EVOLINE

Operating Instructions

Axial Rolling System **F01 / K01 EVO**

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1. General

1.1 Introduction

The *rolling system* is built in line with the state of the art, in compliance with the recognized technical rules and standards governing safety, and manufactured in accordance with TÜV-CERT DIN ISO 9001 and VDA 6.4.

These Operating Instructions exclusively refer to the *rolling system* described in the Operating Instructions.

Terms in italics are defined as a collective term in the appropriate place:

- When the collective term is used, the information refers to all individual terms.
- When the individual term is used, the information exclusively refers to respective individual term.

NOTE

The collective term *rolling system* comprises the individual terms rolling head, all accessory parts, consumables, and spare parts.

We reserve the right to make technical modifications to graphics and information supplied in these Operating Instructions if so required for improving the *rolling system*.

NOTE

Subsequent modifications or supplements to these Operating Instructions can be found online at www.lmt-tools.de/dokumente-downloads.

These Operating Instructions are written with the intention of being read, understood and applied comprehensively by anyone responsible for using the *rolling system*.

Safe and faultless use of the *rolling system* is only possible if the contents of these Operating Instructions are understood and observed in all points by the responsible persons.

NOTE

Work instructions are supplemented by position details. Compare the details with the lists of spare parts in section 7.

Improper use of the *rolling system* can endanger persons and cause damage to property. We accept no liability for damage and operational faults resulting from non-observance of these Operating Instructions.

NOTE

Observe all warning and safety instructions and the Operating Instructions for the processing machine.

Storing the Operating Instructions

The complete Operating Instructions must be stored carefully and must always accompany the *rolling system* as part of the product.

The Operating Instructions must be kept near the *rolling system* in such a way that they are available to all persons working with the *rolling system*, if required.

Warranty and technical support

We guarantee a perfect function of the delivered product at the time of purchase. We are not liable for damage in the event of:

- improper use of the *rolling system*
- the use of non-original components
- the use of accessories not authorized by us
- unauthorized modifications
- the insertion of damaged components.

Modifications of the components are only permitted after written agreement with us.

We carry out modifications to the *rolling system* in order to adapt the *rolling system* to the operator's requirements. We inform the operator about the modifications and effects on use of the *rolling system*. The Operating Instructions describe the use of a *rolling system* without modifications.

If you have any problems or questions, please contact our Service Hotline, which will be happy to help you.

We offer training specifically tailored to your requirements for training your staff on site at your premises. Seminars are also held regularly at the LMT Group Academy, our subsidiaries, and agencies.

1.2 Duty of care on the part of the operator

The operator of the *rolling system* must ensure that

- the *rolling system* is used as intended at all times
- the *rolling system* is always in perfect working order
- only qualified and authorized personnel install and operate the *rolling system* in accordance with these Operating Instructions
- qualified and authorized personnel are regularly informed about all necessary rules of occupational safety and environmental protection
- qualified and authorized personnel are informed in detail about modifications made and their effects
- the required protective equipment is available to qualified and authorized personnel in sufficient numbers and in perfect condition and is worn
- the Operating Instructions are always available in legible condition and in full at the place of use of the *rolling system*.

1.3 Contact

Service-Hotline:

Roller Team
Grabauer Strasse 24
21493 Schwarzenbek
Germany
Tel.: +49 4151 12 391
Fax: +49 4151 12 502
teamrollen@lmt-tools.com

LMT Group Academy:

Grabauer Strasse 24
21493 Schwarzenbek
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academy@lmt-group.com

Postal address:
LMT Fette Werkzeugtechnik
GmbH & Co KG
Postfach 1180
D-21484 Schwarzenbek

Delivery address:
LMT Fette Werkzeugtechnik
GmbH & Co KG
Grabauer Strasse 24
D-21493 Schwarzenbek

1.4 Copyright

2. Safety

2.1 Explanation of symbols and notes

All safety information and warnings in the Operating Instructions are broken down as follows:

Danger level / Signal word

Type and source of danger

Measure for avoiding danger

Hazard symbols

In the Operating Instructions, a distinction is made between three hazard symbols which allow an initial hazard classification.
The yellow triangle indicates a general danger to people, property, animals or the environment.

Danger level

General danger for people, property, animals or the environment by the *rolling system.*

Measure for avoiding danger

The red, octagonal hazard symbol with the signal word IMPORTANT refers to a potentially hazardous situation for the *rolling system*. Adhering to work steps, guidelines and instructions avoids damage to or destruction of the *rolling system*.

IMPORTANT

A potentially hazardous situation for the *rolling system*.

Adhere to all work steps, guidelines and instructions to avoid damage to or destruction of the *rolling system*.

The third hazard symbol with the signal word NOTE contains important information and tips for the user.

NOTE

(No direct danger)

Important information and additional tips for the user on using the *rolling system*

Danger levels / Signal word

With the yellow triangle, the danger level indicates the degree of danger. Three danger levels are used. Each word is marked by a color that indicates the danger levels.

CAUTION

The danger level denotes a hazard with a low degree of risk which, if not avoided, may result in minor or moderate injury.

WARNING

The danger level denotes a hazard with a medium degree of risk which, if not avoided, may result in death or serious injury.

DANGER

The danger level denotes a hazard with a high degree of risk which, if not avoided, will result in death or serious injury.

Example:

DANGER

General danger due to the use of the *rolling system* by unqualified or unauthorized personnel.

Use of the *rolling system* only by qualified and authorized personnel.

2.2 Basic safety information

DANGER

General danger when using the *rolling system*

Follow the Operating Instructions.

These include:

- the basic safety instructions from the entire section 2 for the Operating Instructions as a whole
- the preceding notes for a specific chapter, and
- the embedded notes for a specific step.

Follow all local occupational health and safety and industrial safety regulations.

Section 2 provides information on the basic safety instructions to ensure safe and error-free use with the *rolling system*.

- Contact the operator if any changes occur in the *rolling system*.
- Refrain from any working method that impairs safety.
- Only carry out work on the *rolling system* when the processing machine is at a standstill and, if necessary, remove the *rolling system* from the machine room.
- Before starting work on the *rolling system*, secure the drives and auxiliary equipment of the processing machine against unintentional activation.
- Ensure that there is sufficient installation space in the processing machine and that there is no risk of injury from neighboring tools and machine parts.
- Before each start-up, check whether the screws on the *rolling system* are tightened.

WARNING

Allergic reaction when using the *rolling system*
General risk of injury by sharp edges

Wear protective gloves and goggles when using the *rolling system*.

The weight of the *rolling system* can cause injuries, especially by tipping over and falling down.
There is a general risk of injury when transporting the *rolling system*.

- Secure the *rolling system* against tipping over and falling down.
- Wear safety shoes.
- Use suitable lifting equipment and harnesses.

2.3 Designated use

IMPORTANT

Only use the *rolling system* as designated.

Make sure that the *rolling system* is free of chips at all times.

Do not use force when using the *rolling system*.

The *rolling system* must be used as a tool on a processing machine for the chipless production of profiles on the outside of rotationally symmetrical workpieces.

NOTE

Please note that the *rolling system* is designed to meet the requirements specified by the operator. Contact our Service Hotline if you wish to use the *rolling system* in any way other than the use agreed with us.

The scope of application of the *rolling system* is to perform a rolling process.
The rolling process includes the following production processes:

- threading
- knurling
- reducing
- smoothing and
- cold-forming rotationally symmetrical workpieces for the production of other profiles.

} *Rolling process*

NOTE

The collective term *rolling process* comprises the production processes of knurling, smoothing, reducing and cold-forming of rotationally symmetrical workpieces for the production of other profiles.

Smoothing is a surface densification process.

Sizing by smoothing to reduce tolerance is not possible.

IMPORTANT

When working on the rolling head, be sure to use a torque spanner and observe the tightening torques (see section 3.7) for the respective screws.

CAUTION

Note that there are tensioned springs inside the rolling head. These can come loose if handled carelessly and injure you or bystanders.

Wear protective goggles when handling the *rolling system*.

NOTE

Any use deviating from the intended use is only permissible after written agreement with us.

Any use other than the intended use is considered non-designated use. We are not liable for any damage incurred. The risk is borne by the operator.

Intended use includes observing these Operating Instructions.
For each sub-section, read the corresponding main section.

Coolants and lubricants

Liquids that are also used in machining are suitable as coolants and lubricants:

- emulsions diluted at a ratio of 1: 10 to 1: 20 (possibly with high-pressure additives)
- low-viscosity cutting oils and
- molybdenum(IV) sulfide.

NOTE

Observe the manufacturer's specifications and instructions.

Increase the service life of the rolls by using high-pressure additives, as they improve the sliding properties between the rolls and the workpiece.

Contact our Service Hotline if you wish to carry out dry machining with the *rolling system*.

IMPORTANT

Make sure that the cooling lubricant is free of chips and particles so that no foreign matter is rolled into the profile and the rolls and the rolling head do not wear too much.

Heavy chip infestation has a negative influence on the *rolling process*. Make sure that the rolling head is connected to the central lubrication/cooling system of the processing machine and that no chips adhere to the workpiece.
Install the rolling head in the processing machine in such a way that it is not soiled by direct chips if possible.

IMPORTANT

Only use coolants and lubricants for the *rolling system* that meet the specified properties for avoiding corrosion of the *rolling system*.

Maintain the specified storage temperature and relative humidity to avoid corrosion of the *rolling system*.

Reasonably foreseeable misuse

Reasonably foreseeable misuse of the *rolling system* is:

- use of the *rolling system* by unqualified and unauthorized personnel
- leaving tools stuck in the *rolling system*
- over-shaping the profile
- rolling outside the permissible rolling speed
- rolling outside the permissible working area
- failure to observe the Operating Instructions

IMPORTANT

Avoid reasonably foreseeable misuse of the *rolling system*.
We are not liable for any damage incurred by misuse.

2.4 Authorized personnel and responsibilities

DANGER

General danger due to the use of the *rolling system* by unqualified or unauthorized personnel.

Use of the *rolling system* only by qualified and authorized personnel.

Authorized personnel

- The *rolling system* may only be used by qualified and authorized personnel. These personnel must have received special instruction from the operator about any hazards that may occur.
- The complete Operating Instructions must have been read and understood by every person involved in using the *rolling system*. We recommend that the operator has this confirmed in writing.
- Qualification includes at least mechanical specialist training. In addition, we recommend staff training by us on your premises, training at our LMT Group Academy, our subsidiaries or our representatives.
- The operator is responsible for ensuring that work by personnel to be trained is only carried out under the supervision of qualified and authorized personnel.
- The operator is responsible for ensuring that unauthorized persons do not have any access to the *rolling system*.

Responsibilities

- The operator must define all responsibilities for the use of the *rolling system* so that there are no ambiguous responsibilities in terms of safety.
- The operator must clearly define the responsibilities of personnel for individual activities on the *rolling system*.

3. The rolling system

The axial *rolling system* forms the required profile in the workpiece with axial feed direction. The profile is created by chipless cold-forming. The *rolling system* then opens (the rolls swivel away from the workpiece) and is pulled away from the workpiece against the feed direction.

Rolling system **assemblies**

The *rolling system* comprises three components:

- Rolling head (1)
- Set of rolls (2)
- Closing device (3)

} *Rolling system*

The assemblies of the *rolling system* are depicted in Figure 1:

Figure 1: *Rolling system* assemblies

The *rolling system* is designed specifically for the respective application.
The 3 assemblies are ordered and provided separately from each other.

Designation of the *rolling system*

The designation of the *rolling system* is located on the outer surfaces of the rolling head (see Figure 2).

LMT-Fette:	Manufacturer
F01 EVO:	Rolling head designation
150501:	Serial number (6 digits)
7424840:	ID number
M3.5 – M6	Working area

Figure 2: Designation of the rolling head

3.1 The rolling head

The rolling heads of the *axial rolling systems* F01 and K01 include a set of rolls with 3 rolls.
The rolls are mounted in the front area of the roll cage and the inclined position of the rolls is specified.

NOTE

Axial rolling heads of the F and K series can be used fixed in the F version or rotating in the K version.

We recommend using the largest rolling head that fits the machine, in order to cover the entire working area and to achieve the best possible tool life.

Figure 3: The rolling head

The rolling head can be used over the entire working area. You only need to adjust the rolls and the setting to the individual work cases.

3.2 The rolls and set of rolls

The set of rolls for the F01 / K01 EVOline *rolling systems* comprises 3 rolls.

The rolls have a profile which is embossed according to the rolling process.

IMPORTANT

Only use rolls in the set of rolls supplied by us to avoid damage to the *rolling system* and the workpiece.

Check whether the set of rolls number (serial no.) is identical for all rolls.

Do not combine the various set of rolls.

Labeling the rolls

NOTE

Labeling of the rolls varies depending on the application, but

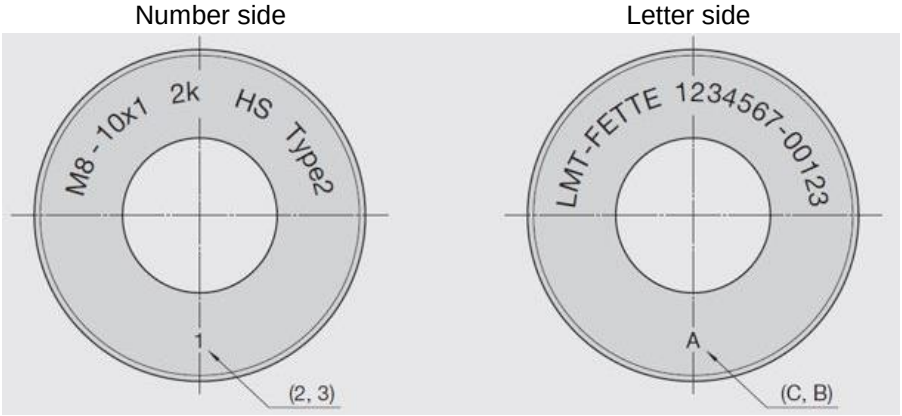
- the ID number,
- the numbers (1, 2, 3) and
- the letters (A, C, B)

are always labeled in the same place on the rolls

When contacting the Service Hotline, always state the identification number of the rolls.

Note the numbers (1, 2, 3) and letters (A, B, C) of the set of rolls when inserting the rolls into the *rolling system*.

Example of roll labeling on rolls for threading:



M8-10x1	= Thread size
2k	= Lead
HS	= Material
Type 2	= Rolling head type
1	= Number 1, 2 or 3
LMT-FETTE	= Company
1234567	= Ident no.
00123	= Serial no.
A	= Letter A, C or B

Figure 4: Number and letter side of rolls

NOTE

When inserting the rolls, note the numbers on the number side or the letters on the letter side:

- Roll 1 – Letter A
- Roll 2 – Letter C
- Roll 3 – Letter B

Use the rolls on both sides for cylindrical workpieces and the following rolling processes to increase the service life:

- threading,
- knurling,
- smoothing and
- reducing (depending on the roll design)

Turn the set of rolls according to section 8 1 Installation and removal of components of the roll cage and set of rolls.

3.3 The closing device

The closing element on the *rolling system* and the machine-side closing element perform the closing of the *rolling system*.

Closing elements

The *rolling system* can be closed with

- a coolant-operated closing device on the *rolling system*
- a handle, closing pin or closing rolls on the *rolling system* or
- a stop or closing cam on the processing machine
- acceleration or deceleration of the circulating *rolling system*

with the aid of the processing machine and the flywheel mass on the *rolling system*.

NOTE

The closing mechanism is dependent on

- the closing element on the *rolling system* and
- the machine-side closing element.

Coolant-operated closing device (KSE)

The closing element on the *rolling system* – the coolant-operated closing device – serves toward closing the rolling head after shaping the requisite profile.

Figure 5: Coolant-operated closing device (KSE)

Designation of the coolant-operated closing device

The designation of the coolant-operated closing device is located on the jacket surface – beside the connection for pressure media and another designation offset by 120°. In addition, you will find information on the operating pressures next to the connection for pressure media.

Assemblies of the coolant-operated closing device

Figure 6: Assemblies of the coolant-operated closing device

NOTE

The collective term coolant-operated closing device - also referred to as KSE - includes the individual terms closing unit, chip guard with integrated stop, coupling with extended shaft, and connection elements for pressure media.

The closing unit

The closing unit consists of the elements shown in Figure 7 “Closing unit components.”

Piece list?

Figure 7: Closing unit components

The closing unit consists of a housing, cover, annular piston, spring bearing, O-ring, compression spring, dowel pins, and pan head screws. The housing has a hole for the pressure medium connection elements.

Closing elements on the *rolling system*

- a closing pin at the housing or
- a closing roll at the housing

Figure 8: Variants of the closing element on the *rolling system*

Flywheel mass

To close the *rolling system* by spindle start-up or deceleration, the flywheel mass can be used in the form of a reinforced chip protection cap to increase inertia.

Figure 9: *Rolling system* with flywheel mass

IMPORTANT

Please note that the closing mechanism of the *rolling system* is coordinated to the requirements stated by the operator.

Contact our Service Hotline if you desire a different closing mechanism than the one agreed with us.

3.4 Dimensions of the *rolling system*

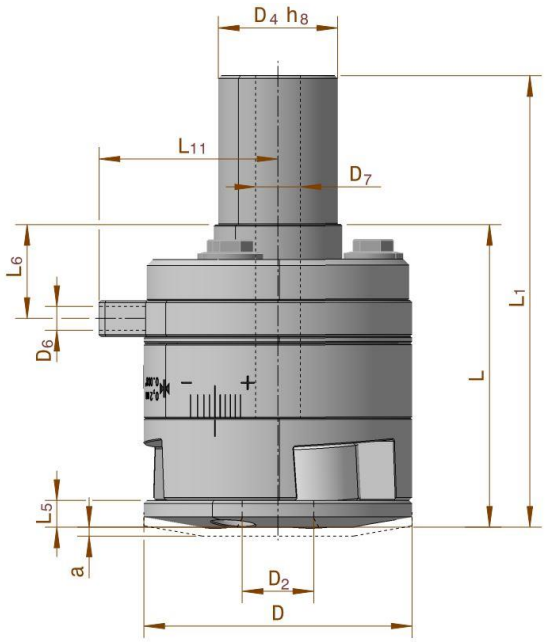


Figure 10: Dimensions of the *rolling system*

Dimensions in mm Dimensions in inches										
D	**D_2**	**D_4**	**D_6**	**D_7**	**L**	**L_1**	**L_5**	**L_6**	**L_{11}**	**a**
45	**12**	**x**	**M4**	**6.5**	**51**	**76**	**4.5**	**16**	**30**	**1.5**
1.772“	0.472“			0.256“	2“	3“	0.177“	0.630“	1.181“	0.059“
m-rolling head		**m-set of rolls**								
approx. 0.5 kg		approx. 0.05 kg								
approx. 110 lb		approx. 11 lb								

Table 1: Dimensions of the *rolling system*

3.5 Working areas

Working areas for cylindrical threads			
Regular thread metric	**Fine thread metric**	**Knurl Outer Ø x pitch**	**UN (C, F)**
M3.5x0.6 - M6x1	M4x0.5 – M6x0.75	Ø3.5x0.5 - Ø6x1.2	UNC 8-32 - 1/4-20

Table 2: Working areas

3.6 Rollable materials

A variety of factors influence the rollability of materials and the ensuing profile quality. The selected parameters:

- elongation at break and
- tensile strength

enable an assessment of the rollability of materials that is suitable for everyday use (reduced complexity).
The reduction in complexity does not guarantee rollability, but it does create an assessment framework that has proven itself in practice.

IMPORTANT

The following data represents empirical values and should not be regarded as fixed limits, but as orientation values.

Metallic materials that have

- elongation at break $\sigma_B \geq 7\%$ and
- tensile strength $\sigma_Z \leq 1000\ \mathrm{MPa}$

as material properties are rollable with *axial rolling systems*.

Contact our Service Hotline if you do not comply with the limit values or if you are carrying out rolling processes in their immediate vicinity.

3.7 Tightening torques

IMPORTANT

Observe the tightening torques.

Tightening torques for *rolling systems*

Connection		Tightening torque
Closing clamp	M2.5x6.8	1.4 Nm
Threaded rod	M4x8	2.7 Nm
Front panel	M4x8	2.7 Nm
Chip guard	M5	5.9 Nm

Table:3 Tightening torques

3.8 Condition on delivery

We deliver your *rolling system* separately in the following condition:

- rolling head without set of rolls with integrated machine mount
- set of rolls (application-specific)
- auxiliaries

  1 hexagon socket screwdriver

  1 open-end spanner and

  2 Allen keys

NOTE

Please note that the components supplied are coordinated to the size of the *rolling system*. Only use the supplied components for the *rolling system* delivered.

The delivery condition is the proper storage condition.

CAUTION

The components of the *rolling system* are sprayed with a commercial penetrating oil for corrosion protection. The oily surface of the components can cause skin irritation. Particularly in the case of open skin injuries and allergy sufferers, skin contact must be avoided.

Do not touch the oiled surface with open skin lesions.
Do not touch the oiled surface if you are concerned about an allergic reaction.
Call the Service Hotline to name the ingredients in the penetrating oil and check their compatibility.

4. Installation

IMPORTANT

Contact our Service Hotline when installing the *rolling system* for the first time.
We will be happy to advise you on the following:

- inserting the rolls into the *rolling system,*
- functional test of the *rolling system*,
- inserting the *rolling system* into the processing machine,
- fixing the closing element on the machine side and
- adapting the closing clamp to the *machine-side closing element*.

WARNING

General risk of injury by sharp edges

Wear protective gloves and goggles when using the *rolling system*.

The weight of the *rolling system* can cause injuries, especially by tipping over and falling down.
There is a general risk of injury when transporting the *rolling system*.

- Secure the *rolling system* against tipping over and falling down.
- Wear safety shoes.
- Use suitable lifting gear and harnesses.

4.1 Requirements on the processing machine

NOTE

If you are unsure whether your processing machine meets the requirements for the use of a *rolling system*, please contact our Service Hotline.

We will be happy to advise you on the following:

- drive power
- torque
- speed
- collision consideration

Drive power, torque and speed

You will find the formulas for torque and speed calculation in section 5.

With the axial method, the thread is produced in an axially advancing manner. Therefore, the thread length has practically no influence on the required drive power.

Please note, however, that a change of the roll dimension has an influence on the required drive power, torque and speed.

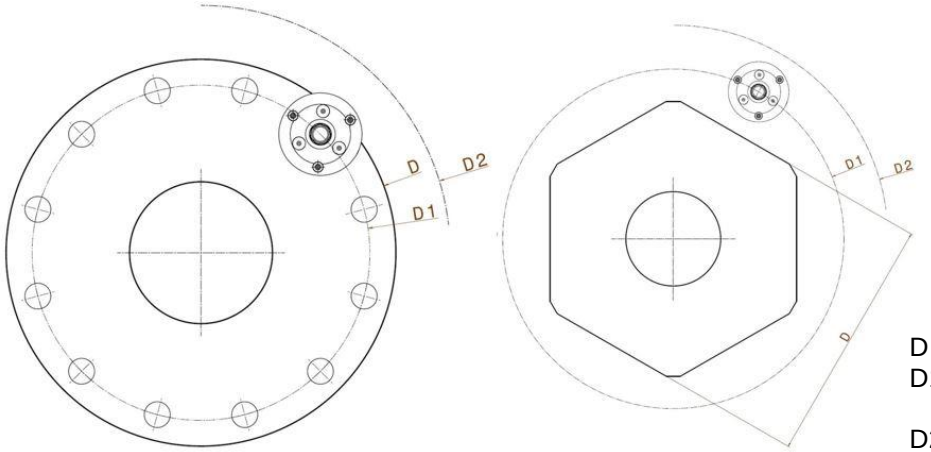
Collision test

WARNING

General risk of injury due to collision.

Do not equip your processing machine with a *rolling system* without checking for collisions.

Contact our Service Hotline if you are equipping your processing machine with a *rolling system* for the first time or if you want to change the processing machines.



D Outer dimension of the turret
D1 Average swing diameter of the *rolling system*
D2 Swing circuit

Figure 11: Collision observation on a disc and a star turret

NOTE

To ensure that the *rolling system* can be switched through on the turret without collision, the respective outer diameter of the *rolling system* added to D1 must be smaller than D2.

Condition: Outer Ø *rolling system* + D1 < D2

Please refer to section 3.4 Dimensions of the *rolling system* for the outer diameter of the *rolling system*.

4.2 Inserting the rolls into the *rolling system*

- Place the rolling head with the coupling/flange on a workbench or clamp the round shaft in a vice so that the front plate faces upward.
- Make sure that the rolling head is secured against tipping over and falling down.
- Remove the front panel screws and remove the front panel.
- Remove the carbide bushings from the eccentric bolt.
- Grease the eccentric bolts, the holes of the carbide bushings, and the slanted surfaces of the front and intermediate panel with molybdenum sulfide paste.
- Place the three carbide bushings on the eccentric pins.
- Grease the roll holes with molybdenum sulfide paste.

IMPORTANT

Lubricate the eccentric bolts, carbide bushings and bearings thinly with molybdenum (IV) sulfide, e.g., Molykote.

- Check whether the designation of the *rolling system* is marked with an L on the front panel.

  Designation is without L (example F01 EVO): insert the rolls clockwise in the order 1-2-3... or A-B-C... onto the carbide bushings.

  Designation is with L (example F01L EVO): insert the rolls anticlockwise in the order 1-2-3... or A-B-C... onto the carbide bushings.
- Put the front panel back on the *rolling system* and tighten the front panel screws to the specified torque.

4.3 Adjusting the thread diameter

The rolling head must be adjusted to the thread diameter in a closed state.

Please proceed as follows:

- Ensure that the rolling head is secured against tipping over and falling down.
- Loosen the 3 hexagon head screws (15).
- When using an adjusting caliber, a thread pattern or a smooth mandrel with the core Ø of the respective thread to be rolled, twist the front part of the rolling head (roll cage) in the area of the three slotted holes (2) until the rolls (18) touch the adjusting caliber with their outer Ø (16).
- Tighten the hexagon head screws (15) again.
- If the desired thread dimensions are not yet achieved with the rolling head set in this way, i.e., if the rolled threads are too large in the flank Ø, the rolling head must be tightened.

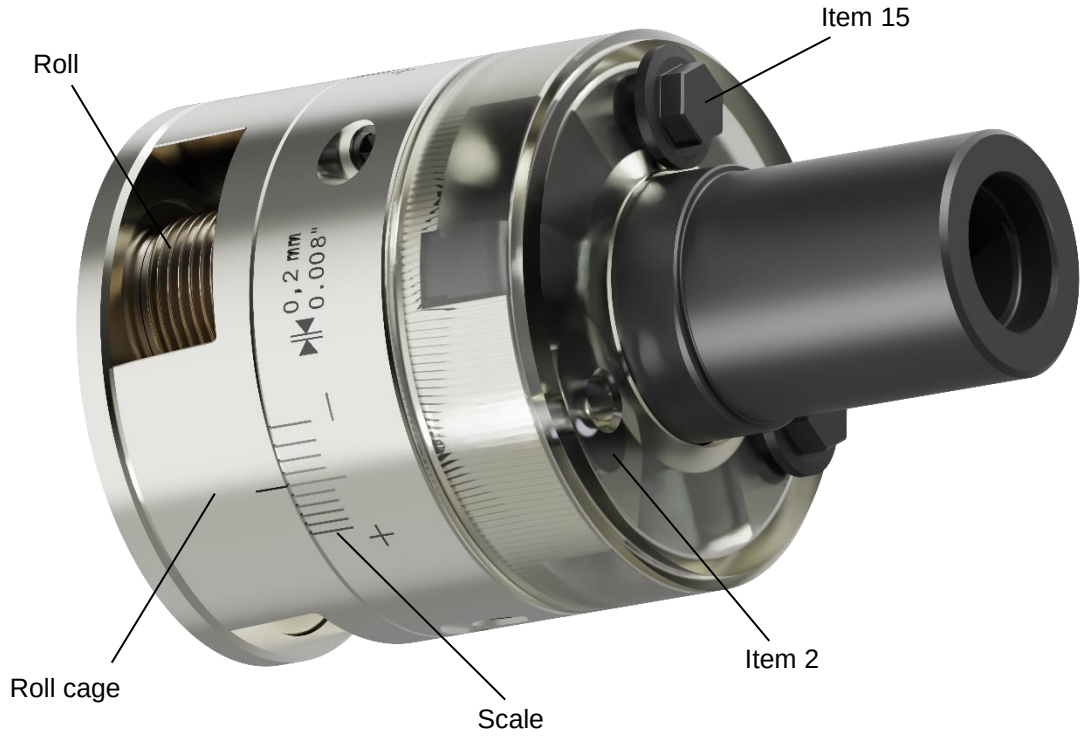


Figure 12: Adjustment scale on the housing of the axial *rolling system*

IMPORTANT

A thread that has already been rolled must not be rolled again.

4.4 Functional test of the *rolling system*

Checking the rolls

Check that the rolls rotate smoothly by moving the three rolls.

Checking the closing clamp

Loosen the clamp screw using the small hexagon socket screwdriver and check whether the clamp can be rotated completely around the *rolling system* housing by moving the clamp back and forth slightly. Then retighten the clamp screws using the small hexagon socket screwdriver.

Checking the switching mechanism

Clamp the *rolling system* on the shaft in suitable clamping jaws.
Manually check the closing and opening mechanism of the *rolling system*:

- If you can turn the rolling head by approx. 30°, the *rolling system* is open.
  First close and then open the *rolling system*.
- If you cannot turn the rolling head smoothly or feel resistance, the *rolling system* is closed.
  First open and then close the *rolling system*.
- Unclamp the *rolling system* from the clamping jaws.

NOTE

Opening the *rolling system*

The rolling head cannot be turned smoothly.
Reach under the *rolling system* housing and pull the rolling head away from the clamping jaws. The rolling head moves forward until the coupling disengages and turns by approx. 30°.

Closing the *rolling system*

The rolling head can be turned smoothly by approx. 30°.
Turn the rolling head by approx. 30° until the coupling engages. The rolling head moves approx. 1.5 mm toward the shaft.

IMPORTANT

Contact our Service Hotline if you are unable to carry out the functional test.

4.5 Inserting the *rolling system* into the processing machine

Clamp the *rolling system* to the change shaft in the processing machine.

NOTE

Ensure sufficient workpiece clamping in the processing machine, enabling the torque generated by the rolling process to be absorbed.

WARNING

The weight of the *rolling system* can cause injuries, especially by tipping over and falling down.

There is a general risk of injury when transporting the *rolling system*.

- Secure the *rolling system* against tipping over and falling down.
- Wear safety shoes.
- Use suitable lifting gear and harnesses.

4.6 Fixing the machine-side closing element

When closing, the rolls are returned to the working position.

Set the machine-side closing element depending on the conditions of the processing machine.

You can close the *rolling system* via

- the coolant pressure connection using the coolant-operated closing device (KSE),
- the closing curve using the processing machine
- the spindle start-up or braking
- the stop using the processing machine or
- the user, manually

} *machine-side closing elements*

.

NOTE

We will gladly advise you when selecting a suitable closing element.

Please contact our Service Hotline.

5. Operation

IMPORTANT

Carry out the steps in section 4 first.

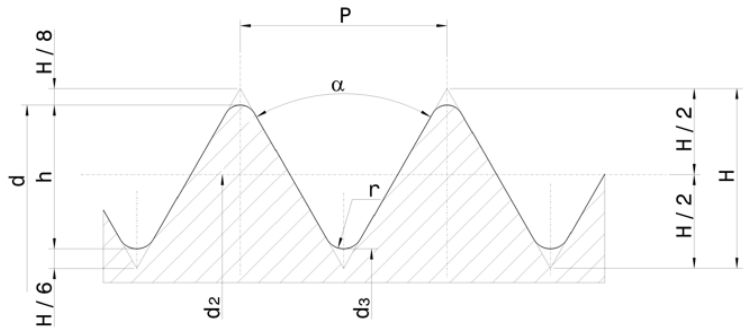
Contact our Service Hotline when commissioning the *rolling system* for the first time.

We will be happy to advise you on:

- preparing the workpiece
- determining the process variables
- fine-tuning the *rolling system*
- fine-tuning the closing element on the *rolling system*

5.1 Characteristics of the thread and the workpiece to be formed

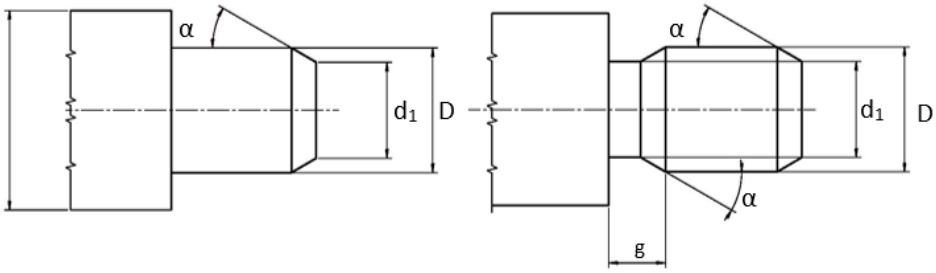
Characteristics of threads



P = Thread lead [mm]
or thread pitch (multi-start thread)
α = Flank angle
H = Theoretical profile height [mm]
h = Profile depth [mm]
r = Core radius [mm]
d = Nominal diameter [mm]
d_2 = Flank diameter [mm]
d_3 = Core diameter [mm]

Figure 13: Characteristics of threads (example: metric ISO thread)

Characteristics of the workpiece to be formed



g = Undercut (thread run-out) [mm]
α = Chamfer angle [°]
D = Initial diameter [mm]
d_1 = Internal diameter [mm]
d_3 = Core diameter [mm]

Figure 14: Characteristics of the workpiece to be formed

IMPORTANT

The determined initial diameter must be adhered to with a tolerance of ± 0.015 mm.

The chamfer angle should be α ≤ 30°. The diameter d_1 must be below the core diameter d_3:

$d_1 = d_3 – 0.1$ mm [mm]

A chamfer angle α = 30° results in a chamfer of approx. 45° after thread rolling on the workpiece.

5.2 Preparing the workpiece

Pre-turning diameter

Carry out the steps for the initial diameter only for the threading and knurling rolling operations.

The following applies for threading:

$d_A \approx d_2 - 0.03$ mm

d_A : initial diameter [mm]

d_2 : flank diameter [mm]

When adjusting the initial diameter, note that in Fig. 15 surfaces 1 and 2 are of equal size. This means that an increase of the initial diameter d_A by Δd_A results in a 3 to 5-fold increase of the external diameter d by Δd.

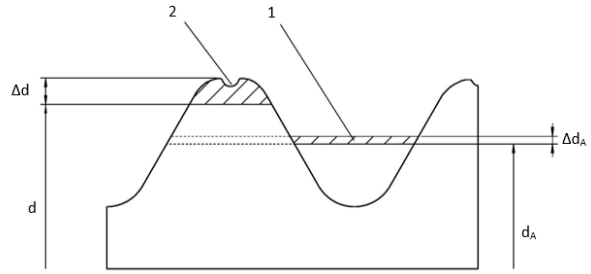


Figure 15: Changing the initial diameter

The following applies for knurling:

$d_A \approx d - h_Z$

d_A : initial diameter [mm]

d : outer diameter:

h_Z *: tooth height according to DIN* [mm]

Smoothing:

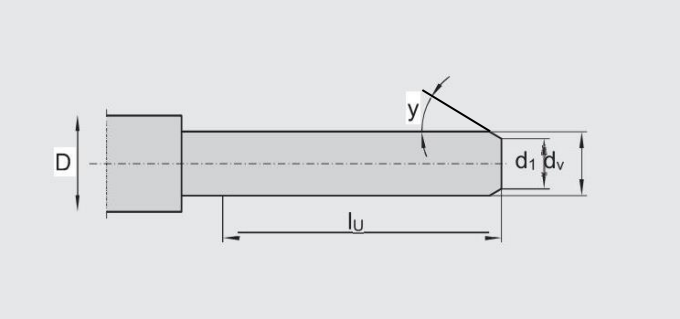
The greater the roughness, the better the rolling result.

Chamfer

Chamfer the workpiece only during the following *rolling processes*:

- threading,
- knurling and
- cold-forming of rotationally symmetrical workpieces for the production of other profiles

Perform the chamfer according to Fig. 16 Preparing the workpiece without undercut



γ : chamfer angle [°]
D : shoulder diameter [mm]
d_1 : face diameter [mm]
d_V : pre-turning diameter [mm]
l_U : workpiece length to be formed

Figure 16: Preparing the workpiece without undercut

Chamfer the workpiece with an angle of γ = 10°-30° to the workpiece axis.
Chamfer the workpiece so that the face diameter d1 is maintained.

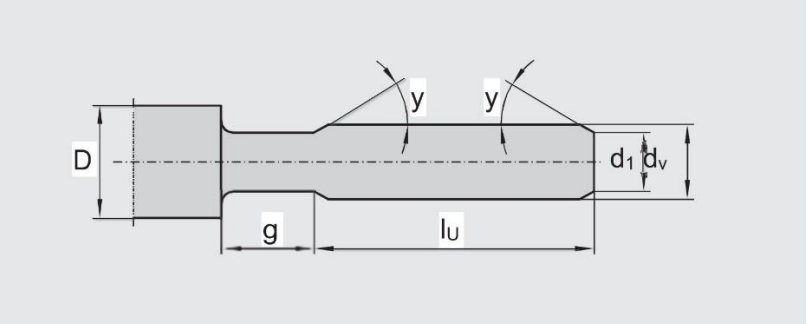
$d_1 \approx d_3 - 0{,}1\text{mm}$

d_1 : face diameter [mm]
d_3 : core diameter [mm]

Undercut

The minimum undercut (thread run-out) g is dependent on:

- the rolling head size,
- the thread lead and
- the thread rolling start-up.



g : undercut (thread run-out) [mm]
γ : chamfer angle [°]
D : shoulder diameter [mm]
d_1 : face diameter [mm]
d_V : pre-turning diameter [mm]
l_U : workpiece length to be formed

Figure 17: Preparing the workpiece with undercut (thread run-out)

- Determine the thread lead.
- Determine the thread roll start-up b.

NOTE

The thread roll start-up b designates the number of teeth that lie in front of a fully-profiled tooth.

We distinguish between b = 1 K and b = 2 K.

The thread roll start-up is shown in Fig. 18 Thread roll start-up 1 K and Thread roll start-up 2 K.

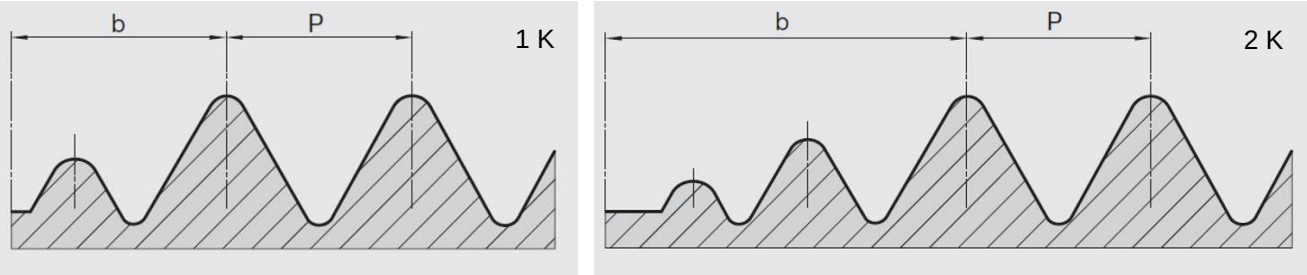


Figure: 18 Thread roll start-up 1 K and 2 K

- Read off the minimum undercut (thread run-out) *g* using the values determined in Table 4.
- Carry out the undercut (thread run-out) and the two chamfers according to Fig. 17 Preparing the workpiece with undercut (thread run-out).

Thread run-out (undercut)												
Pitch		Thread roll start-up b				Pitch			Thread roll start-up b			
[mm]	[inch]	1 K		2 K		[mm]	[inch]	[Number of starts]	1 K		2 K	
0.5	0.020	1.167	0.046	1.667	0.066	0.577	0.023	44	1.440	0.057	2.017	0.079
0.6	0.024	1.300	0.051	1.900	0.075	0.635	0.025	40	1.402	0.055	2.037	0.080
0.7	0.028	1.733	0.068	2.433	0.096	0.706	0.028	36	1.705	0.067	2.411	0.095
0.8	0.030	1.875	0.074	2.625	0.103	0.794	0.031	32	2.089	0.082	2.883	0.114
0.8	0.031	2.067	0.081	2.867	0.113	0.847	0.033	30	1.895	0.075	2.742	0.108
0.9	0.035	2.150	0.085	3.050	0.120	0.907	0.036	28	2.128	0.084	3.035	0.119
1.0	0.039	2.333	0.092	3.333	0.131	1.058	0.042	24	2.708	0.107	3.766	0.148
						1.27	0.05	20	2.883	0.114	4.153	0.164

Table 4: Thread run-out

5.3 Process sequence

The *axial rolling systems* of the F and K series are suitable for use on CNC processing machines.

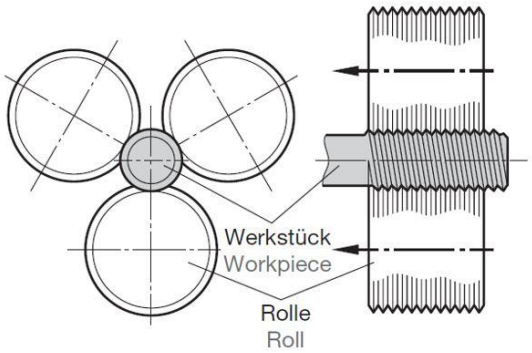
IMPORTANT

When opening the rolling head, it is pulled axially forward out of the coupling and becomes approx. 1.5 mm longer.

For a successful rolling process, either the workpiece must rotate or, in the K design, the *rolling system*. Basically, the process sequence can be divided into the following steps:

- **Axial feeding** of the workpiece into the axial *rolling system*
- **Pressing** the workpiece into the rolling head
- **Forming process**
- **Tracking feed movement** of the rolling head (thread lead -5%)
- **Opening the rolling system by feed stop or inside stop**
- Return to **starting position**
- **Removal** of the manufactured **workpiece**
- **Closing** the *rolling system* → **ready for operation**

The F01 / K01 axial *rolling systems* have 3 thread rolls. These have pitch-free profile rings.
They are installed in the rolling head swiveled around their horizontal axis, so that the workpiece or the rolling head moves axially with a complete rotation by the thread lead (see Fig. 16).



Feed is axial (direction of arrow)

1. Rolling head stationary (F01), workpiece rotating
2. Rolling head rotating (K01), workpiece stationary

Figure 19: Functional principle of the axial rolling process

NOTE

With axial thread rolling, the processing machine has “only” a tracking function after the rolling process has started.

Working feed rate

Due to the elongation of the material during the forming process, the machine feed rate should be approx. 5% smaller than the pitch of the thread to be produced.
Example:
Thread M20 x 1.5 / thread lead 1.5 mm
Machine feed approx. 5% less: 1.47 mm/rotation

Helix angle and lead angle

With the axial rolling heads, it is possible to roll not only standardized standard threads, but also all other threads of all kinds, as long as their diameter corresponds to the respective thread rolling head and with their helix angle lies within a certain range for the inclination of the rolling head.

NOTE

Metric, UN, BS, BA and similar threads, even if they are not standardized, can be rolled in a given axial rolling head if their lead angle does not deviate by more than ±30% from the rolling head's pitch.

In borderline cases, please contact us, as well as for all other thread forms where conditions may vary.

NOTE

The rule is:

$$\alpha = \arctan \frac{p}{\pi \cdot D}$$

α = lead angle	[degrees]
p = pitch	[mm]
D = flank-Ø	[mm]

5.4 Rolling speed and machine rotation speed

Rolling speed

Set the rolling speed to 20-60 m/min. The rolling speed can also be up to 100 m/min. for certain tasks.

Steel group	Strength N/mm²	Abbreviation	Material number	Rollability	Rolling speed m/min
Ferrous metals					
General structural steels	500	S235JRC	1.0120	☺	40-80
	500-600	S550GD	1.0531	☺	30-60
	750-900	C50	1.0540	☺	20-50
	630-850	C45E	1.1191	☺	20-50
Case-hardening steels	590-780	C15E	1.1141	☺	40-70
	780-1080	16MnCr5	1.7131	😐	30-50
Nitriding steels	780	34CrAl6	1.8504	😐	20-50
	900-1300	31CrMoV9	1.8519	😐	20-40
Free cutting steels	350-530	10S10	1.0711	☺	30-60
	360-760	11SMnPb30	1.0718	☺	30-60
	590-830	35S20	1.0726	☺	30-60
Heat treatable steels	630-780	C35	1.0501	☺	40-70
	850-1000	C60E	1.1221	😐	30-60
	1100-1300	42CrMo4	1.7225	😐	20-50
	1250-1450	30CrMoV9	1.7707	☹	20-40
	1200-1400	34CrNiMo6	1.6582	☹	20-40
	1100-1300	51CrV4	1.8159	☹	20-40
Tool steels	800-850	X210Cr12	1.2080	😐	30-50
	800-1000	X130W5	1.2453	😐	20-40
	760-810	115CrV3	1.2210	😐	30-50
High-speed steels	920	HS6-5-2C	1.3343	☹	20-40
	880	HS6-5-2-5	1.3243	☹	20-40
Stainless steels	650-730	X12Cr13	1.4006	😐	30-50
	800-950	X17CrNi16-2	1.4057	😐	30-50
	650-850	X14CrMoS17	1.4104	😐	30-50
	500-700	X5CrNi18-10	1.4301	☺	35-55
	500-750	X8CrNiS18-9	1.4305	☺	35-55
	500-700	X5CrNiMo17-12-2	1.4401	😐	30-50
	500-700	X6CrNiMoTi17-12-2	1.4571	😐	30-50
Cast steel	380-530	GE200	1.0420	☺	40-60
	540	G36Mn5	1.1176	☺	40-60
	1000-1200	G50CrMo4	1.7232	😐	30-50
Malleable cast iron	450	EN-GJMB-450-06	EN-JM 1140	😐	30-60
	650	EN-GJMB-650-02	EN-JM 1180	😐	30-60
Cast iron	400	EN-GJS-400-15	EN-JS 1030	☺	30-60
	500	EN-GJS-500-7	EN-JS 1050	😐	30-50
	600	EN-GJS-600-3	EN-JS 1060	😐	30-50
High-temperature materials	≥970	NiCo20Cr20CoMoTi (Nimonic 263)	2.4650	😐	30-50
	700-950	NiMo16Cr15W (Hastelloy C276)	2.4819	😐	20-40
Nickel alloys	580-800	NiCr15Fe (Inconell 600)	2.4816	☹	20-40

Non-ferrous metals					
Copper	240-300	E-Cu	CW004A	☺	40-80
Copper wrought alloys	310	CuZn37	CW508L (R310)	☺	40-80
	410	CuZn38Pb2	CW608N (R410)	😐	40-70
	360	CuZn38Pb2	CW608N (R360)	☺	40-70
	430	CuZn39Pb3	CW614N (R430)	😐	40-70
Aluminum alloys	150-240	AlMg2	EN AW-5251	☺	40-70
	160-310	AlSi1MgMn	EN AW-6082	😐	40-70
	220-350	AlZn4,5Mg1	EN AW-7020	☹	30-50
	220-440	AlCu4Mg1	EN AW-2024	😐	30-50
	275-540	AlZn5,5MgCu	EN AW-7075	😐	30-50
Titanium alloys	390-540	Ti2	3.7035	☺	30-60
	540-650	TiCu2	3.7124	☺	30-60
	750-950	TiAl5Sn2,5	3.7115	😐	30-60
	1030-1100	Ti6Al4V	3.7164.7	😐	20-40

Table 5: Rolling speeds

Symbols:	☺ good rollable	😐 rollable	☹ limited rollable

NOTE

Depending on the workpiece material, determine the rolling speed with using Table 5.
Recommended rolling speed depending on material:

- Triangular thread: Select the value indicated in the table.
- Trapezoidal and round thread: Select 50% of the value indicated in the table.

Tensile strength and elongation at break of the material

Roll at approx. 20-30 m/min. for high tensile strengths of the material.
Note that the rolling speed depends on the tensile strength.
Choose low rolling speeds for high tensile strengths and high rolling speeds for low tensile strengths.

Machine rotation speed

NOTE

The machine rotation speed is calculated as follows:

$$n = \frac{1000 \cdot v}{d_A \cdot \pi} \text{ [min}^{-1}\text{]}$$

n : machine rotation speed [min^{-1}]
v : rolling speed [m /min]
d_A : initial diameter [mm]

5.5 Rolling time

NOTE

Rolling time for threading and cold forming of rotationally symmetrical workpieces for the production of other profiles

$$t_R \approx \frac{60 * L}{n * P} \; [s]$$

t_R : rolling time [s]
L : rolling length (thread length) [mm]
n : machine rotation speed [min^{-1}]
P : thread lead [mm]

NOTE

Rolling time for smoothing and knurling

Determine the rolling speed using the *rolling head* constant *k*:

- Depending on the *rolling head* angle, determine the *rolling head* constant *k*:
- Determining the rolling time
- Determine the thread lead.

$$t_R \approx \frac{60 * L}{n * d_V * k} \; [s]$$

t_R : rolling time [s]
L : roll length [mm]
n : machine rotation speed [min^{-1}]
d_V : pre-turning diameter [mm]
k : *rolling head* constant [1] => (tan (rolling head angle) * π)

5.6 Drive power and torque of the processing machine

Output of the processing machine

The length of the workpiece to be formed has theoretically no influence on the required drive power, since the forming is generated axially progressively.

NOTE

Output:

$N \approx 0.174 \cdot 10\text{–}6 \cdot C \cdot \delta_B \cdot P \cdot d \cdot n$ [kW]

N	: output [kW]
$C = 1$	: form factor for triangular thread [1]
$C = 2$	: form factor for trapezoidal and round thread [1]
δ_B	: tensile strength [N/mm^2]
P	: thread lead [mm]
d	: thread diameter [mm]
n	: machine speed [min^{-1}]

Torque of the processing machine

NOTE

Torque:

$n = \frac{1000 \cdot v}{d_A \cdot \pi}$ [Nm]

M	: torque [Nm]
N	: output [kW]
n	: machine rotation speed [min^{-1}]

5.7 Fine adjustment of the *rolling system*

Once you have completed installation according to section 4, you will receive an unformed threaded tooth. The rolling head must be adjusted to the thread diameter in a closed state.

- Ensure that the rolling head is secured against tipping over and falling down.
- Loosen the 3 screws (4) and the threaded pins (3) in the spring housing (2).
- Rotate the roll cage (1) relative to the spring housing (2) until the rolls (5) have the desired distance to each other.
- Tighten the screws (4) and the threaded pins (3) in the spring housing (2) again.

A slight correction on the guide scale in minus is probably necessary for the adjustment. The exact setting should be determined by a rolling test.

- If the flank diameters achieved are too large or too small, the rolling head setting must be corrected in minus or plus.

Figure 20 depicts the scale on the *rolling system* housing.

Figure 20: Fine adjustment scale

Check the rolled profile carefully. Figure 21 shows the possible degrees of deformation of a threaded tooth:

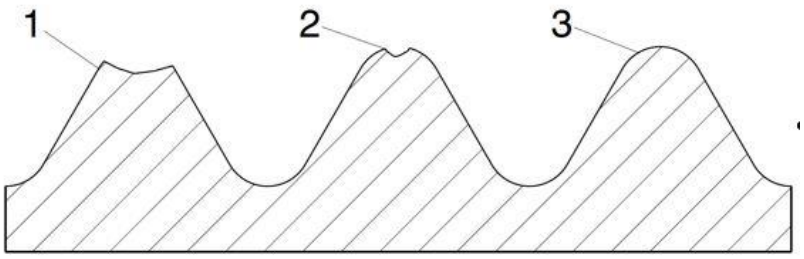


Figure: 21 Degree of deformation on the threaded tooth

- Tooth 1 shows an **undeformed** threaded tooth. As a rule, this degree of deformation is sufficient to obtain a load-bearing thread. In most applications, this degree of deformation is desired.
- Tooth 2 shows a **deformed** threaded tooth. This degree of forming is used to meet the highest demands in terms of appearance and tightness.
- Tooth 3 shows an **overformed** threaded tooth.

NOTE

Note that the thread tolerances must be checked depending on the degree of deformation.

NOTE

The workpiece outer diameter *d* must not be press-finished or overformed in the thread tips after thread rolling. This leads to increased thread roll wear.

Due to the infeed of the rolls, more material is pressed into the tooth tip. This automatically increases the outer diameter of the thread.

- If the flank diameter is correct after correction of the roll infeed, but the thread tooth is overformed, reduce the initial diameter d_A.
  Less material flows into the tooth tip.
- If the flank diameter is correct after correcting the roll infeed, but the outer diameter is too small, increase the initial diameter.
  More material flows into the tooth tip.

IMPORTANT

Observe the tightening torques (see section 3.7).

6. Dismantling after operation

IMPORTANT

Contact our Service Hotline when dismantling after operation for the first time.
We will be happy to advise you on:

- removing the *rolling system* from the processing machine,
- dismantling the rolling head and
- dismantling the rolls.

Check all assemblies of the *rolling system* for wear and damage. Contact the operator if you notice any wear or deterioration of any component of the *rolling system*.

CAUTION

Caution against hand injuries!

During decommissioning, dismantling or disposal, there is a risk of injury from rough, sharp surfaces of transport boxes, cartons, pallets as well as packaging aids.

Wear safety gloves to avoid cuts.

WARNING

General risk of injury by sharp edges

Wear protective gloves and goggles when using the *rolling system*.

The weight of the *rolling system* can cause injuries, especially by tipping over and falling down.
There is a general risk of injury when transporting the *rolling system*.

- Secure the *rolling system* against tipping over and falling down.
- Wear safety shoes.
- Use suitable lifting gear and fastening equipment.

6.1 Removing the *rolling system* from the processing machine

WARNING

Risk of burns from the hot surface of the *rolling system*.

Do not remove the *rolling system* until it has cooled down.

Danger of cutting due to chips adhering to the *rolling system*.
Remove any chips adhering to the *rolling system* before removing the *rolling system* from the processing machine.

- Check whether a suitable hoist, e.g., a crane, is required to remove the *rolling system* from the processing machine.

  We recommend using a suitable harness or hoist to lift *rolling systems* with a weight of 5 kg or more.

NOTE

Suitable harnesses can be, e.g.

- ropes
- chains
- lifting straps or belts.

Before lifting the *rolling system*, please discuss with the responsible occupational safety specialist which lifting gear and harnesses are suitable.

- Secure the *rolling system* against falling down.
- Loosen the screw connection to the processing machine.
- Lift the *rolling system* out of the processing machine.

6.2 Dismantling the rolls

Removing the rolls:

- Place the rolling head with the coupling on a workbench or clamp the rolling head in a vice so that the front panel faces upward.
- Ensure that the rolling head is secured against tipping over and falling down.
- Remove the front panel screws and remove the front panel.
- Remove the rolls.
- Put the front panel back on the *rolling system* and tighten the front panel screws.

NOTE

Only use rolls with the same set of rolls number (profile dimension, rolling head type, roll code number, roll width, and roll design type).
Be sure to lubricate the roll holes and the axles with molybdenum sulfide grease (e.g., Molykote).

After changing the rolls, check the rolled profile. If the outer diameter in particular is not correct, compensate for this by making changes to the rolling head setting.

7. Wear parts, spare parts list

Wear parts

NOTE

Wear parts are

- the clutch with shank (1)
- the center plate (3)
- the front panel (4)
- the eccentric spindle (5)
- the carbide bushings (13)
- the set of rolls (not illustrated).

Contact the operator if you notice any wear or deterioration of any component of the *rolling system*.

Spare parts list

NOTE

When reordering rolling heads, spare parts and thread rolls, please be sure to state the signed designation and the ID number.

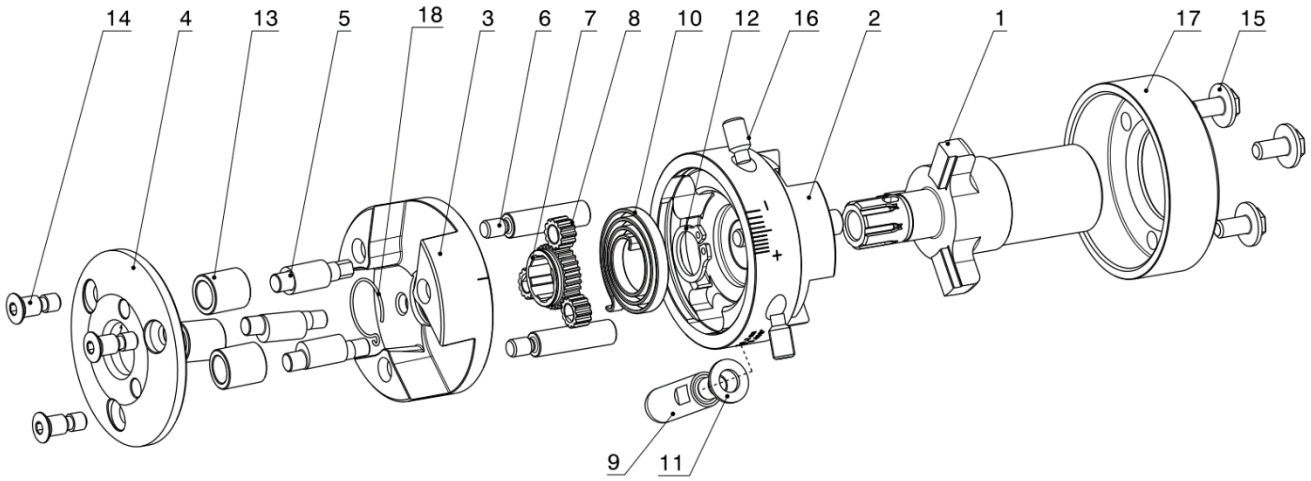


Figure 22: Exploded view F01

The following ID numbers apply to the standard rolling head versions:

Rolling head			F01	F01 L	Rolling head			K01	K01 L
Item	**Pce.**	**Name**	**ID no.**	**ID no.**	**Item**	**Pce.**	**Name**	**ID no.**	**ID no.**
1	1	Clutch with shank Ø 16	7424858		1	1	Clutch with shank Ø 16	7424858	
1	1	Clutch with shank Ø 20	7424856		1	1	Clutch with shank Ø 20	7424856	
1	1	Clutch with shank Ø 5/8”	7424859		1	1	Clutch with shank Ø 5/8”	7424859	
1	1	Clutch with shank Ø 3/4”	7424857		1	1	Clutch with shank Ø 3/4”	7424857	
2	1	Spring housing	7424860	7424861	2	1	Spring housing	7424861	7424860
3	1	Center plate	7424862	7424863	3	1	Center plate	7424864	7424865
4	1	Front plate	7424866	7424867	4	1	Front plate	7424868	7424869
5	3	Eccentric spindle	7159845		5	3	Eccentric spindle	7159845	
6	3	Stud	7424838		6	3	Stud	7424838	
7	1	Center gear	7424870	7424871	7	1	Center gear	7424872	7424873
8	3	Spur gear	7202831		8	3	Spur gear	7202831	
9	1	Closing pin	2164584		9	1	Closing pin	7159851	
10	1	Coil spring	2164554	2164580	10	1	Coil spring	2164580	2164554
11	1	Screw T8 M2.5X4	1045829		11	1	Screw T8 M2.5X4	1045829	
12	1	Circlip DIN471 A11x1	7159849		12	1	Circlip DIN471 A11x1	7159849	
13	3	Carbide bushing	2164574		13	3	Carbide bushing	2164574	
14	3	Front plate screw M4	2164551		14	3	Front plate screw M4	2164551	
15	3	Screw M4X8	7202838		15	3	Screw M4X8	7202838	
16	2	Set screw	2142159		16	2	Set screw	2142159	
17	1	Chip guard	7202832		17	1	Chip guard	7202832	
18	1	Circlip	2164513		18	1	Circlip	2164513	

Table 6: Spare parts list

8. Installing and removing components

IMPORTANT

Contact our Service Hotline if you have any queries about installing components. Check all assemblies of the *rolling system* for wear and damage.
Contact the operator if you notice any damage to or wear of any component of the *rolling system*.
Have maintenance work carried out by the manufacturer; contact our Service Hotline for this.

WARNING

The weight of the *rolling system* can cause injuries, especially by tipping over and falling down.

There is a general risk of injury when transporting the *rolling system*.

- Secure the *rolling system* against tipping over and falling down.
- Wear safety shoes.
- Use suitable lifting gear and harnesses.

- To remove the *rolling system*, follow the instructions in section 6.1.
- Refer to section 3 for information on which component the part to be installed or removed belongs to.
- Replace the corresponding component in the corresponding work step.

Changing the rolls

Carry out the steps described in section 6.2.

NOTE

Carry out section 5.7 after each change of the set of rolls.

Gearbox view

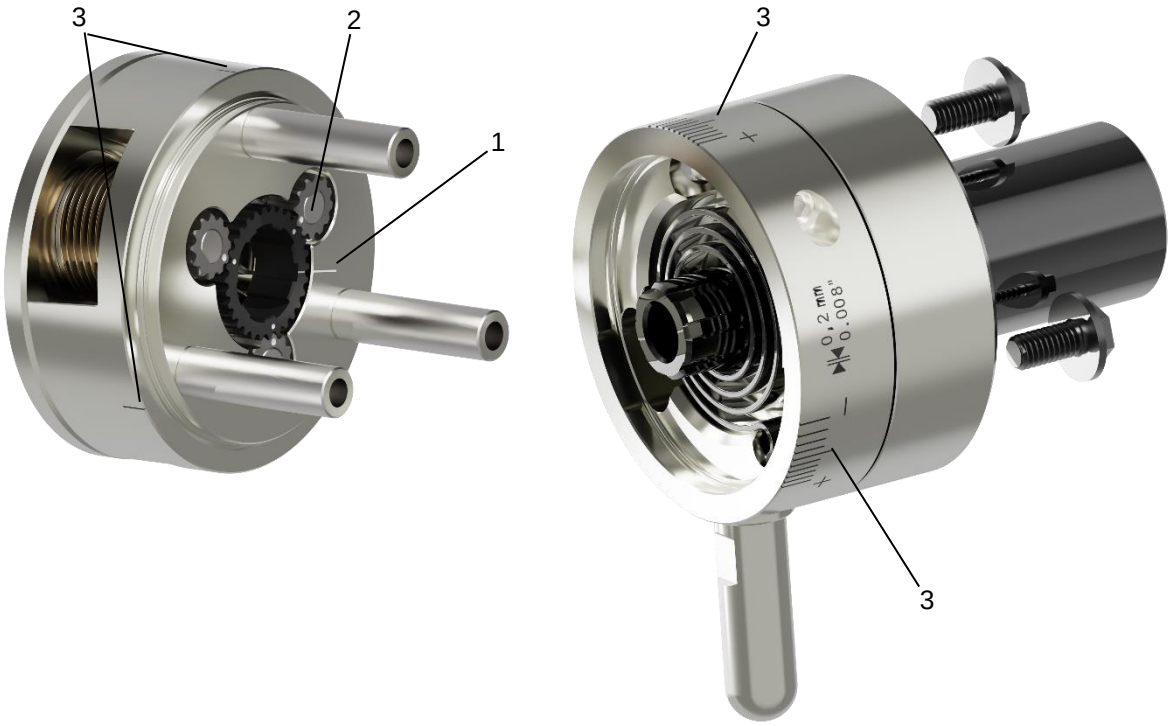


Figure 23 Gearbox view F01EVO

Pos.1: In the basic position, the line on the center gear must match the line on the center plate.

Pos.2: The markings on the spur gears must match the markings on the center gear.

Pos.3: The two lines on the center plate must match the two scales on the spring housing.

9. Maintenance

Maintenance during operation

Daily:

Check all assemblies of the *rolling system* for wear and damage.

Weekly:

- Carry out the steps in section 6.
- Carry out the steps in section 4.

Maintenance when changing a set of rolls

- Carry out the steps in section 6.
- Carry out the steps in section 4.

Maintenance intervals

It is essential to adhere to the maintenance intervals listed in Table 14. If you use the *rolling system* under difficult conditions, shorten the cleaning and maintenance intervals.

Interval	Performed by	Description
Daily	Machine operator	- Remove chips from the thread rolls and check for any flaking.
Weekly	Only by the fitter	- Clean and grease thread rolls and axles.
Quarterly/ after a longer period of non-use	Only by the fitter	- Dismantle the tool and free it from contamination and chips. Lubricate all parts according to the specifications when reassembling.

Table 7: Cleaning and maintenance intervals

10. Storage

NOTE

The storage condition is the delivery condition.

- Carry out section 6 Dismantling after operation.
- Preserve the *rolling system*.
- Store the *rolling system*.

Storage temperature: min. –10 °C, max. +30 °C

Relative humidity: < 60%

11. Disposal

NOTE

Properly dispose of the *rolling system* with harmful build-up such as oils and greases. Improper disposal of the materials used pollutes the environment. Observe the national and local regulations when disposing of all materials to avoid polluting the environment.

Ensure that all national and local safety requirements are observed.

- After the rolling head has been taken out of service, it must be disposed of according to type.
- Separate ferrous, non-ferrous metals etc.
- Greases, oils and objects and lines contaminated with them must be disposed of separately.

12. Troubleshooting

NOTE

Perform a visual and functional check before any troubleshooting.

	Fault	Cause	Solution
1	Conical thread	a) Front plate worn out	a) Replace front plate
		b) Eccentric spindle worn	b) Measure bolt, if difference in Ø > 0.03 mm, replace eccentric spindle
		c) Rolling head not aligned with workpiece (≥ 0.2 mm error)	c) Realign machine
		d) Conically pre-turned	d) Prepare workpiece cylindrically
2	Thread outside the tolerance	a) Rolling head not adjusted accurately	a) Readjust rolling head
		b) Blank not prepared according to workpiece (too large / too small)	b) Preparation of workpiece according to section 5.2
3	Pitch error	a) Rolling head not aligned with the workpiece (≥ 0.2 mm error)	a) Realign machine
		b) Wrong rolling head angle	b) Insert suitable rolling head
		c) Material unsuitable	c) Check rollability; if this is given, use material from same batch if possible
		d) Feed wrong	d) Feed according to section 5.2
4	Roll breakage	a) Chamfering not true to roll	a) Preparation of the workpiece according to section 5.2
		b) Blank diameter too large	b) Preparation of the workpiece according to section 5.2
		c) Rolling head set too small	c) Adjust rolling head larger, see section 4.3
		d) Rolling head not aligned with the workpiece	d) Realign machine
		e) Material too hard	e) Stop rolling process immediately, consult 'Team Rollen'
		f) Too much material has to be formed	f) Reinforce rolling head or select larger rolling head
		g) Rolling is carried out with overpressure	g) Open rolling head, see section 4.3
5	Excessive rolling wear	a) Poor rolling material	a) Select other material, see section 3.6
		b) Rolling speed not correct	b) Adjust values according to section 5.4
		c) Elongation of material too low	c) Do not carry out rolling process, consult 'Team Rollen'
		d) Insufficient cooling	d) Targeted supply of rolls with cooling lubricant
		e) Chamfering not suitable for rolling	e) Preparation of the workpiece according to section 5.2
6	Thread profile not clean	a) Incorrect roll installation in the rolling head	a) Install rolls according to section 4.2
		b) Chamfering not correct for rolling	b) Preparation of the workpiece according to section 5.2
		c) Rolling speed is too low or too high	c) Set values according to section 5.4
		d) Rolling speed is too low or too high	d) Check the installation of the rolls (see 4.2), check preparation of the workpiece (5.2)

Table 8: Troubleshooting

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