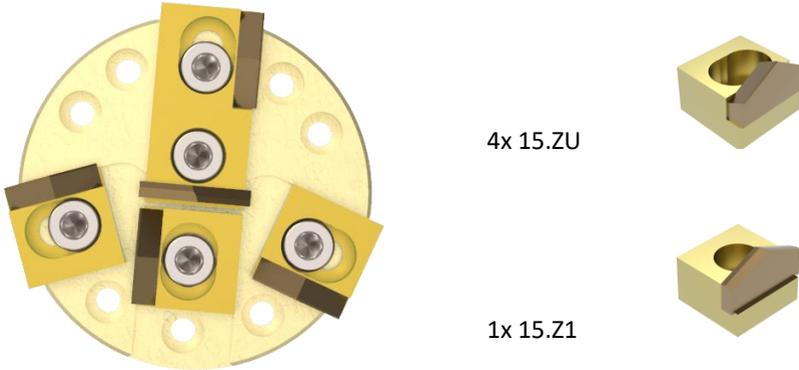


Figure 7: Cutting teeth on the centre cap

5.3 Cutting teeth on the inner ring

All cutting teeth on the inner ring of the cutter head are always mounted in the neutral position. The universal tooth made of carbide 15.ZU is mounted as standard.

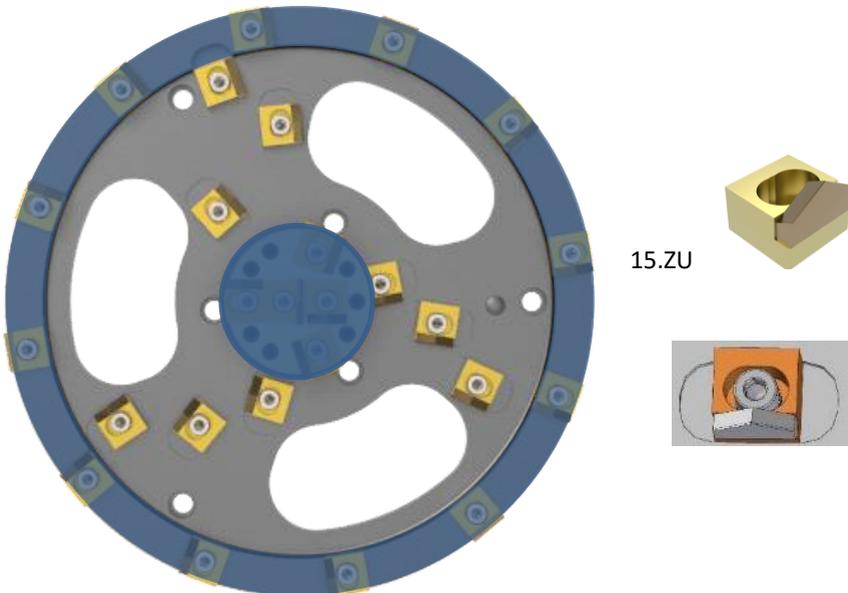


Figure 8: Cutting teeth on the inner ring

5.4 Cutting teeth on the outer ring

As standard, three carbide impact cutters 15.ZHU are always mounted on the outer ring which protect the remaining universal cutting teeth 15.ZU against excessive wear. As standard, the universal cutting teeth 15.ZU on the outer ring are mounted in the neutral position. For cutting in plastic pipes, the cutting teeth must be offset inwards. For cutting work in cast or steel pipes, they can be mounted offset to the outside.

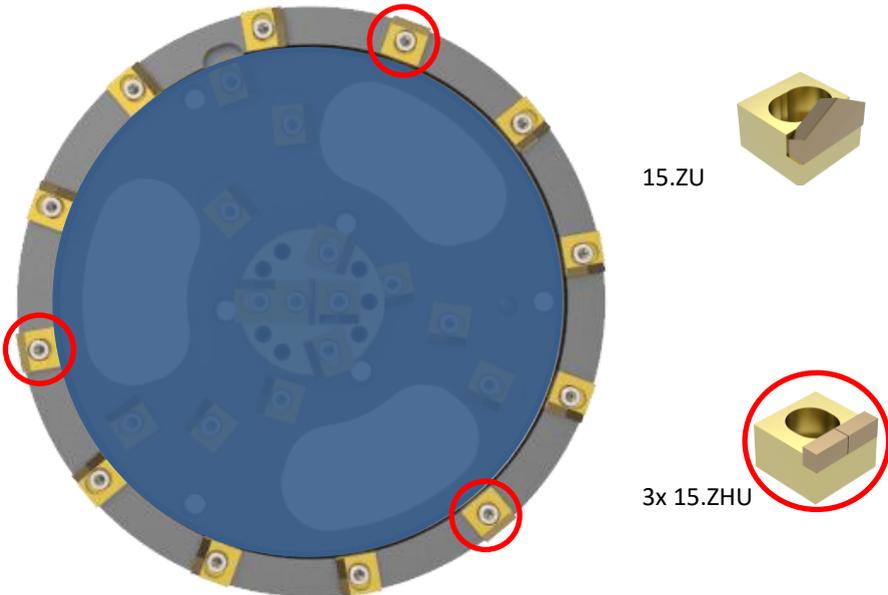


Figure 9: Cutting teeth on the outer ring

5.4.1 Tooth position on the outer ring

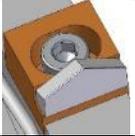
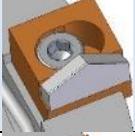
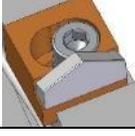
	<p>As standard, the universal cutting teeth 15.ZU are mounted in the neutral position for calcareous deposits in concrete or steel pipes.</p>
	<p>In cast, steel and concrete pipes, the universal cutting teeth can be mounted offset to the “outside”.</p>
	<p>In plastic pipes, the universal cutting teeth 15.ZU are offset to the “inside” in order not to damage the wall of the pipe.</p>

Table 7: Tooth position on the outer ring



The ground teeth 15.ZU-GSL for plastic or wooden deposits are always mounted in the neutral position.

5.5 Equipping for calcareous deposits

To cut calcareous deposits, the normal centre cap must be used. The cutter head is equipped with universal cutting teeth 15.ZU in the neutral position and three peripheral cutting teeth 15.ZHU on the outer ring.

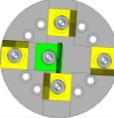
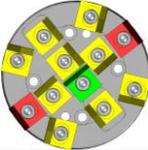
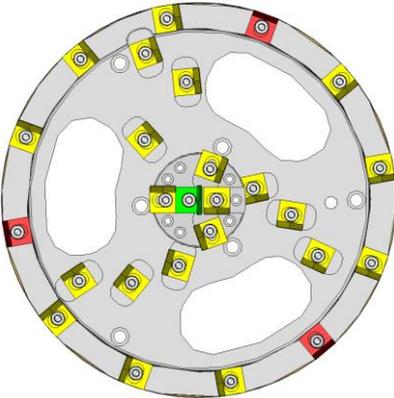
Figure	15.ZU	15.ZHU	15.Z1	15.Z1-100
14.100 	4			1
14.120 	4		1	
14.150 	9	2	1	
14.400 	22	3	1	

Table 8: Table equipping 14.100-14.400 for calcareous deposits

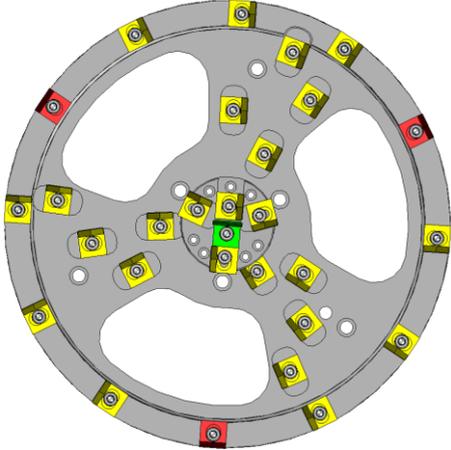
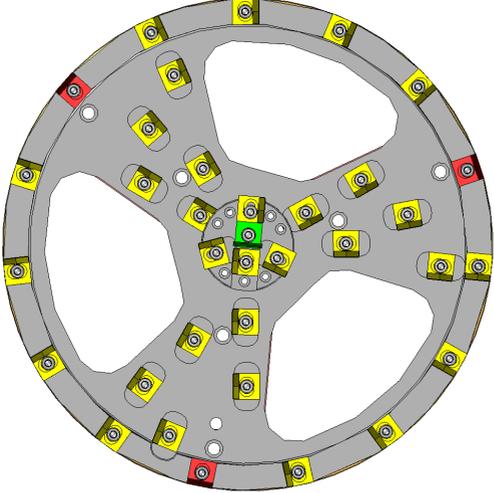
Figure	15.ZU	15.ZHU	15.Z1	15.Z1-100
<p>14.450</p> 	25	3	1	
<p>14.500</p> 	31	3	1	

Table 9: Equipping 14.450-14.500 for calcareous deposits

Figure	15.ZU	15.ZHU	15.Z1	15.Z1-100
<p>14.600</p>	37	3	1	

Table 10: Equipping 14.600 for calcareous deposits

5.5.1 Calcareous deposits in plastic pipes

The normal centre cap is used to cut calcareous deposits in plastic pipes. The universal cutting teeth 15.ZU on the outer ring are mounted offset to the “inside” and the three peripheral cutting teeth 15.ZHU are replaced by 15.ZU.

5.6 Wood and plastic deposits

Specially ground teeth 15.ZU-GSL are used to cut wood and plastic deposits in pipes. These teeth are mounted on the outer and inner ring in a neutral position. The three peripheral cutting teeth 15.ZHU are also replaced by 15.ZU-GSL. The normal centre cap is used for the milling work.

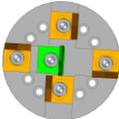
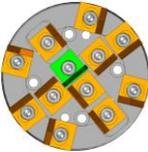
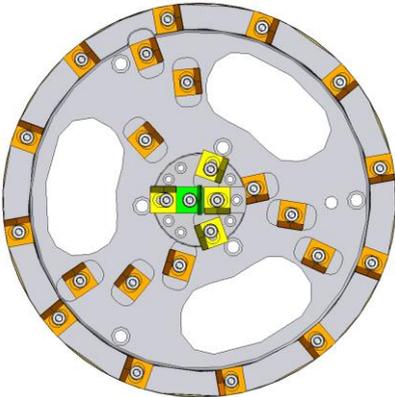
Figure	15.ZU	15.ZU-GSL	15.Z1	15.Z1-100
<p>14.100</p> 		4		1
<p>14.120</p> 		4	1	
<p>14.150</p> 		11	1	
<p>14.400</p> 	4	21	1	

Table 11: Equipping 14.100-14.400 for wood and plastic deposits

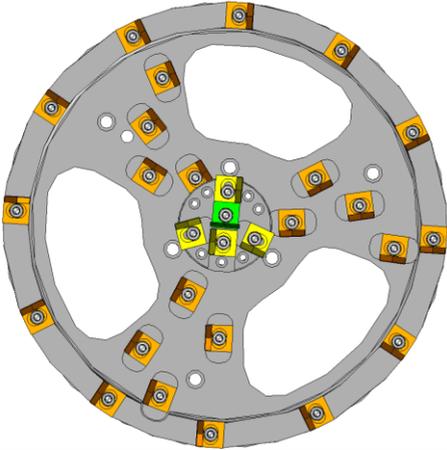
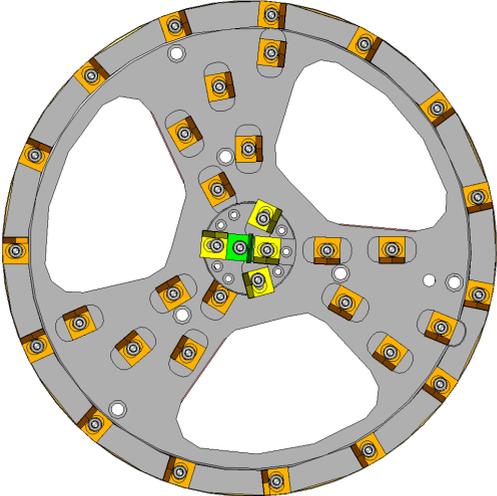
Figure	15.ZU	15.ZU-GSL	15.Z1	15.Z1-100
<p>14.450</p> 	4	24	1	
<p>14.500</p> 	4	30	1	

Table 12: Equipping 14.450-14.500 for wood and plastic deposits

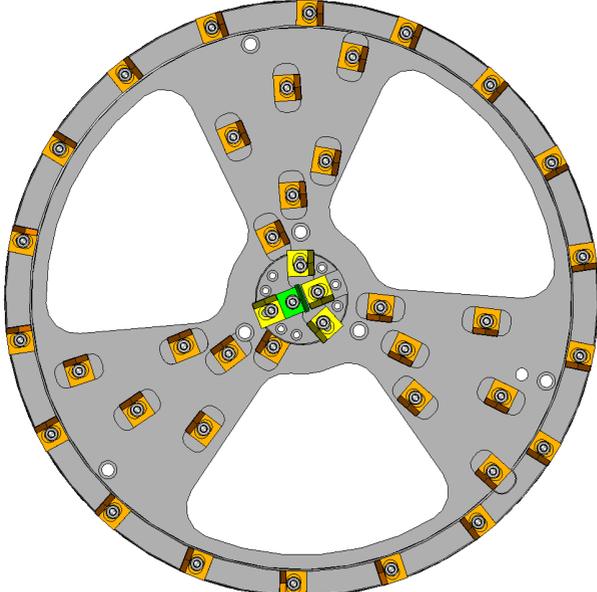
Figure	15.ZU	15.ZU-GSL	15.Z1	15.Z1-100
<p>14.600</p> 	4	36	1	

Table 13: Equipping 14.600 for wood or plastic deposits



If the pipe is filled half full with plastic deposits, the ground teeth 15.ZU-GSL can also be mounted on the centre cap.

5.7 Equipping for concrete deposits

For extremely hard deposits and concrete where the impact milling cutter with the universal cutting teeth no longer provides the necessary performance, diamond teeth should be mounted. The diamond teeth are mounted on the complete outer ring.

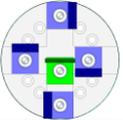
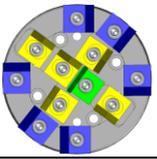
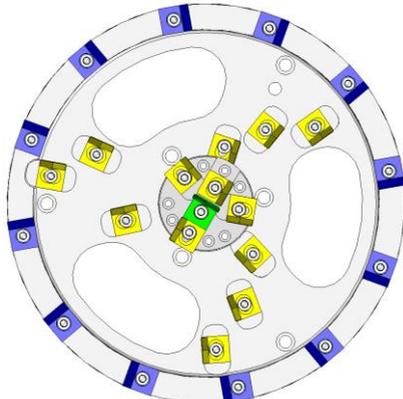
Figure	15.ZU	15.ZD	15.Z1	15.Z1-100
14.100 		4		1
14.120 		4	1	
14.150 	5	6	1	
14.400 	13	12	1	

Table 14: Equipping 14.100-14.400 for concrete deposits

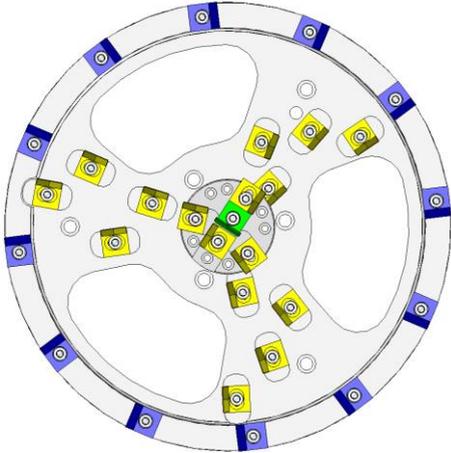
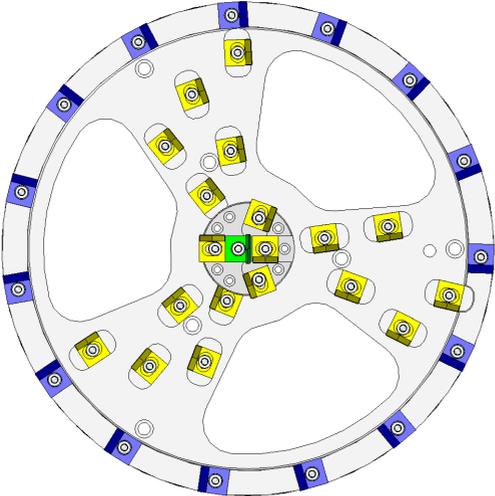
Figure	15.ZU	15.ZD	15.Z1	15.Z1-100
<p>14.450</p> 	16	12	1	
<p>14.500</p> 	19	15	1	

Table 15: Equipping 14.450-14.500 for concrete deposits

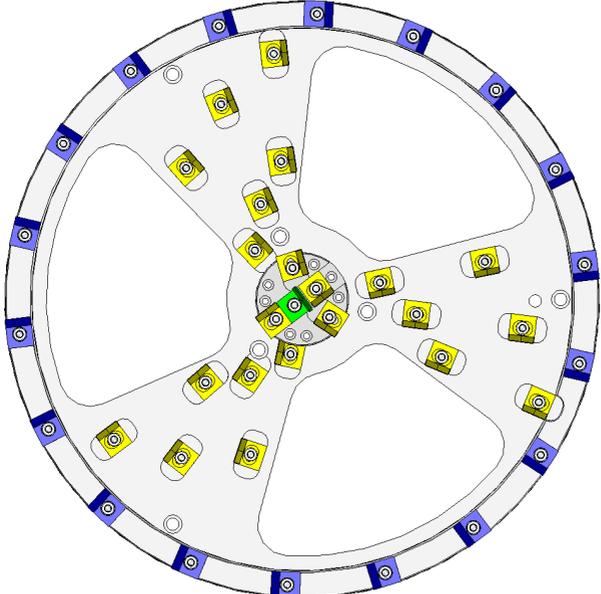
Figure	15.ZU	15.ZD	15.Z1	15.Z1-100
<p>14.600</p> 	22	18	1	

Table 16: Equipping 14.600 for concrete deposits



If the concrete deposits increase, the cutting teeth can be moved to the “outside” on the outer ring in order to cut a little. Then the cutting teeth are set back to “neutral”. This prevents the milling cutter from running upwards.

5.8 Teeth position overview

Pipe material	Deposit			Tooth position
	Lime	Concrete	Plastic	
Concrete- and Cast-Iron pipe	With	With	Without	Inside
				Neutral
Plastic pipe	Without	Without	Without	Inside
				Neutral
15.ZU			Percussion:	With
15.ZU-GSL				Without
15.ZD				

6 Installation

6.1 Equipping

To match the impact milling cutters optimally to the flushing vehicle, enz® technik ag needs the following parameters for each order:

- | | | |
|--------------------|-------------------|----------|
| • Pumping capacity | [l/min] | [US gpm] |
| • Pump pressure | [bar] | [psi] |
| • Hose diameter | [mm] | [inch] |
| • Hose length | [m] | [feet] |
| • Hose material | Plastic or rubber | |
-



If changes are made to the parameters, you should re-adjust the impact milling cutter.

6.2 Assembly of the tools

The tools are supplied ready for use and are set to “Milling with impact” ex-factory. After unpacking, check , that the delivery is complete. Then the impact milling cutter is screwed onto the pressure hose. The impact milling cutters have different thread dimensions which are apparent in the chapter “Technical data” from page [15](#).

As standard the impact milling cutters rotate counter-clockwise. This means that it cannot be disconnected from pressure hose during operation.



When screwing on the pressure hose, make sure that no contamination can enter in the tool. Particles may clog the inserts.

6.3 Preparation work

Before a milling project can even be implemented, the following points must be clarified with the customer:

- Organise plans where the pipeline route is apparent
- Photographic and video material of the pipe condition
- Raw material
- Internal diameter and length of the pipe
- Material of the deposits in the pipe
- Length of the deposits in the pipe
- Direction of flow of the water
- Inclination
- Access to the pipe
- Have the exclusion of liability signed by the customer

6.4 Setting up the workplace

Prior to working with the impact milling cutter, the following actions must be taken:

-  Set up barriers and safety equipment (warning triangle, block off the area, etc.)
-  The necessary information on the wastewater flowing through the shaft must be obtained (chemicals, gas, vapors, etc.)
-  Measuring instruments such as explosive gas meters, oxygen meters, gas warning devices, etc. must be readily available.
-  The work area must be blocked off and secured so that there is no risk of falling or other traffic-related dangers.
-  Have the liability waiver signed to protect against any possible damages.
-  Secure access to the pipe so that the cutter can be used in the pipe without problems. Clear out at least 20 cm of deposits in the shaft.
-  Organize a rinsing device with sufficient power.
-  For heavy milling, organize a tripod winch (do not leave on the hose in the shaft)
-  Trained operating personnel who are familiar with milling work must be available for the milling project.



Figure 10: Working area cordoned-off & marked



If you cut in the direction of flow or against the direction of flow, or in pipes with slopes or inclines, the thrust nozzles must be adapted.

7 Operation

7.1 Operating principle

The impact milling cutter is guided in the pipe on skids with rollers (1). The thrust nozzles (2) generate the thrust force and pushes the milling cutter forwards in the pipe. The swivel joint (3) between the impact milling cutter and hose prevents the hose from twisting. The cutter head (4) with the rotation nozzles (5) is sped up to 5,000 - 6,000 rpm at idle. During use, it rotates at 200 - 1,000 rpm. In doing so, the carbide teeth (6) cut the deposits (7) away with a cadence of 600 - 3,000 impacts per minute and up to 12 tons of impact force.

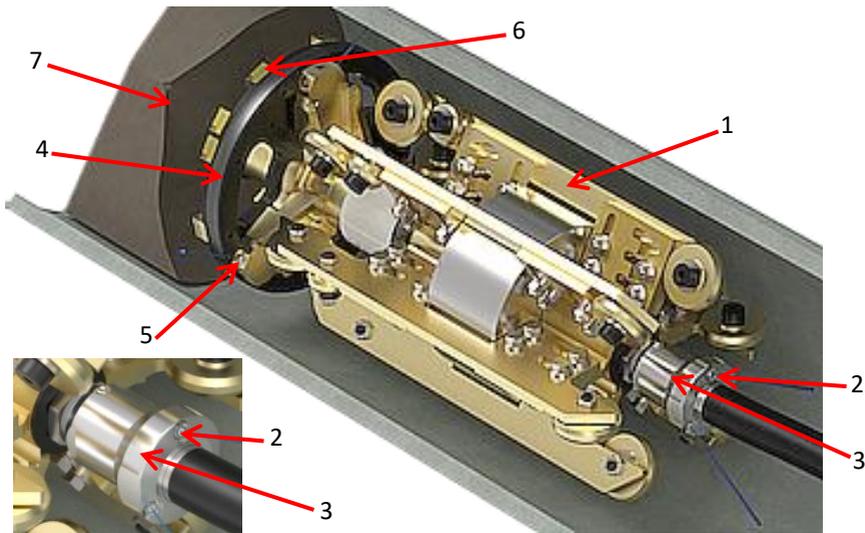


Figure 11: Operating principle

7.2 Nozzle insert

The three thrust nozzles (2) which are mounted on the swivel joint (3) can be exchanged for the respective work deployment at any time. This controls the contact pressure and the forwards sliding of the tool. For the milling project, organise different nozzle inserts for the thrust in advance. Changing the nozzle inserts is described in chapter "Changing the nozzle inserts" on page [51](#).

When equipped correctly, the impact milling cutter works quicker and more efficient.



Please observe that in most cases, the thrust nozzles have to be adapted.

7.3 Operating the tool against the direction of flow

1. Please flush all loose debris from the pipe prior to working with the standard nozzle. Gravel may impair the work process and damage the cutter's teeth.
 2. Use a camera to check and survey the condition of the pipes.
 3. Check the screws using a torque wrench (page **20**) to make sure they are tightened and then guide the impact milling cutter into the pipe.
 4. Push the impact milling cutter into the pipe to be cleaned to at least half the cutter's length (if possible, always work against the flow direction).
 5. Start up the impact milling cutter at approx. 80 bar and guide it in up to the blockage.
 6. Slowly increase the pressure to 100 bar on the impact milling cutter. Under normal circumstances, this pressure is sufficient to clean a pipe effectively.
 7. Hold the high pressure hose in your hand and feel the vibrations from the impact on the high pressure hose. When you no longer feel vibrations, pull the cutter back slightly and then slowly guide it back onto the material.
 8. Stop work after 2 minutes, reduce the pressure on the impact milling cutter to below 50 bar and recheck the teeth. Tighten again with a torque wrench (page **20**), if necessary.
 9. At the same time, use a camera to check the condition of the pipe to see if it is at all damaged.
 10. Then insert the impact milling cutter back into the pipe and continue the milling work.
 11. Every hour, check the teeth of the impact milling cutter for damage and/or wear. Then retighten the teeth using a torque wrench (page **20**). Check the screws and nuts on the skids to ensure a firm fit every hour.
 12. Use a special sewer pipe video camera to regularly monitor the work.
 13. For best results, carry out an all-round cleaning with a rotating nozzle after milling.
 14. After completing the work, close all of the shaft covers.
-



If possible, always work in the direction of flow in order not to interrupt the flow of water in the channel.

7.4 Operating the tool in the direction of flow

When working in a downward sloping pipe where the water cannot flow downward, the water has to be pumped out first in order to correctly place the impact milling cutter. As the water level rises, the water's back pressure on the milling cutter will increase and the impact force gradually diminish. This will become noticeable as the vibrations on the hose lessen.

When operating the cutter in a pipe with a steep downward slope, the vibrations on the hose are so well absorbed that they are barely noticeable, which means that the operator will not be able to determine whether the cutter is rotating or idle. An assistant (with radio contact to the cutter operator) must be positioned at the next closest manhole to where the milling work is being done to listen for milling noises and watch for discharging water. Typical impact noises indicate good milling operation.



In event of insufficient impact force, pump out the pipe in order to then be able to work more efficient again.



If the water can drain but too much water is added during operation, pull the impact milling cutter back by 0.5 metres and interrupt work until the water has drained.



Observe that in most cases, the thrust nozzles have to be adapted when milling in the direction of flow or against the direction of flow, or when milling greater inclinations.



Protect the hose against wear from coarse surfaces using a flex guide, protective tubing or a deflection roller. This protection increases the service life of the hose significantly.



CAUTION!

The impact milling cutters may only be used in pipes installed in a straight line. This may result in significant property damage.



CAUTION!

Always use the matching cutter diameter for the respective pipe. Otherwise damage may be caused to the pipe wall and tool.

**CAUTION!**

Never allow the cutter to jump (pulling the hose back manually and then letting go)! This can result in damage to the pipe and tool.

**CAUTION!**

Take care that in event of penetration, do not continue cutting with the impact milling cutter. This may result in damage to the pipe wall and shaft.

7.5 Cleaning of sensitive pipes

7.5.1 PE plastic pipes

In order to prevent damage to the pipe when working in plastic pipes, the cutter teeth must be retracted approx. 2 mm from the outside ring. Loosen the screws on the outer teeth and remove them. Set the teeth inward and then screw the teeth tightly to 38 Nm with a torque wrench.

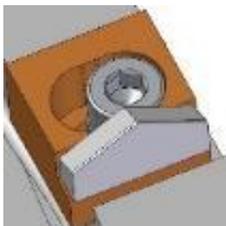


Figure 12: Tooth position «inside» for plastic pipes

7.5.2 PVC plastic pipes

PVC pipes may only be cut if they are embedded in concrete! Otherwise, it is the same process as when milling plastic pipes. This means that the teeth have to be turned roughly 2 mm from the outside ring toward the inside in order not to damage the pipe.

7.6 Working in a slightly damaged pipe

Slightly damaged pipes usually exhibit cracks in the pipe's wall. If detected, please contact the respective department or authorities.

Use extreme caution when working inside a slightly damaged pipe. When flushing the cracks, pipe fragments can break off and the surrounding area may be flushed out.

Use a worn out pair of cam disks (impact disks). This will soften the impact.



WARNING!

By washing out by cracks, pipe fragments may break away and the area around the pipe flushed out. This may result in severe injury and property damage.



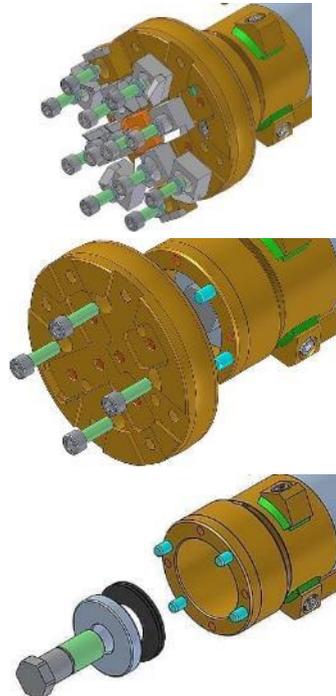
Use a worn pair of cam plates. This provides a softer impact.

7.7 Working with diamond crown

The diamond crown is used to remove shorter elements such as steel reinforcements.

7.7.1 Mounting the diamond crown

1. Remove all cutting teeth
2. Undo the four screws and remove the cutter head.
3. Undo the centring screw and remove the plate spring.



4. Pull off the complete hub and place the large spacer (\varnothing 80 mm) over the shaft. Then put the hub back onto the shaft.
5. Insert the smaller spacer (60 mm) instead of the plate spring. Apply a coat of Loctite 243 (C192) to the centring screw and tighten this to a tightening torque of 180 Nm.
6. Apply a coat of Loctite 243 (C192) to the head screws and tighten this to 50 Nm.
7. Put on the diamond crone. Coat the four screws with Plantogel 4000 (14.99005), place the Nord-Lock washers on the screws and tighten them to a tightening torque of 38 Nm.

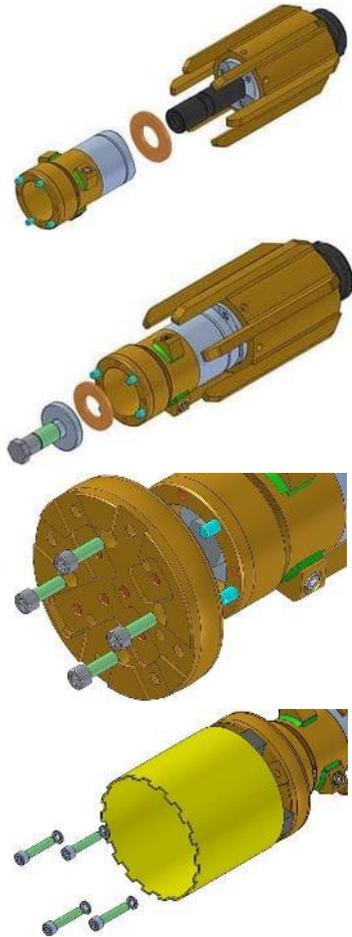


Figure 13: Mounting the diamond crown

7.8 After use

There are several points that have to be observed after using the impact milling cutter:

- Flush the impact milling cutter with fresh water.
- Spray the entire impact milling cutter with Oil Spray Bio (C191). Then rotate the cutter head several times by hand.
- Check the carbide teeth for wear and if necessary, replace any defective carbide teeth.
- Tighten all screws on the skids with a tightening torque of 42 Nm.
- After approx. 20 operating hours, apply a stroke of universal grease to the grease nipple on the swivel joint using the grease gun. In case of intensive use, every two days.



Figure 14: Lubricating nipple

7.9 Concluding work

After finishing your work, check the cleaned pipes using a channel inspection camera. Observe in particular if there is any damage as well as if fluids are leaking into the environment. After you have finished cleaning the channels, close all shafts again.

7.10 Disassemble and mount the centre cap

1. Undo the seven Allen screws.
 - ❗ The screws are secured with Tuflok and can be released using an Allen key.
2. Remove the centre cap by knocking against the edge of the centre cap equally to the front using a nylon hammer.
3. Clean the support surfaces The internal and external thread of the screws must be free from oil and grease. Place the centre cap onto the hub and apply a coat of Loctite 243 (C192) to the screws.
4. Use a torque wrench to tighten the screws to 12 Nm. Allow the adhesive to dry for at least 24 hours.

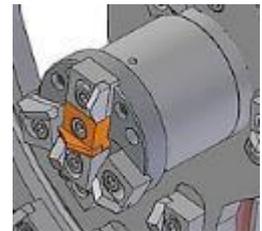
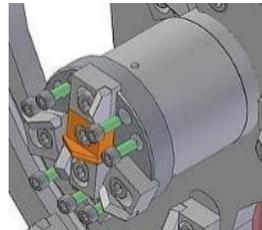
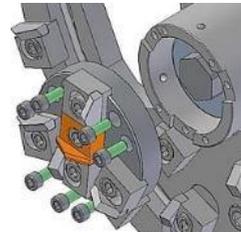
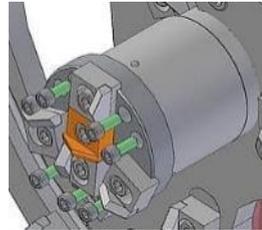


Figure 15: Disassemble and mount the centre cap

7.11 Mount the pull rod

Follow the steps described in sub-chapter [7.10](#) and supplement with the following:

- After step two, also undo the centring screw.
- Replace the centre cap by the centre cap with bored hole (15.ZKB).
- Follow steps three and four.
- Apply a coat of Loctite 243 (192) to the pull rod and mount this instead of centring screw to a tightening torque of 180 Nm. Allow the adhesive to dry for at least 24 hours.

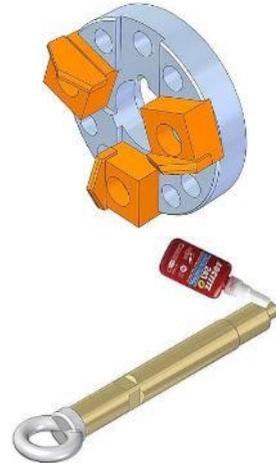
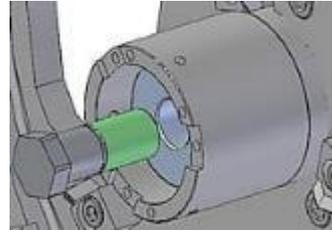


Figure 16: Mount the pull rod

7.12 Concert the impact milling cutter to another diameter

7.12.1 Changing the cutter head

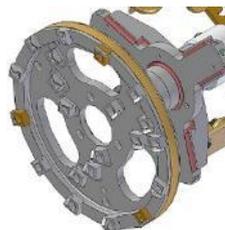
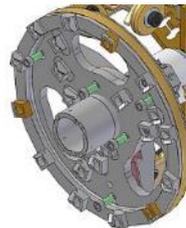
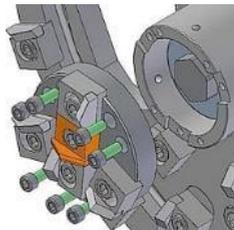
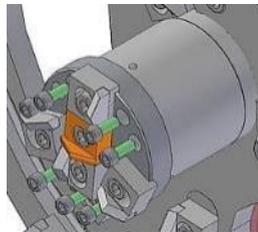
1. Undo the seven Allen screws.
 - ❗ The screws are secured with Tuflok and can be released using an Allen key.

2. Remove the centre cap by knocking against the edge of the centre cap equally to the front using a nylon hammer.

3. Undo the six Allen screws for the cutter head.
 - ❗ The screws are secured with Loctite, but can still be released using an Allen key.

4. Remove the cutter head from the hub.

5. Clean the support surfaces The internal and external thread of the screws must be free from oil and grease. Then fit a new cutter head, the centre pin specifies the correct position in the process.



6. Coat the thread of the six Allen screws with Loctite 243 (C192). Then tighten these to a tightening torque of 50 Nm.
7. Clean the support surfaces The internal and external thread of the screws must be free from oil and grease. Place the centre cap onto the hub and apply a coat of Loctite 243 (C192) to the screws.
5. Use a torque wrench to tighten the screws to 12 Nm. Allow the adhesive to dry for at least 24 hours.

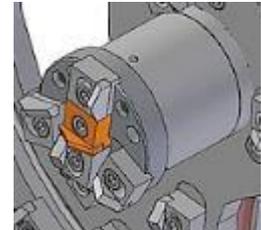
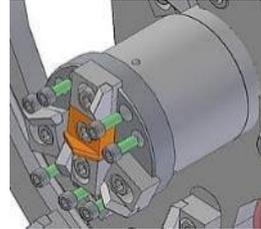


Figure 17: Changing the cutter head

7.12.2 Set the skids

1. Loosen the screws until the screw is loose.
2. Offset boreholes or slots are already included in the lugs. These allow you to adjust the skids to the inside or outside.
3. Set the desired diameter and tighten the screws to a tightening torque of 42 Nm.

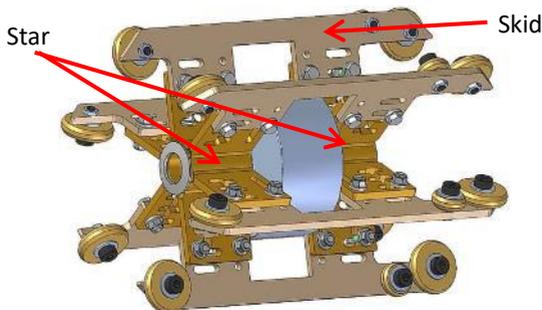


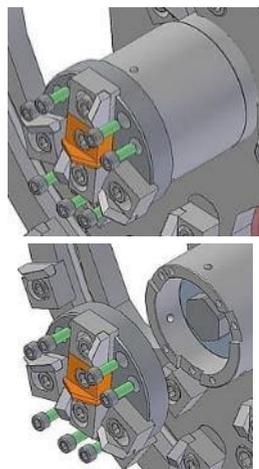
Figure 18: Set the skids



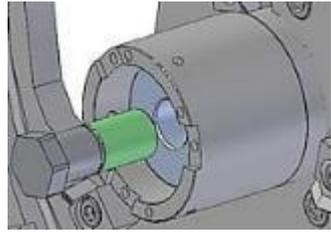
Take care that the skid diameter is approx. 10 mm larger than the cutter head diameter.

7.13 Switch the impact off and on

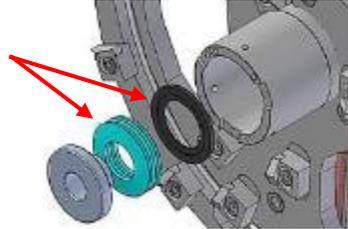
1. Undo the seven Allen screws.
 - ⓘ The screws are secured with Tuflok and can be released using an Allen key.
2. Remove the centre cap by knocking against the edge of the centre cap equally to the front using a nylon hammer.



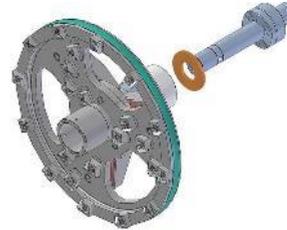
3. Undo the centring screw.



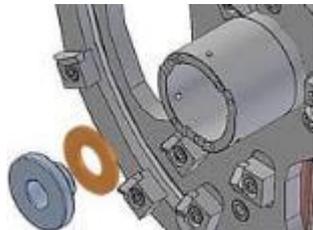
4. Remove the three plate springs and slide disc.



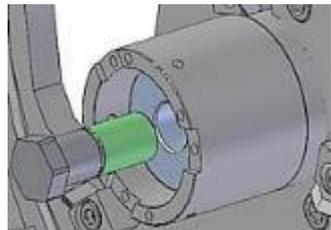
5. Remove the hub from the shaft and place the larger spacer on the shaft. Grease the shaft with Plantogel 4000 (14.99005) and then place the hub back onto the shaft.



6. Mount the small spacer and cover.



7. Apply a coat of Loctite 243 (C192) to the centring screw and tighten this to 180 Nm.



8. Clean the support surfaces The internal and external thread of the screws must be free from oil and grease. Place the centre cap onto the hub and apply a coat of Loctite 243 (C192) to the screws.
9. Use a torque wrench to tighten the screws to 12 Nm. Allow the adhesive to dry for at least 24 hours.
10. To switch the impact back on, carry out steps 4 to 6 in the reverse order.

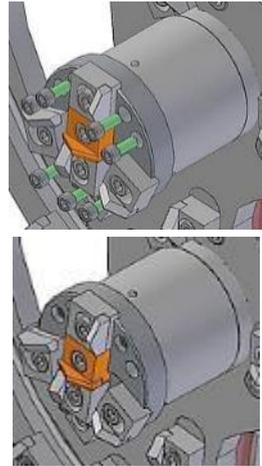


Figure 19: Switch the impact off and on

7.14 Malfunctions

7.14.1 The impact milling cutter blocks

1. To restart the impact milling cutter, pull the cutter back slightly (approx. 20 - 30 mm).
2. Shake the water hose until the impact mechanism is released and the cutter head can freely rotate again.
3. Carefully approach the area where work was interrupted and start again.

7.14.2 The impact milling cutter blocks frequently

Thrust force and rotation force are not optimally aligned to one another, to correctly align them, reduce the thrust force.

7.14.3 Insufficient impact force

If you notice weak vibrations in the hose, this means there is insufficient impact force. Slowly rotate the milling head by hand. In the process, guided by the cam disk, the milling head moves back and forth. The travel must be at least 2mm. If the travel is less, it means the two cam disks are worn and must be replaced (page 54).

7.14.4 The impact milling cutter runs upwards

Small but solid deposits inside the pipe can cause the tool to “slide up” on these deposits. Set the cutting teeth 15.ZU on the outside ring outward. This corrective action ensures that the cutter moves forward and that the pipe’s wall is milled lightly, giving the pipe a nice, smooth surface.

8 Maintenance

8.1 Changing the nozzle inserts

To ensure for an optimum cleaning performance, the nozzle inserts must be checked at regular intervals. The wear depends on the degree of contamination of the water used.



CAUTION!

Worn nozzle inserts impair the function and cleaning performance of the tools. This may result in damage to the tool and pipe system.

Another reason to change nozzle inserts, is a repositioning. In this case, the JetCalc must be used for determination of the nozzle inserts.

Follow the next steps in order to replace the nozzle inserts:

1. Clear the nozzle insert from dirt and heat it for approx. 10 seconds using a gas torch (C158).
2. Disassemble the nozzle insert using a socket spanner.
3. Clean the threaded hole and the new nozzle insert fat free. E.g. using acetone.
4. Coat the thread of the nozzle insert with Loctite 243 (C192).
5. Using the socket spanner, immediately screw the nozzle insert into the tool body to the stop.
6. Leave the adhesive to harden for at least 24 hours at room temperature.

8.2 Care

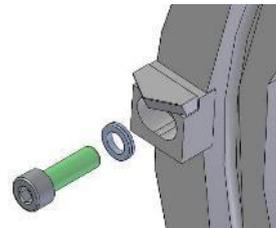
After using each time, clean the impact milling cutter with fresh water and then apply Oil Spray Bio (C191) to the cutters to protect them against corrosion.



If not used for a longer period, also spray the nozzle holes and the connecting thread.

8.3 Changing the cutting tooth

1. Undo the screws and remove the Nord-Lock washer.



2. Remove the old cutting tooth and clean the support surface.
3. Mount the new cutting tooth in the «Neutral» position (see page **24**). For this purpose, coat the screw with Plantogel 4000 (14.99005) and put on the Nord-Lock washer.
4. Tighten the screw to 38 Nm.

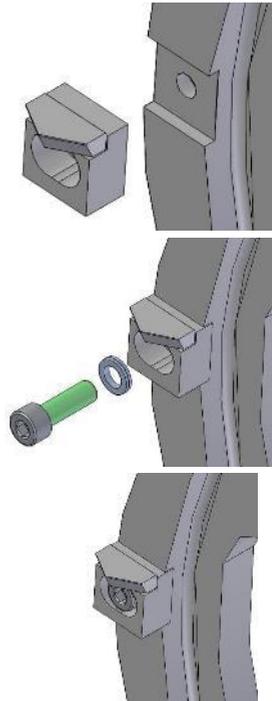
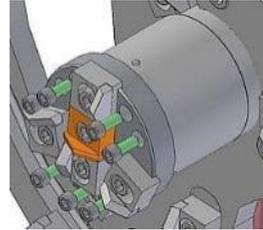


Figure 20: Changing the cutting tooth

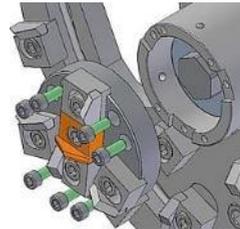
8.4 Change the slide disc and plate springs

All impact milling cutters are fitted with a disc which absorbs additional impact forces. The disc must be replaced at the latest when the ring with a thickness of 4.0 mm has worn down to 2.0 mm. The wear differs significantly depending on the load of the tool.

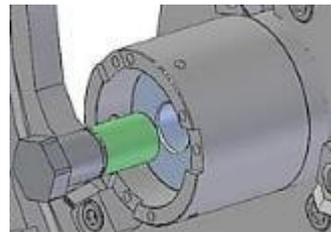
1. Undo the seven Allen screws.
! The screws are secured with Tuflok and can be released using an Allen key.



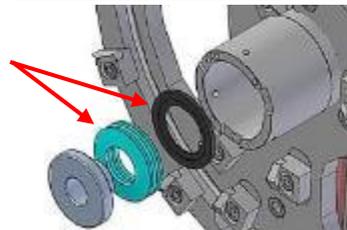
2. Remove the centre cap by knocking against the edge of the centre cap equally to the front using a nylon hammer.



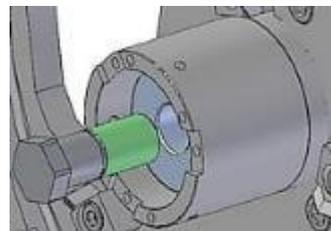
3. Undo the centring screw.



4. Replace the slide disc and plate springs with new spare parts.



5. Apply a coat of Loctite 243 (C192) to the centring screw and tighten this to 180 Nm.



6. Clean the support surfaces The internal and external thread of the screws must be free from oil and grease. Place the centre cap onto the hub and apply a coat of Loctite 243 (C192) to the screws.
7. Use a torque wrench to tighten the screws to 12 Nm. Allow the adhesive to dry for at least 24 hours.

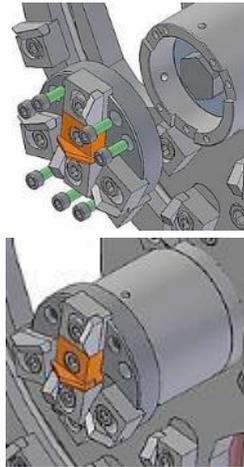
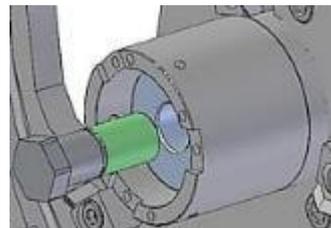
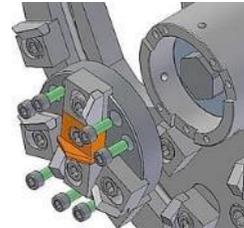
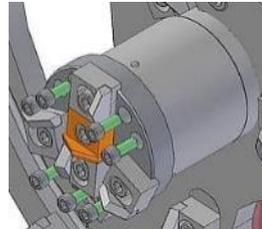


Figure 21: Change the slide disc and plate springs

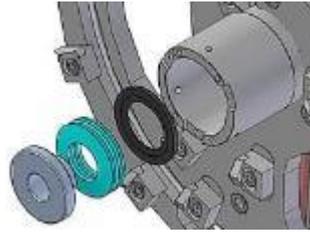
8.5 Change the cam plates

Every now and then, the cam plates art.-no. 14.K04 / 14.K05 must be exchanged (after approx. 30 hours, or when the stroke is less than 2 mm). The wear differs significantly and is orientated on the load of the impact milling cutter.

1. Undo the seven Allen screws.
 - ❗ The screws are secured with Tuflok and can be released using an Allen key.
2. Remove the centre cap by knocking against it equally to the front using a nylon hammer.
3. Undo the centring screw.



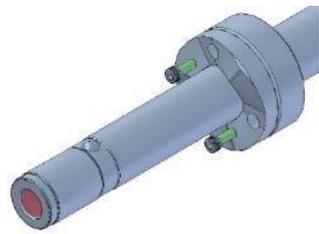
4. Remove the slide disc and plate springs.



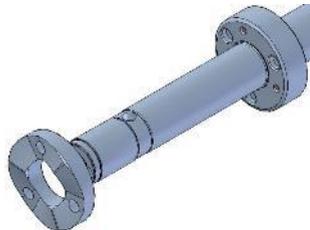
5. Pull the hub off the shaft.



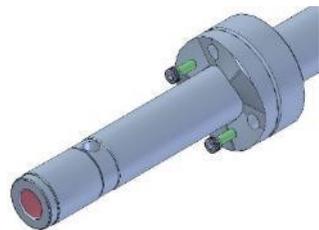
6. Undo the three screws of the cam plate



7. Replace the cam plates with new ones.

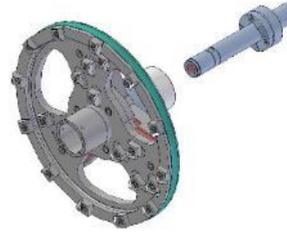


8. Tighten the screws to 12 Nm.

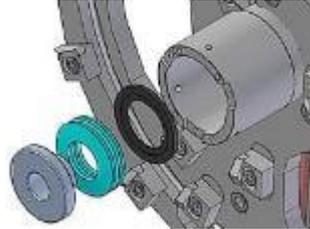


9. Carry out work steps 6 to 8 on the back side of the hub.

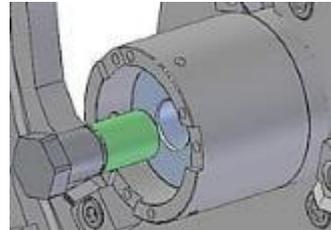
10. Put the hub on the shaft.



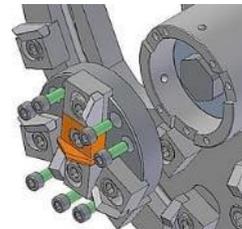
11. Insert the slide disc and plate springs.



12. Apply a coat of Loctite 243 (C192) to the centring screw and tighten this to 180 Nm.



13. Clean the support surfaces. The internal and external thread of the screws must be free from oil and grease. Place the centre cap onto the hub and apply a coat of Loctite 243 (C192) to the screws.



14. Use a torque wrench to tighten the screws to 12 Nm. Allow the adhesive to dry for at least 24 hours.

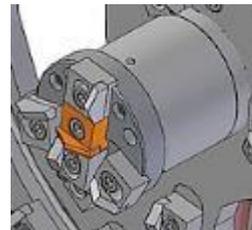
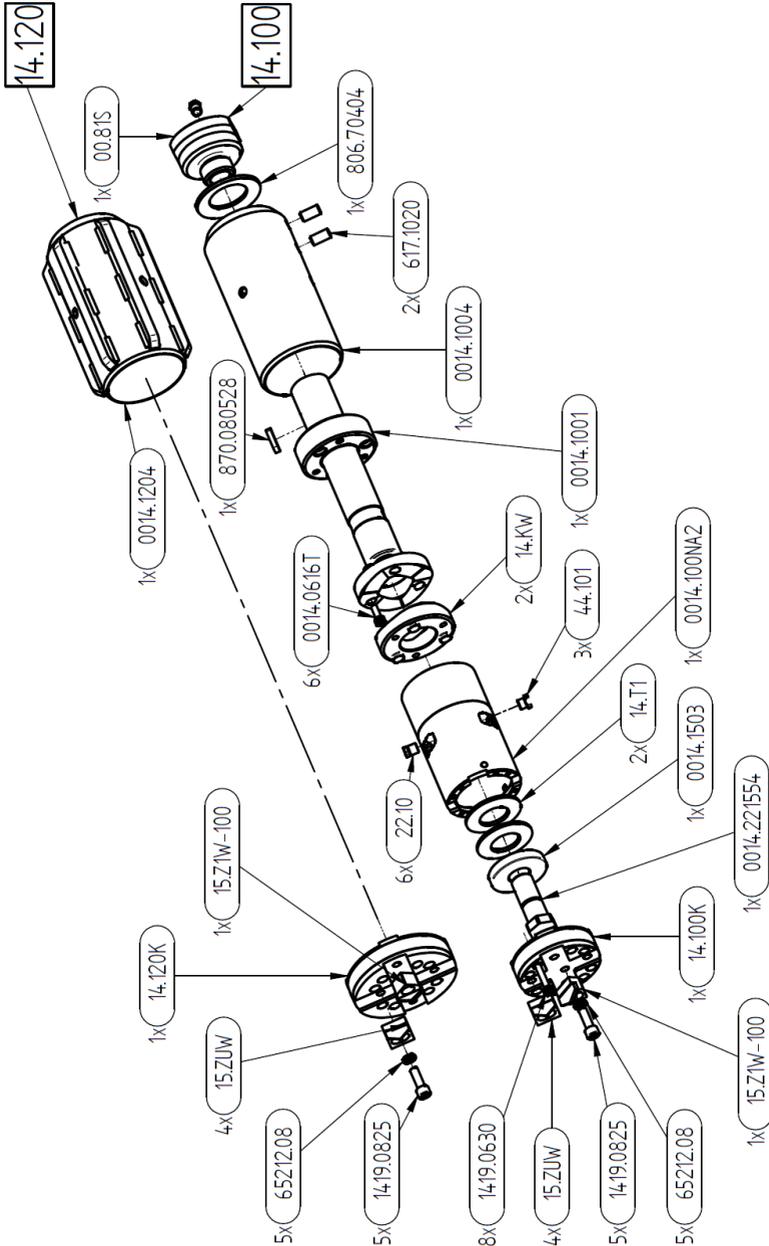


Figure 22: Change the cam plates

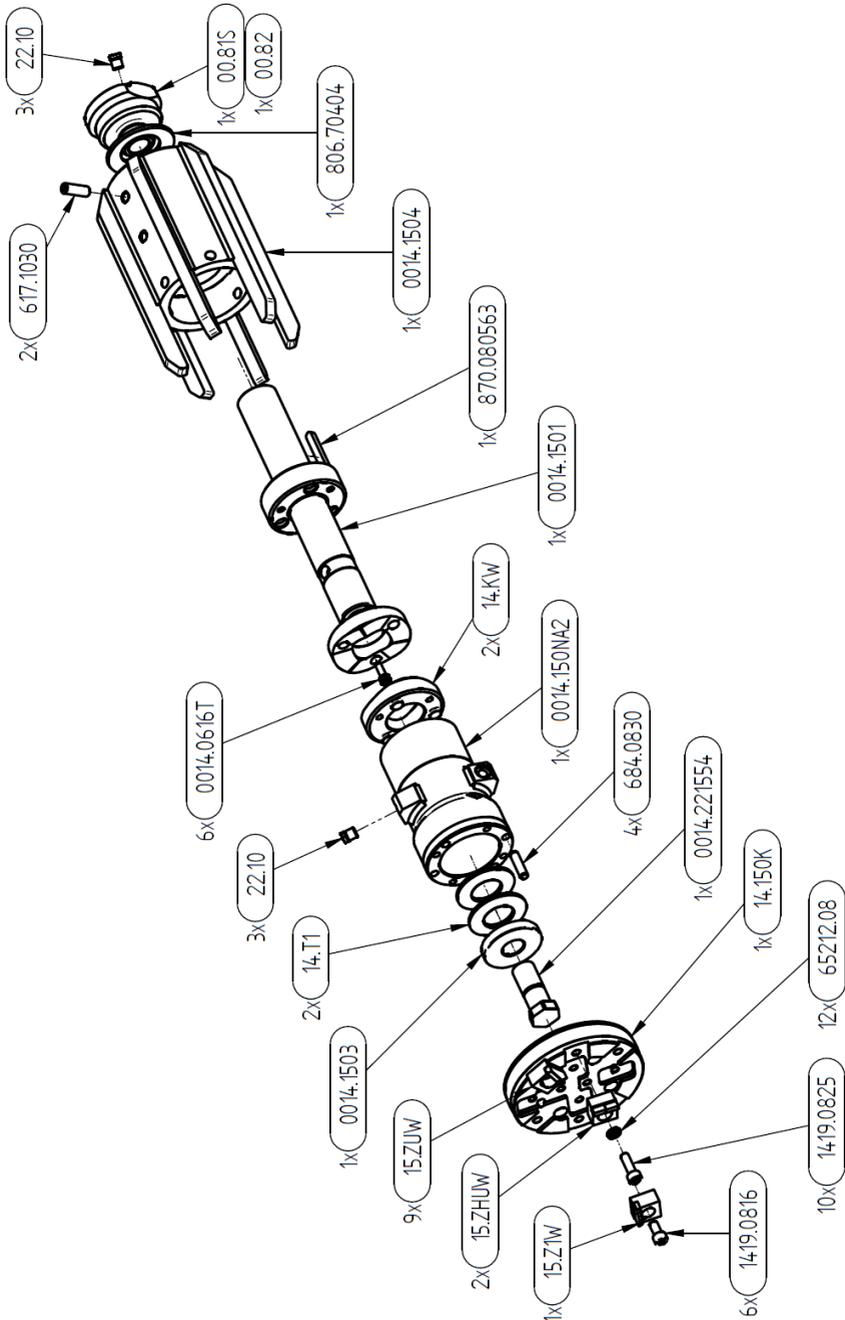
9 Spare parts / Accessories

9.1 14.100 and 14.120



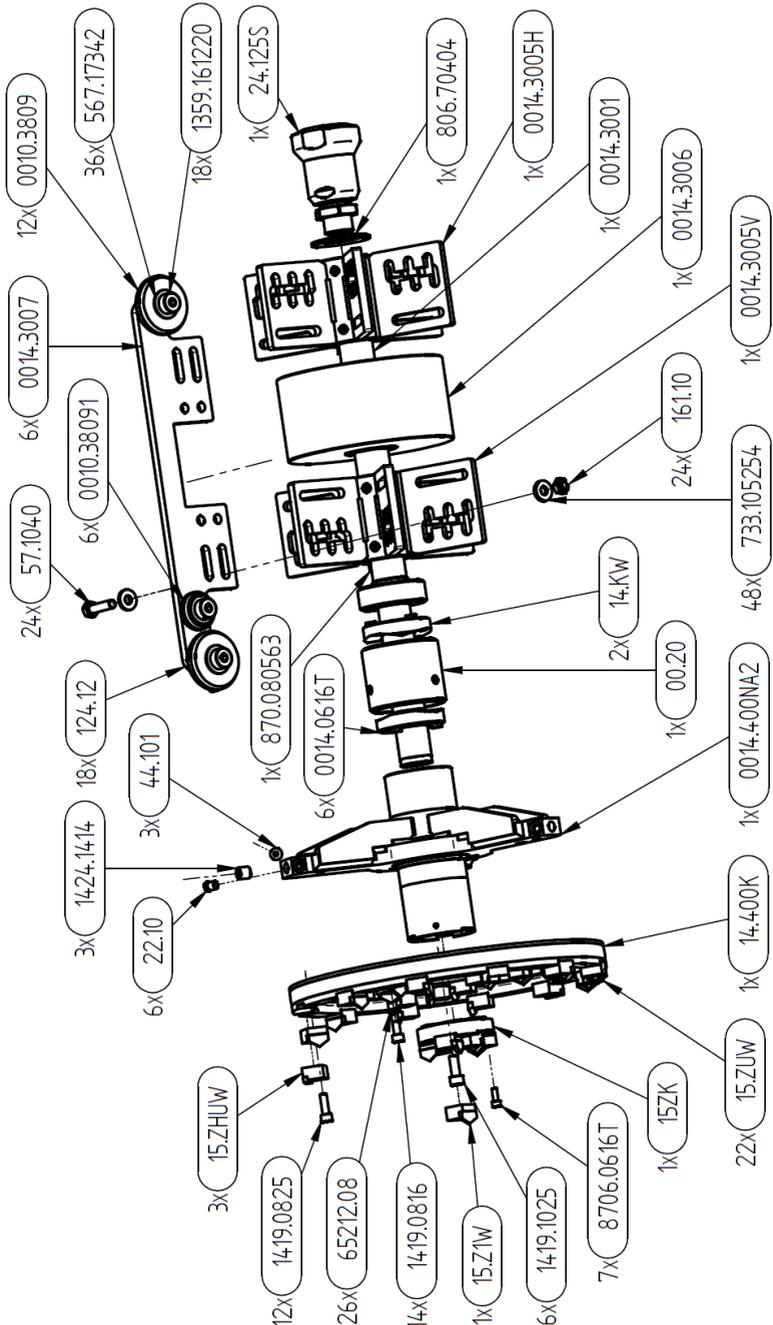
Drawing 1: Explosion 14.100 and 14.120

9.2 14.150



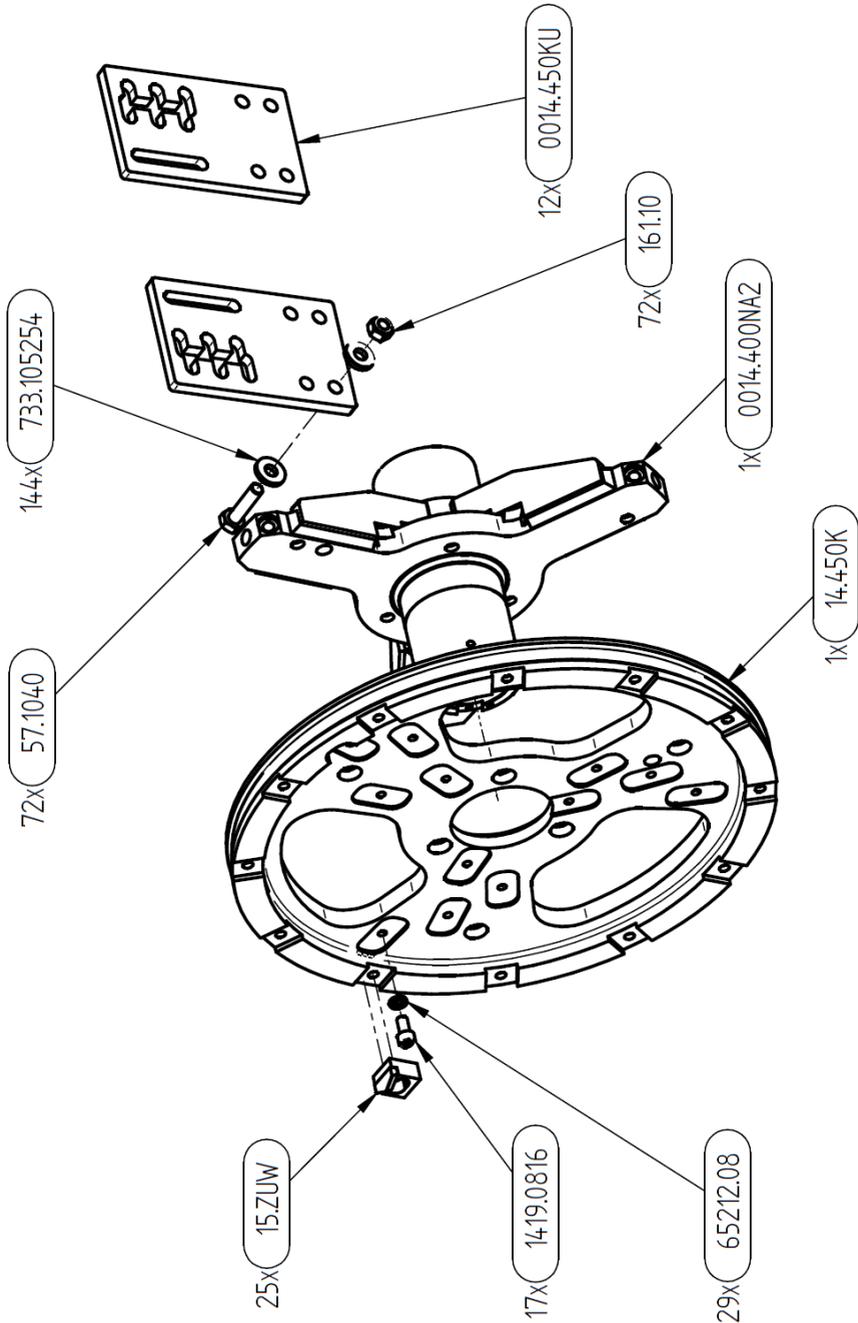
Drawing 2: Explosion 14.150

9.3 14.400



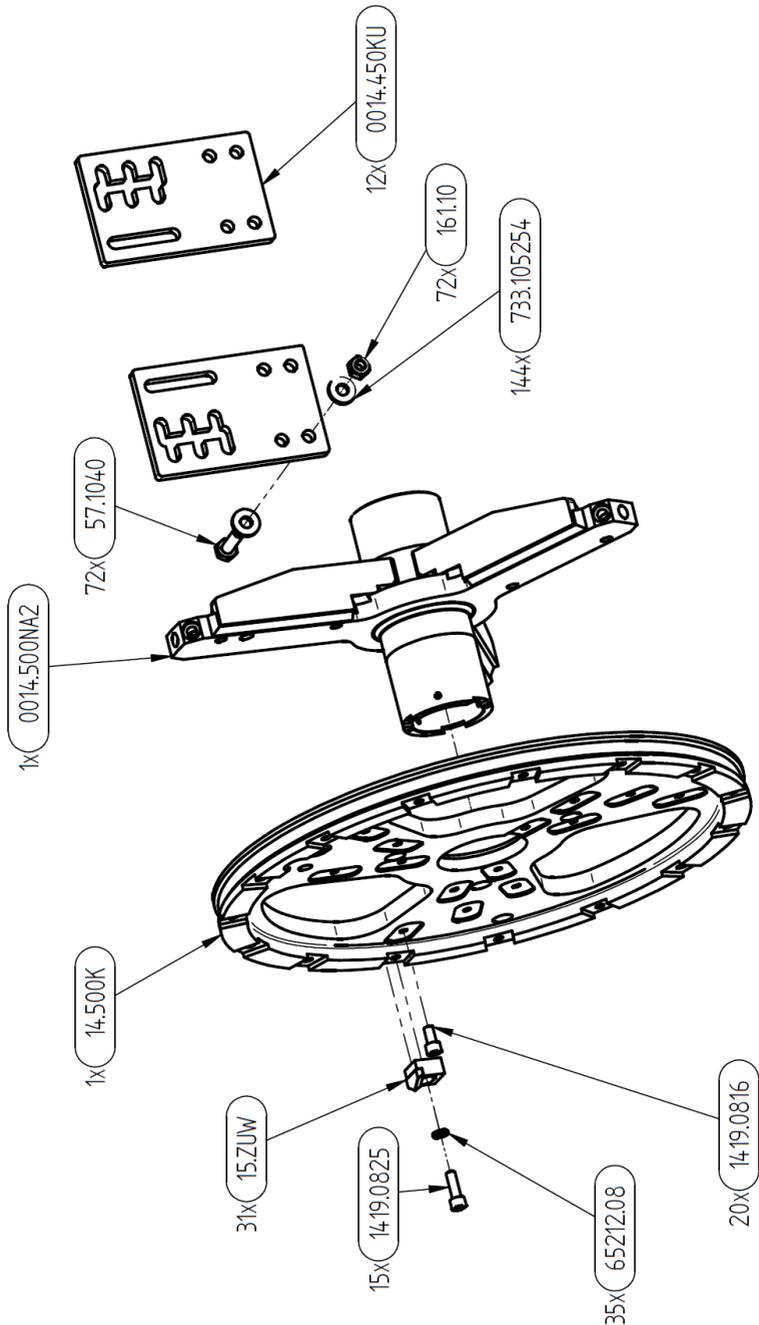
Drawing 3: Explosion 14.400

9.4 14.450 (difference to 14.400)



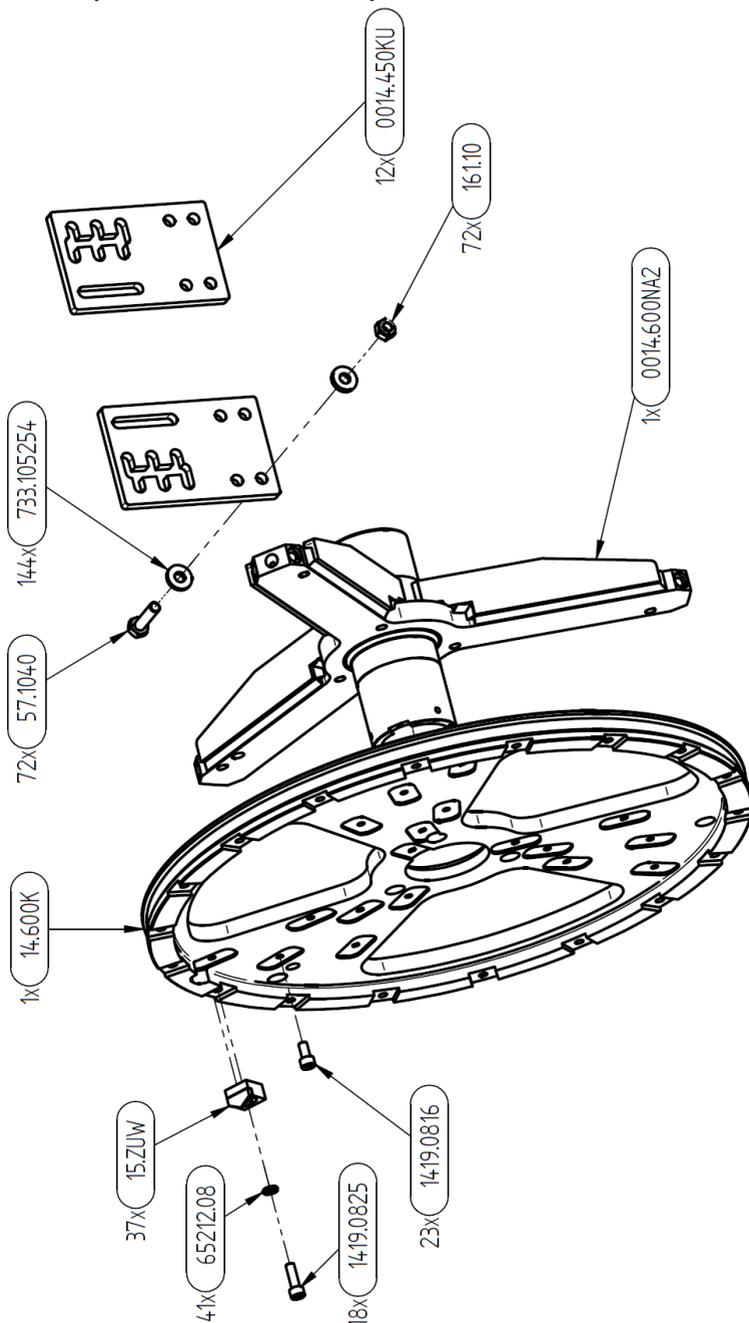
Drawing 4: Explosion 14.450 (difference to 14.400)

9.5 14.500 (difference to 14.400)



Drawing 5: Explosion 14.500 (difference to 14.400)

9.6 14.600 (difference to 14.400)



Drawing 6: Explosion 14.600 (difference to 14.400)

9.7 Accessories

9.7.1 Cutting teeth

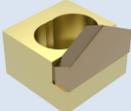
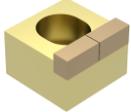
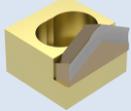
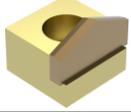
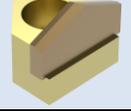
Figure	Article number	Designation	Use
	15.ZU	Universal tooth	14.100-14.600
	15.ZHU	Carbide tooth for impact cutter	14.150-14.600
	15.ZU-GSL	Universal tooth ground	14.100-14.600
	15.Z1	Impact segment tooth for the centre	14.120-14.600
	15.Z1-100	Impact segment tooth for the centre	14.100
	15.ZD	Diamond tooth	14.100-14.600

Table 17: Accessories, cutting teeth

9.7.2 Centre caps and cutter heads

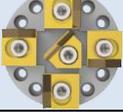
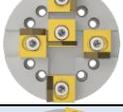
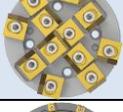
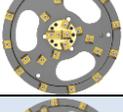
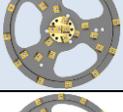
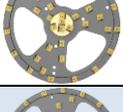
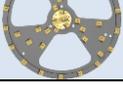
Figure	Article number	Designation	Use
	15.ZK	Centre cap	14.400-14.600
	15.ZKB	Centre cap with bored hole for the pull rod	14.400-14.600
	14.100K	Impact milling cutter head with 100 mm teeth	14.100
	14.120K	Impact milling cutter head with 120 mm teeth	14.120
	14.150K	Impact milling cutter head with 150 mm teeth	14.150
	14.400K	Impact milling cutter head with 400 mm teeth	14.400
	14.450K	Impact milling cutter head with 450 mm teeth	14.450
	14.500K	Impact milling cutter head with 500 mm teeth	14.500
	14.600K	Impact milling cutter head with 600 mm teeth	14.600

Table 18: Accessories, centre caps and cutter heads

9.7.3 Hubs

Figure	Article number	Designation	Use
	14.100NA	Hub for 100-120 mm impact milling cutter	14.100-14.120
	14.150NA	Hub for 150 mm impact milling cutter	14.150
	14.400NA	Hub for 400-450 mm impact milling cutter	14.400-14.450
	14.500NA	Hub for 500 mm impact milling cutter	14.500
	14.600NA	Hub for 600 mm impact milling cutter	14.600

Table 19: Accessories, hubs

9.7.4 Diamond crowns

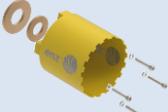
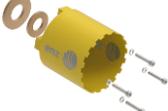
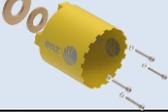
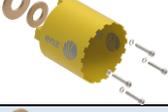
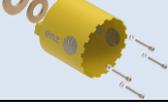
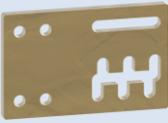
Figure	Article number	Designation	Use
	0014.100D	Diamond crown	14.100
	0014.120D	Diamond crown	14.120
	0014.150D	Diamond crown	14.150
	0014.400D	Diamond crown	14.400
	0014.450D	Diamond crown	14.450

Table 20: Accessories, diamond crowns

9.7.5 Miscellaneous

Figure	Article number	Designation	Use
	14.K04	Cam plate 4 mm with screws	14.100-14.150
	14.K05	Cam plate 5 mm with screws	14.400-14.600
	0014.0616T	Cylinder head screws for cam plate	14.K04 14.K05
	0014.3007	Skid Impact milling cutter incl. rollers	14.400-14.600
	14.450KU	1 set adapter plates for skids incl. screws	14.450-14.600
	0010.3809	Steel rollers for the impact milling cutter Ø 60 mm	14.400-14.600
	0,010.38091	Steel rollers Skid centre Ø 40 mm	14.400-14.600
	14.T1	Cup spring annealed 3.5 mm	14.100-14.600
	14.G	Glide plate for the impact milling cutter	14.400-14.600
	14.D	Spacers	14.100-14.600

	0014.1503	Cover	14.100-14.150
	0014.3003	Cover	14.400-14.600
	14.2215ZS	Pull rod	14.400-14.600
	001430011	Shaft extension	14.400-14.600
	0014.3008	Additional weight for the impact milling cutter	14.400-14.600
	20141.08SS	Nord-Lock wedge lock washer M8	14.100-14.600
	24.125S	Swivel joint with thrust jets	14.100-14.600
	14.99001	Torque wrench	
	14.99004	Hand lever grease gun	
	14.99005	Plantogel 4000 grease	
	C191	Oil Spray Bio 500 ml	

	C192	Loctite 243 50 ml	
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A large, dynamic splash of clear blue water with many bubbles, moving from the right side of the page towards the left, creating a sense of motion and freshness.

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