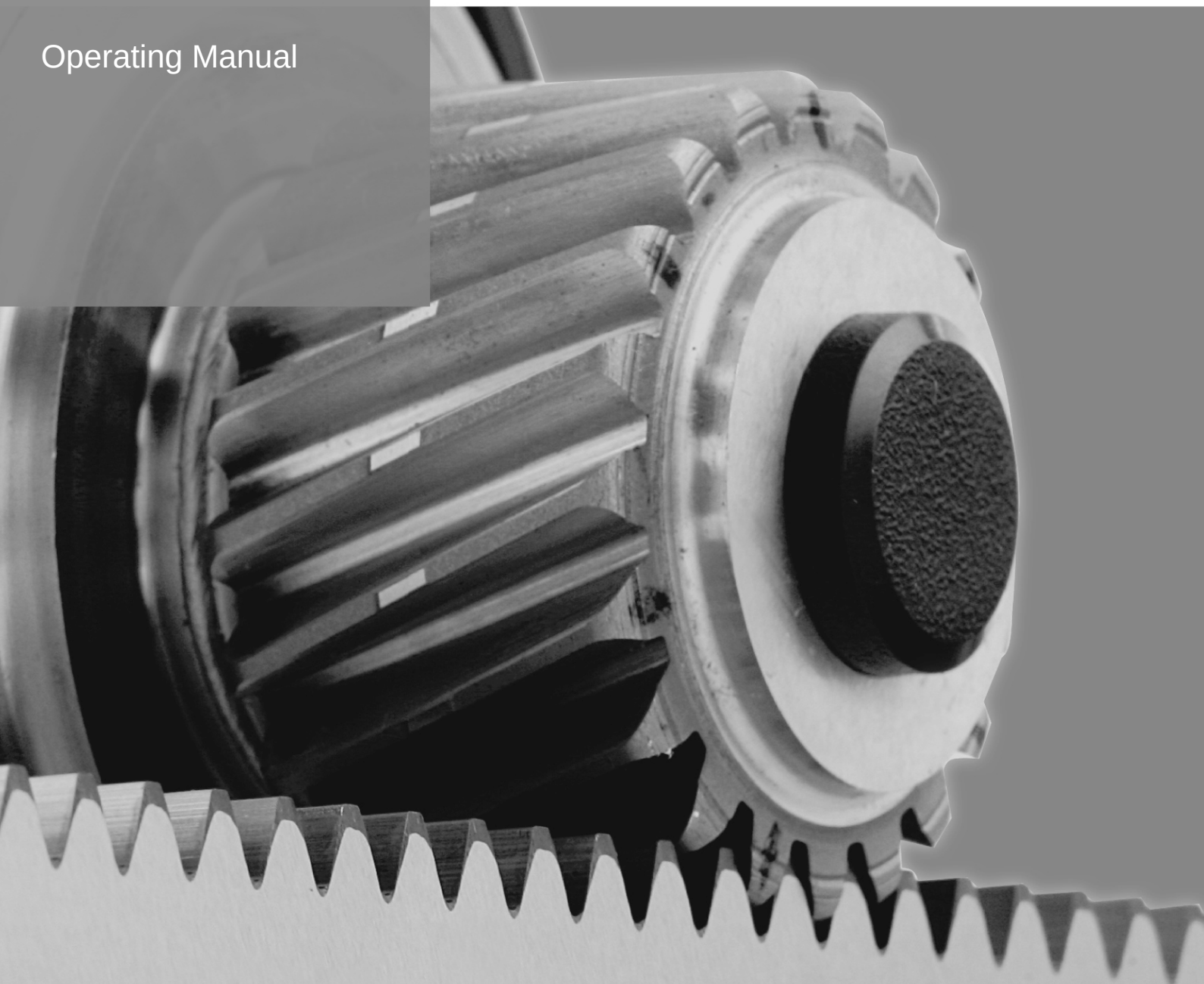
WITTENSTEIN | alpha

alpha Rack&Pinion System

Operating Manual



1 Contents

1.1 Service contact

If you have technical questions, please contact our Customer Service department:

WITTENSTEIN alpha GmbH
Customer Service
Walter-Wittenstein-Str. 1
97999 Igersheim, Germany
Tel.: +49 (0) 79 31 / 493-12900
Fax: +49 (0) 79 31 / 493-10903
E-mail: service-alpha@wittenstein.de

2 General

The original instructions were prepared in German; all other language versions are translations of these instructions.

2.1 Description, designations

The alpha rack&pinion system (in the following named only drive system) is constructed and built for feed drives.

2.2 Whom is this manual addressed to?

This manual concerns all persons who install, operate, or maintain this drive system.
They may only carry out work on the drive system, if they have read and understood this operating manual. Pass the safety instructions on to other persons as well.

2.3 Which signs and symbols are referred to in this manual?

Ü An 'instruction' requests the operator to perform an action.

Ñ A 'test' can be used to determine whether the device is ready for the next steps.

J An 'application hint' indicates ways to facilitate or improve usage.

The safety instructions symbols are described in Chapter 3 „Safety“.

2.4 Exclusion of liability

The manufacturer does not accept liability for damage or injury ensuing from improper handling of the drive system.

2.5 Modifications, reconstructions

Modifications or reconstructions of the drive system may only be carried out with the express written authorization of **WITTENSTEIN alpha GmbH**. Use only original parts when you service or expand the drive system (e.g. toothed rack). **WITTENSTEIN alpha GmbH** assumes no liabilities for damages or injuries caused by third-party parts.

2.6 EC Machinery Directive

The drive system is considered a "machine component" and is therefore not subject to the EC Machinery Directive 2006/42/EC.
Operation is prohibited within the area of validity of the EC directive until it has been determined that the machine in which this product is installed corresponds to the regulations within this directive.

2.7 Technical modifications

WITTENSTEIN alpha GmbH reserves the right of carrying out technical modifications to improve the product.

2.8 Copyright

3 Safety

3.1 Intended use

The drive system is constructed and built for feed drives that do not fall under article 2 of the directive 2002/95/EU (usage restriction of certain dangerous materials on electro and electronic equipment).
Refer to our catalogue or our Internet page for the maximum permitted forces and torques: www.wittenstein-rack-pinion.com.

Ü Consult our Customer Service department (see 1.1) if your drive system is older than one year. In this way, you receive valid data.

3.2 Improper use

Any use transgressing the above-named restrictions (especially higher forces and torques) is not compliant with the regulations, and is thus prohibited.
The operation of the drive system is prohibited if:

- It was not installed properly (e.g. alignment of the gearhead to the toothed rack),
- It is not maintained properly (e.g. use of the wrong lubricant) or
- The dirt protection is insufficient.

3.3 Safety instructions

This manual uses the following signal words to warn the operator of potential risks:

DANGER
This signal word points out to an imminent danger that can cause serious injuries and even death.

WARNING
This signal word points out to a possible danger that can cause serious injuries and even death.

CAUTION
This signal word points out to a possible danger that can cause slight to serious injuries.

A note without a signal word indicates application hints or especially important information for handling the gearhead.

In addition to the safety instructions in this manual, also observe any applicable legal and otherwise environmental and accident prevention regulations (e.g. personal safety equipment).

For special situations, the general warning symbol  is replaced by appropriate warning symbols (e.g. "electrical voltage" ).

Environmental hazard
The signal word "Environmental hazard" warns the operator of a risk of pollution.

3.3.1 General safety instructions

Working on the drive system

WARNING

Improperly executed work can lead to injury and damage.

Ü Ensure that the drive system is only installed, maintained, and dismantled by trained technicians.

WARNING

Impurities spinning through the air can cause serious injury.

Ü Before putting the drive system into operation, check that there are no impurities or tools near the drive system.

CAUTION

Loose or overloaded screw connections can cause damage.

Ü Always use a calibrated torque wrench to tighten and check all screw connections for which a tightening torque has been specified.

Operation

WARNING

Moving machinery may lead to injuries. There is danger of being trapped or pulled in!

Ü Keep a sufficient distance to rotating machinery.

Maintenance

WARNING

An unintentional start of the machine during maintenance work can lead to serious accidents.

Ü Secure the machine against being started while somebody is working on it.

Ü Secure the machine against restarting and unintentional movements during assembly and maintenance work.

WARNING

Even only briefly running the machine during maintenance work can lead to accidents if the safety devices are not operating.

Ü Check that all safety devices have been mounted and are activated.

Lubricants

Environmental hazard

Lubricants (oils and greases) are hazardous substances that can contaminate soil and water.

Ü Collect drained lubricant into suitable containers and dispose of it according to valid national directives.

4 Technical specifications

4.1 Setup

The drive system consists of a gearhead with one pinion at the output as well as the corresponding toothed rack for fixed assembly in a customer construction. Refer to our catalogue or our Internet page for the corresponding installation dimensions: www.wittenstein-rack-pinion.com.

Pinion / Toothed rack	High Performance Class	Premium Class$^+$	Premium Class RTP	Standard Class RSP	Value Class
(High-) Performance	(High-) Performance Linear System				
Premium Class		Precision System	Precision System		
Value Class				Economy System$^+$	Economy System
Smart Class		Smart System	Smart System	Smart System	Smart System

Table 4.1

4.1.1 High Performance/ Performance Linear System

The (high-) performance toothed racks are suited for employment in high-end applications with high requirements for dynamics and positioning accuracy due to their feed power reserves just as much as in mid-range applications that require a high power density for example with very compact mounting volume. In combination with the High Performance Class pinion, the application range spans from mid-range to high-end.

4.1.2 Precision System

Premium Class$^+$ pinion

The pinions for the SP/TP output stand out by highest linear rigidity and dynamics. This is effected by a small effective circular diameter and the high eccentricity precision. The pinion is suited for high-end applications with highest dynamics and positioning accuracy.

Premium Class RTP pinion

The pinion for the TP output features a medium linear dynamic rigidity with very good positioning accuracy due to its large effective circular diameter.

Premium Class toothed rack

The toothed racks of the Premium Class are suited for high dynamic and precise positioning accuracies. A stop angle in the machine base allows for an easy assembly. Upon consultation with **WITTENSTEIN alpha GmbH**, the drive system (rack&pinion system) can be set to be free of backlash due to the high accuracy.

J Additionally, a sorting of the toothed racks is possible, whereby the glass scale for determining the position can be omitted. Consult our Customer Service department (see 1.1) to receive further information.

4.1.3 Economy+ System

Standard Class RSP pinion

The pinions for the SP involute output stand out by a high linear rigidity and dynamics. This is effected by a small effective circular diameter and medium eccentricity precision. The pinion is suited for mid-range applications with high dynamics and positioning accuracy.

Value Class toothed rack

The Value Class toothed racks are suited for low-cost applications. A stop angle in the machine base allows for an easy assembly.

4.1.4 Economy System

Value Class pinion

The pinion with keyway for the LP/(SP) output features a lesser positioning accuracy in combination with a low linear rigidity. High speeds are possible with only minor concentricity error are possible. The pinion is suited for low-cost applications.

Value Class toothed rack

The Value Class toothed racks are suited for low-cost applications. A stop angle in the machine base allows for an easy assembly.

4.1.5 Smart System

Smart Class toothed rack

The Smart Class toothed racks are suitable for all applications with highly flexible assembly requirements and modular design due to their dynamic positioning accuracy and the free flexible assembly without assembly edge. This toothed rack can be optimally aligned to the guide rails. The application ranges span from low-cost to high-end depending on the pinion.

4.1.6 Performance System

The high-performance toothed rack is suited for employment in high-end applications with high requirements for dynamics and positioning accuracy due to their feed power reserves just as much as in mid-range applications that require a high power density for example with very compact mounting volume. In combination with the Premium Class+ /Premium Class RTP pinion, the application range spans from mid-range to high-end.

4.2 Weight

The total weight of the drive system is the combination of the weight of the gearhead with the pinion and the corresponding toothed rack.

- J Refer to the operating manual of the gearhead for the weight of the gearhead.
- J In Table 4.2 and Table 4.3, you will find the weights of the individual toothed racks.

Weight [kg] **helically toothed** toothed racks						
Module	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**	**8.0**
Length [mm]						
167	0.7	-	-	-	-	-
250	-	1.5	-	-	-	-
333	1.4	-	-	-	-	-
480	1.9	2.7	4.7	-	-	21.0
500	2.1	3.0	-	6.5	9.9	-
506	-	-	5.4	-	-	-
960	-	-	-	-	-	42.0
1000	4.1	5.9	10.7	13.1	19.9	-
1500	6.15	8.85	-	19.50	27.10	-
2000	8.20	11.0	21.40	26.0	36.20	-

Table 4.2

Weight [kg] **spur-toothed** toothed racks						
Module	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**	**8.0**
Length [mm]						
167 - 2000	on request					

Table 4.3

4.3 Lubricant

Rack&Pinion System

CAUTION

Too little lubrication damages the gearing.

Ü Always make sure that there is sufficient lubrication and exchange the lubricator in time.

The lubrication of the pinion or the toothed racks is provided by a lubricator via a lubricating felt pinion.

The lubricator is available in two sizes (type 125 and type 475) and is factory-filled with "Klüber Microlube GB 0".

- J The recommended lubricant quantity at a movement speed of 90 m/min is for example 0.175 - 0.35 cm³/Tag for module 2.
- J Further information for setting the automated lubrication can be found in the instructions of the lubricator.

The ambient temperature may not be under +10 °C and not over +50 °C.

The operating temperature may not exceed +90 °C.

Gearhead

The gearhead is filled by the manufacturer with synthetic gear oil (polyglycols) of viscosity class ISO VG 220 or with a high-performance grease.

- J Further specifications can be found in the gearhead's operating manual.

4.4 Performance statistics

Refer to our catalogues or our Internet page for the maximum permitted forces and torques of the gearhead: www.wittenstein-rack-pinion.com.

Ü Consult our Customer Service department (see 1.1) if your gearhead is older than one year.

4.5 Ordering code

The ordering code (A) is located on the toothed racks.
The identification plate for the gearhead is located on the gearhead housing.

J Further notes on the identification plate can be found in the gearhead's operating manual.

Toothed rack

The ordering code (e.g.: ZST 200-HE6-1000-035-R1_) provides the following data:

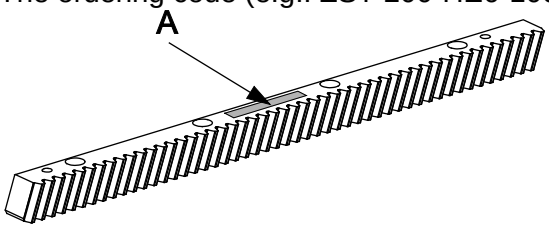


Fig. 4.1

ZST 200-HE6-1000-035-R1_

Rack type
ZST = Rack

Module
200 = 2.00
300 = 3.00
400 = 4.00
500 = 5.00
600 = 6.00

Version
PA/PE = Premium Class
SB = Smart Class
VB/VE = Value Class
HE = (High-) Performance Class

Quality
5 = alpha Q5 acc. DIN 3962/63/67 (Premium Class)
6 = alpha Q6 acc. DIN 3962/63/67 (Smart Class, Value Class, Performance Class)

Hole pattern
_ = standard
0 = without
1 = 62.5 mm
X = special

Helical angle
0 = 0°
1 = 19° 31' 42"
X = special

Direction of helical angle
R = ascending to the right
L = ascending to the left
G = straight toothed

Pitch total deviation Fp in µm / length rack

Length [mm]

Fig. 4.2 Ordering code

Premium Class+ and Value Class pinion

RMT 200-VC6-18L1-016-019

Designation
RMT= Pinion mounted ex works
RMX= Pinion mounted offset 180°
(only for Value Class Ritzel)

Module
200 = 2.00
300 = 3.00
400 = 4.00
500 = 5.00
600 = 6.00

Design
HC = High Performance Class
PC = Premium Class
VC = Value Class

Quality
5 = alpha Q5 acc. DIN 3962/63/67 (Premium Class)
6 = alpha Q6 acc. DIN 3962/63/67 (Value Class)

Pinion distance
(only for Value Class Ritzel)

Connection diameter

Helical angle
0 = 0°
1 = 19° 31' 42"

Direction of helical angle
R = ascending to the right
L = ascending to the left
G = straight toothed

Number of teeth

Fig. 4.3 Ordering code

Standard Class RSP and Premium Class RTP pinion

RTPA 025-A02-5e24-040-A30

Designation
RSP = Standard Class RSP pinion for SP involute output as per DIN 5480
RTP = Premium Class RTP pinion for TP-Abtrieb as per ISO 9409
RTPA = Premium Class RTP pinion for TP-HIGH-TORQUE-output

Gearhead size
For SP output: 060, 075, 100, 140, 180, 210, 240
For TP output: 004, 010, 025, 050, 110, 300, 500

Material
A = 16MnCr5

Module
02 = 2.00
03 = 3.00
04 = 4.00
05 = 5.00
06 = 6.00

Quality
5 = alpha Q5 acc. DIN 3962/63/67 (Premium Class)
6 = alpha Q6 acc. DIN 3962/63/67 (Standard Class)

Tolerance class
e24 = acc. to DIN 3967
e25 = acc. to DIN 3967

Number of teeth
015 = 15
018 = 18 etc.

Crowning
A = Standard

Helical angle
1 = 19.5283°, ascending to the right (Special)
2 = 0°
3 = 19.5283°, ascending to the left (Standard)

Concentricity tolerance
0 = Standard

Fig. 4.4 Ordering code

5 Delivery Status, Transport, Storage

5.1 Delivery status

Every toothed rack has been conserved all around and packaged.
Anti-corrosion agent is applied to the drive and to the factory-mounted pinion of the gearheads.
They are packed in film and boxes. The film and boxes can be recycled.
All gearheads are filled with lubricant during manufacture.

5.2 Transport

No special direction or position is prescribed to transport the drive system.
The total weight of the drive system is the combination of the weight of the gearhead with the pinion and the toothed racks. An assignment to the gearhead sizes can be found Table 4.2 in Chapter 4.2 „Weight“.

5.2.1 Transport using hoisting equipment

WARNING

Falling loads or breakage of sling equipment (e.g. ropes, chains, cables) may cause injury.
Ü Do not stand under suspended loads.
Ü Keep as safe a distance as possible from sling equipment.

CAUTION

Falling or hard dropping can damage the drive system.
Ü Only use hoists and attachment parts (e.g. ropes, chains) approved for the mass/weight of the drive system.
Ü Make sure that the load is slowly and carefully handled and placed.

5.3 Storage

The drive systems can be stored dry and in a horizontal position in the original packing for a maximum of 2 years at a temperature between 0 °C and +40 °C. For storage logistics, we recommend the "first in - first out" principle.

6 Mounting, initial operation

Ü Observe the instructions in the Chapter 3.3.1 „General safety instructions”.

WARNING

Risk of injury!
Sharp edges can cause cutting injuries.
Ü Wear protective gloves during assembly.

WARNING

Touching hot surfaces can lead to burns.
Ü Use suitable safety equipment (e.g. gloves) during assembly.

CAUTION

Avoid heat transfer to the toothed racks during assembly.
Ü Use suitable safety equipment (e.g. gloves) during assembly.

6.1 Toothed rack attachment

6.1.1 General information

CAUTION

The improper usage of clamping devices such as vises can damage the gear teeth of the toothed rack.

Ü Always use immediate layers of plastic or brass.

Depending on the application, the fitting surface should have a planarity of between 0.04 mm (machine base made of cast iron or steel) and 0.1 mm (machine base made of aluminum) for the surface the toothed rack should be screwed onto.

(High-) Performance Class / Premium Class / Value Class

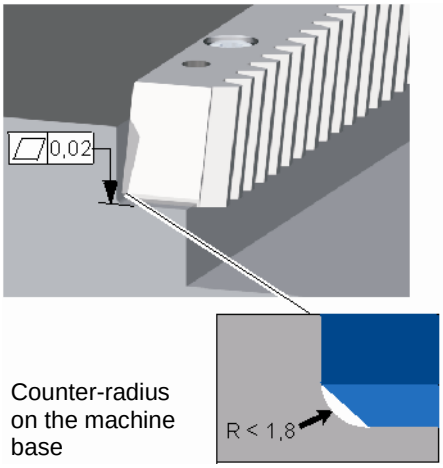


Fig. 6.1

The toothed rack has at the assembly edge a chamfered corner of 2x45° (Fig. 6.1). The machine base should be constructed in such a way that facilitates the clamping of the assembly of the toothed rack. This is achieved when the height of the stop edge is more than 50 % of the toothed rack height. The minimum height should not be less than 5 mm (note the corner chamfer).

The threaded holes for the fastening screws have to feature a sufficient screw-in depth depending on the material of the machine base.

Depending on the type of application, the stop surfaces in the machine base should feature a parallelism of no more than 30 mmeters to the sled guide (parallelism should lie within the prescribed parallelism tolerance of the manufacturer of rail guides). If you use stop rails, align them appropriately.

Smart Class

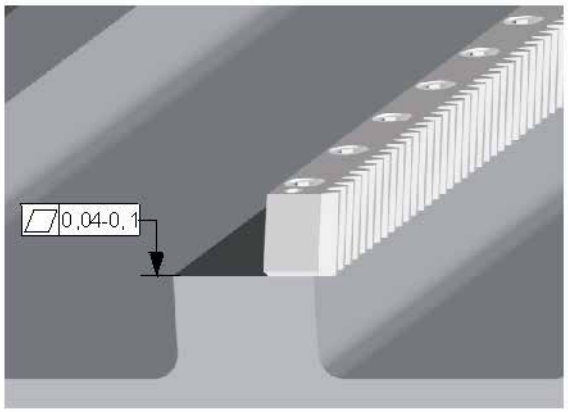


Fig. 6.2

The machine base should be constructed in such a way that toothed racks can be mounted easily. A stop angle for the free assembly is not necessary due to the higher fastening mode of the toothed rack.

The threaded holes for the fastening screws have to feature a sufficient screw-in depth depending on the material of the machine base.

The parallelism between 20 mm and 40 mm to the sled guide is achieved by with a distance piece (see Fig. 6.3) during assembly (the parallelism should lie ideally within the prescribed parallelism tolerance of the manufacturer of rail guides).

6.1.2 Preparing mounting

The drive system always has to be installed in a clean and dry environment. Coarse dust and liquids of all kinds impair its function.

To fasten the toothed racks, you need cylinder head screws and cylinder pins per toothed rack according to the Table 6.1 listed below.
The lengths of the screws and the pins depend on the construction of the machine base (not included in the scope of delivery from **WITTENSTEIN alpha GmbH**).

Module	Length	Class				Cylinder head screw DIN EN ISO 4762–12.9 (quantity x thread)	Tightening torque [Nm]	Quantity x cylinder pin with interior thread DIN 7979/DIN EN ISO 8735 Form A
		High-Performance	Premium	Smart	Value / Performance			
2	1000				X	8 x M6	15.4	2 x 6 m4
2	1000	X				16 x M6	15.4	3 x 6 m4
2	500		X			4 x M6	15.4	2 x 6 m4
2	480			X		8 x M8	37.3	2 x 8 m5
2	333		X			4 x M6	15.4	2 x 6 m4
2	167		X			2 x M6	15.4	2 x 6 m4
3	1000				X	8 x M8	37.3	2 x 8 m5
3	1000	X				16 x M8	37.3	2 x 8 m5
3	500		X			4 x M8	37.3	2 x 8 m5
3	480			X		8 x M10	73.4	2 x 8 m5
3	250		X			2 x M8	37.3	2 x 8 m5
4	1000				X[1]	8 x M8	37.3	2 x 8 m5
4	1000	X				16 x M10	73.4	2 x 8 m5
4	1000				X[2]	8 x M10	73.4	2 x 8 m5
4	507		X			4 x M10	73.4	2 x 10 m6
4	480			X		8 x M12	126	2 x 10 m6
5	1000				X	8 x M12	126	2 x 12 m8
5	1000	X				16 x M12	126	2 x 12 m8
5	500		X			4 x M12	126	2 x 12 m8
6	1000				X	8 x M16	310	2 x 16 m8
6	1000	X				16 x M16	310	2 x 16 m8
6	500		X			4 x M16	310	2 x 16 m8
8	480				X	4 x M20	604	2 x 20 m10
8	960				X	8 x M20	604	2 x 20 m10
8	960	X				15 x M20	604	3 x 20 m10

[1] only Value Class
[2] only Performance Class

Table 6.1

Ü Check the ordering codes (see Chapter 4.5) of all toothed racks. Use only toothed racks with the same ordering code for the same application. Observe the same identification for helix angle and height tolerance.

J Always enter the ordering code when ordering spare parts so that you receive precisely coordinated toothed racks and pinions.

The gearhead housing has through-holes for bolting to the customer's construction.

J Information on the attachment of the gearhead can be found in Chapter 6.2 and in the operating manual of the gearhead.

For the alignment of the transfers between the individual toothed racks, you need an assembly feeler gauge. For the final inspection with the dial gauge, you need a needle roller (metering roller).

J The order numbers for assembly feeler gauge and needle roller can be found under Chapter 11.1 or our Internet page: www.wittenstein-rack-pinion.com.

Smart Class

The bores in the machine base should have a tolerance of ±0.2 (absolute measurement).

Ü Manufacture a spacer especially for your machine (possible design, see Fig. 6.3).

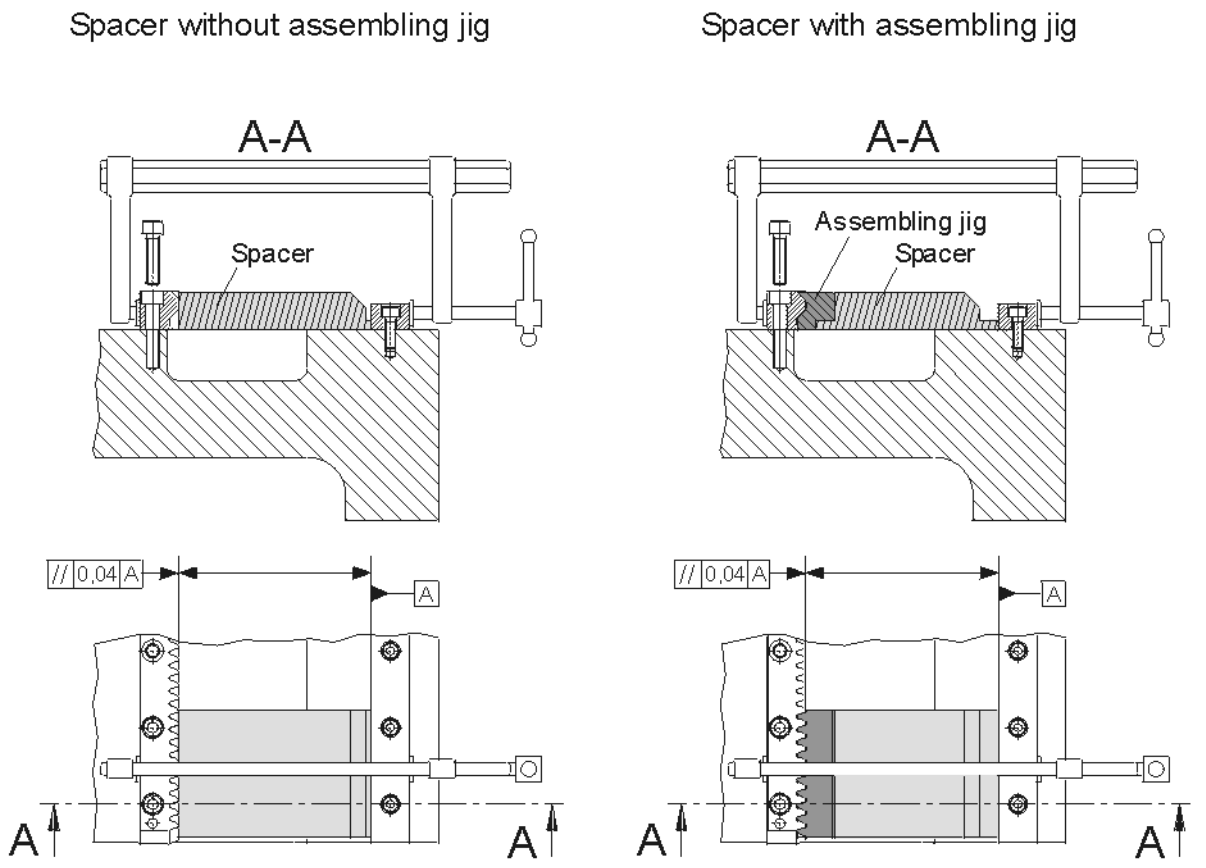


Fig. 6.3

6.1.3 Cleaning

Ü Observe the safety and processing instructions of the cleaning agents to be used.

Ü Remove all traces of the anti-corrosion agent before mounting the toothed racks. Use a clean cloth moistened with a suitable cleaning agent (fat dissolving but non-aggressive, e.g. with Aceton, Fig. 6.4).
Ü Clean the spacer (for Smart Class).
Ü Clean the guide bed's stop angles or otherwise the surfaces to be screwed onto and rub them with an oil stone.

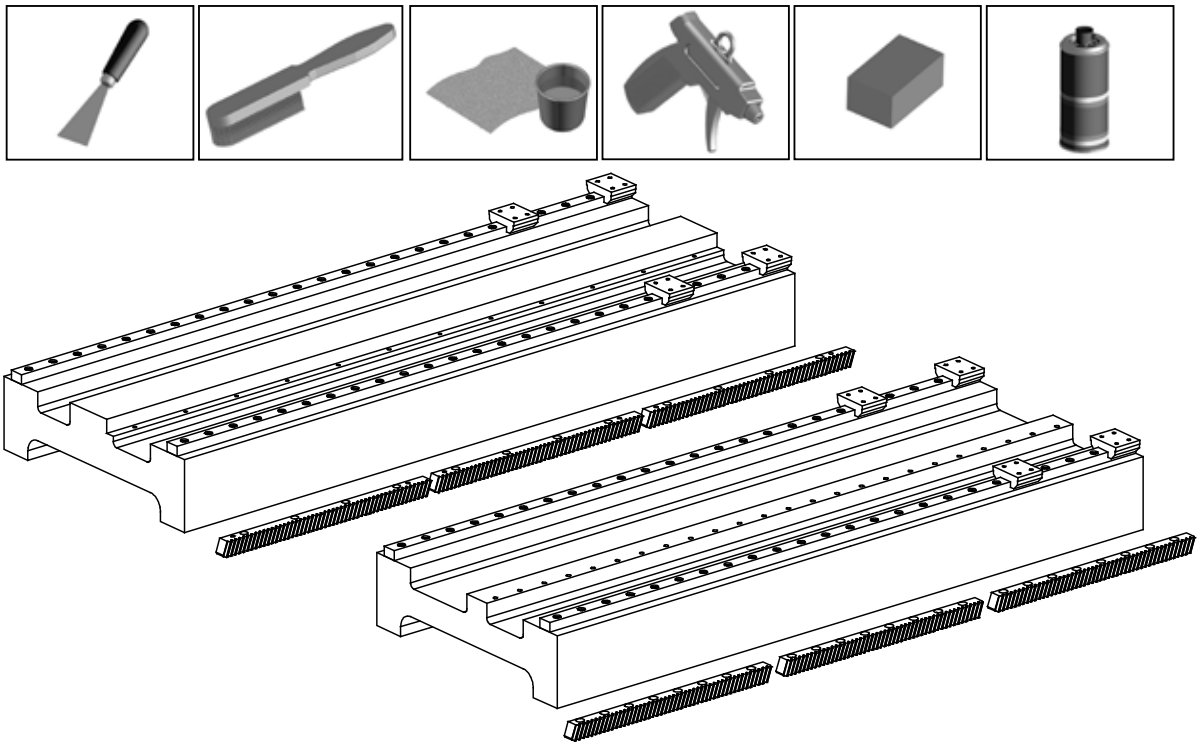
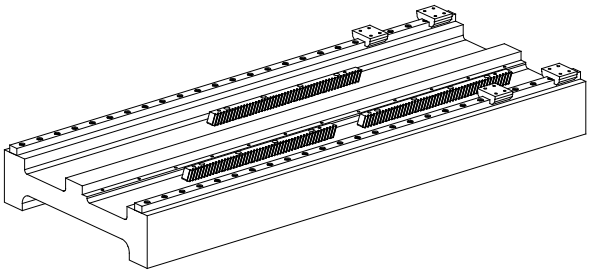


Fig. 6.4

After the cleaning



Ü Place the toothed racks onto the machine base for at least four hours so that the temperatures can equalize.

Fig. 6.5

6.1.4 Mount first toothed rack

Ñ An optimal alignment is achieved by aligning the stop rails to the guide sled beforehand.

(High-) Performance Class / Premium Class / Value Class

Ü Put on the first toothed rack and position it in the middle of the machine base over the corresponding threaded boreholes.
Ü Clamp the toothed rack to the machine base in the area of the fastening bores (e.g. with vises).
Ü Insert the first cylinder head screw.
Ü Tighten the cylinder head screws with the predetermined tightening torque (see Table 6.1 in Chapter 6.1.2), while the clamping device (in the following simply called vise) holds the position.
Ü Repeat the previous steps for the remaining cylinder head screws (see Table 6.1 in Chapter 6.1.2).
Ü Remove the vises.

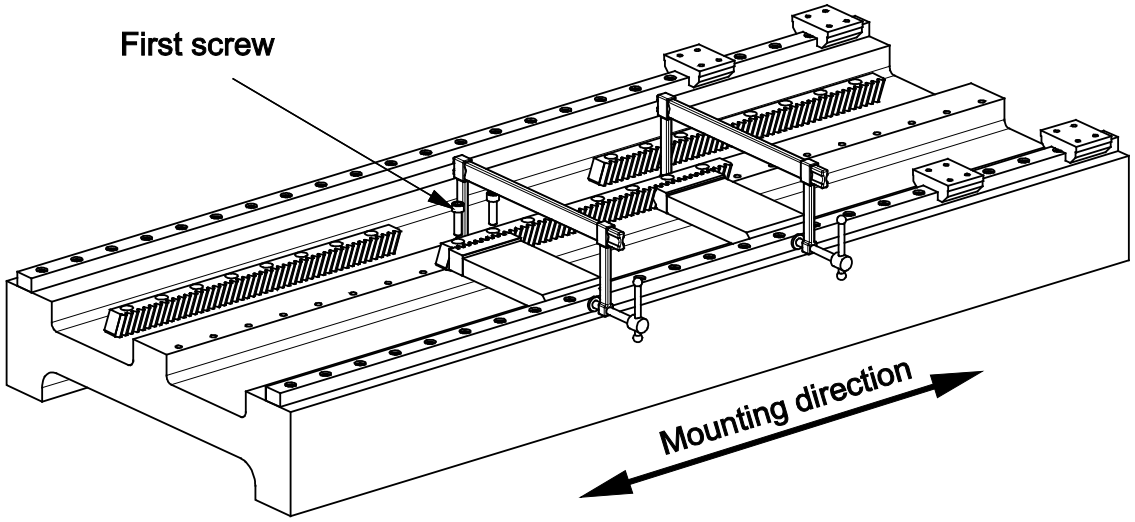


Fig. 6.6

Smart Class

- Ü Put on the first toothed rack and position it in the middle of the machine base over the corresponding threaded boreholes.
- J For precise positioning, clamp an assembly feeler gauge with spacer (see Fig. 6.3 in Chapter 6.1.2) between toothed racks and guide rail.
- Ü Clamp the toothed rack with the help of a spacer slightly against the reference rail angle (guide rail) in the area of the fastening bore (e.g. vises).
- Ü Insert the first cylinder head screw.
- J To secure the cylinder head screws, we recommend using a threadlocker (e.g. Loctite 243).
- Ü Tighten the cylinder head screws with the predetermined tightening torque (see Table 6.1 in Chapter 6.1.2), while the clamping device (in the following simply called vise) holds the position.
- Ü Repeat the previous steps for the remaining cylinder head screws (see Table 6.1 in Chapter 6.1.2).
- Ü Remove the vises.

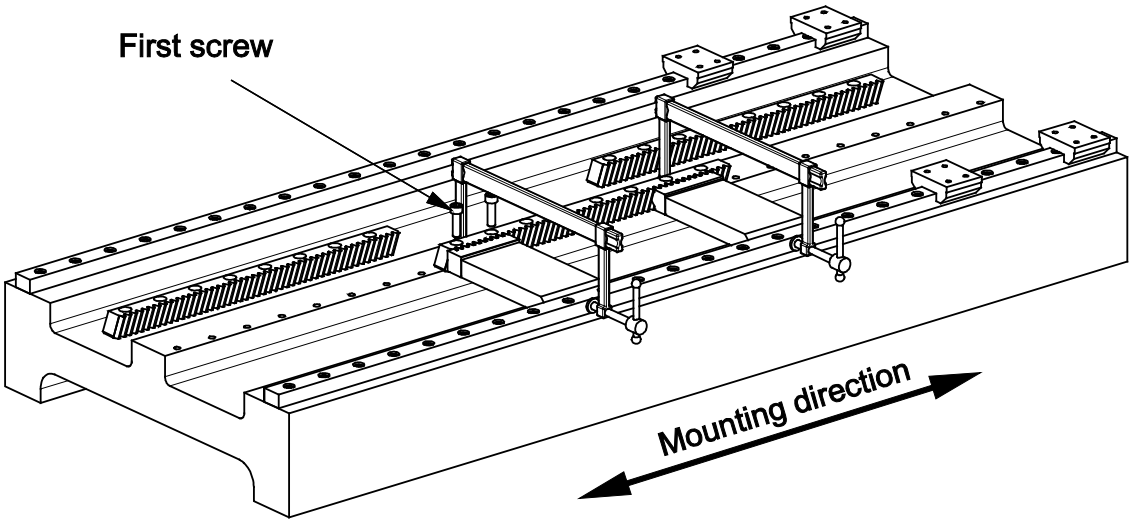


Fig. 6.7

6.1.5 Mount following toothed racks

Ñ Due to too much pressing force of the assembly feeler gauge for the connection of two toothed racks, the toothed rack gap can widen. The assembly feeler gauge should serve only as an insert between two toothed racks.

(High-) Performance Class / Premium Class / Value Class

Ü Put on the next toothed rack and position it over the corresponding fastening boreholes.
Ü Position the assembly feeler gauge and clamp it slightly.
Ü Clamp the toothed rack to the machine base in the area of the fastening bores.
Ü Insert the first cylinder head screw in assembly direction.
J To secure the cylinder head screws, we recommend using a threadlocker (e.g. Loctite 243).
Ü Tighten the cylinder head screws with half of the predetermined tightening torque (see Table 6.1 in Chapter 6.1.2).
Ü Repeat the previous steps for the remaining cylinder head screws.
Ü Loosen all vises and the assembly feeler gauge.
Ñ For checking, hold the assembly feeler gauge in the transfer point of the two toothed racks. The toothed racks are optimally aligned to each other when the assembly feeler gauge can be put on without backlash.
Ñ Check the levelness of the butt joint as described in Chapter 6.1.6 before you mount the next toothed rack.

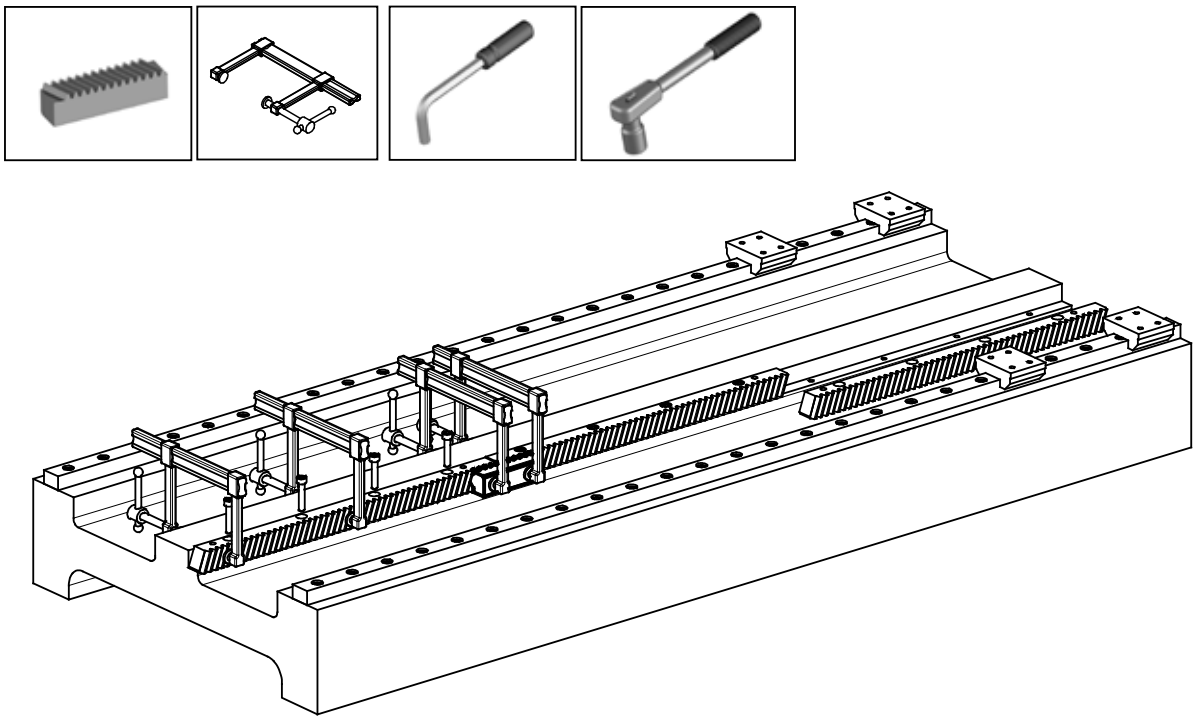
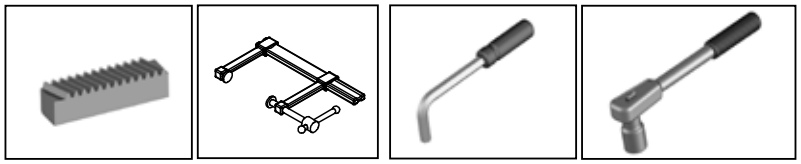


Fig. 6.8

Smart Class

- Ü Place the next toothed rack and position it centrally over the corresponding fastening boreholes.
- Ü Place the spacer between the toothed rack and the guide rail and clamp the toothed rack against the spacer and guide rail (e.g. with a vise). The clamping force should be selected so that a later taking out of the assembly aid (spacer with or without assembly feeler gauge) can be done easily after the screwing in.
- Ü Insert the first cylinder head screw in assembly direction.
- Ü Tighten the cylinder head screw with the predetermined tightening torque (see Table 6.1 in Chapter 6.1.2) and repeat the previous steps for the remaining cylinder head screws.
- J You can check the levelness of the butt joint as described in Chapter 6.1.6 (Premium Class / Value Class / Performance Class) before you mount the next toothed rack.
- Ü Repeat the previous steps for the remaining toothed racks.



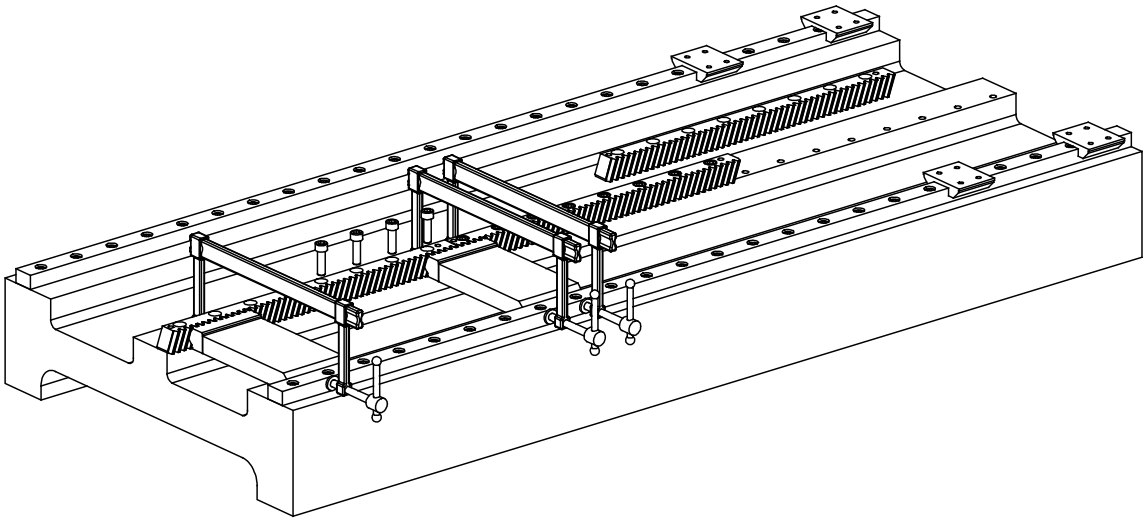


Fig. 6.9

6.1.6 Checking during assembly

Ü Check the levelness of the butt joint before the next toothed rack is placed.

(High-) Performance Class / Premium Class / Value Class

Possible procedure:

Ü Fasten the dial gauge holder on the machine sled.
J The needle roller can be positioned easier if you magnetize it beforehand or place a magnet on the toothed rack.
Ü Place the needle roller in the butt joint (B) and in the gearing to the left (A) and right (C) of that (see Fig. 6.10) and measure the respective height deviation.
Ñ The permitted height deviation from toothed rack to toothed rack may be about 30 µm. The butt joint (B) should lie between highest and lowest measure (A and C) of the toothed racks.
Ü In case of deviation, align the parallelism to a minimum by achieving the desired height tolerance on the dial gauge with strikes on a copper punch on the first screw-on bore in or counter the assembly direction to the previous toothed rack.
J Due to the narrow height tolerance limitations, no assembly alignments is necessary as a rule if the corresponding parallelism of the reference surface to the guide rail is given (see prescribed parallelism tolerance of the manufacturer of rail guides).
Ü After successful checking of the butt joint, clamp only the vises tight again and tighten the cylinder head screws with the full tightening torque (see Table 6.1 in Chapter 6.1.2).
Ü Repeat the previous steps for the remaining toothed racks (Fig. 6.8).
Ü Remove the vises.

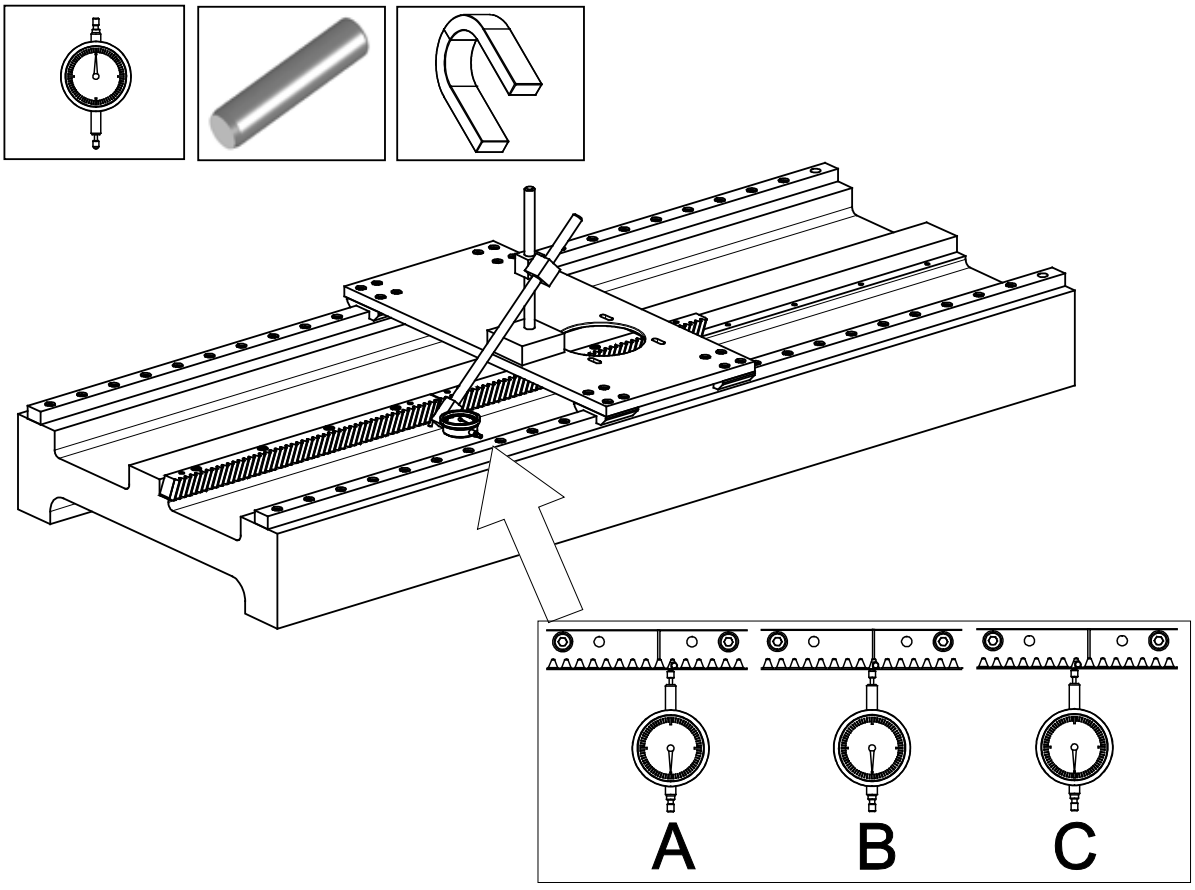


Fig. 6.10

Checking the planarity

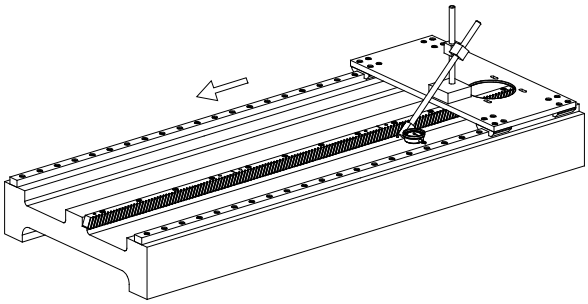


Fig. 6.11

- Ü Fasten the dial gauge holder on the machine sled and move it in the direction of the outer toothed rack.
- Ü Place the needle roller in any tooth base.
- Ü Position the dial gauge on the needle roller and set the dial gauge to zero.
- Ü Mark the measuring point (reference point) with a pin on the toothed rack.

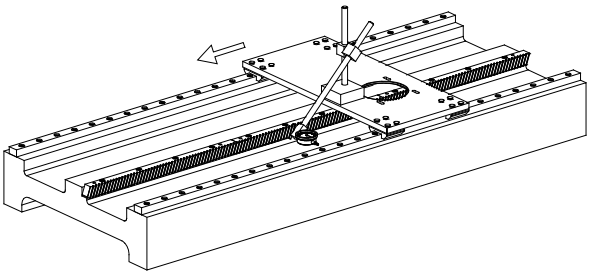


Fig. 6.12

- Ü Move the machine table into the next measuring position.
- Ü Place the needle roller again in a tooth base.
- Ü Check the deviation now to the precious dimension.
- Ü Mark the measuring point and note the deviation on the toothed rack.
- Ñ The permitted height deviation may be about 30 µm.

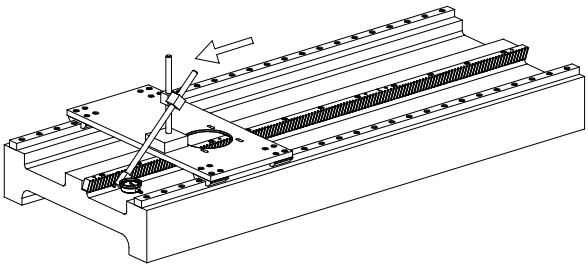


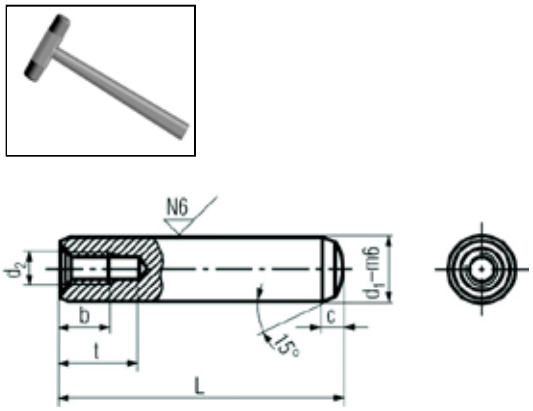
Fig. 6.13

- Ü Repeat the procedure for further measuring points.
- Ü Specify the highest measuring point of the entire movement range. You need this measuring point for the gearhead assembly.

6.1.7 Pinning the mounted and aligned toothed rack

(High-) Performance Class / Premium Class / Value Class

- Ü Clamp the toothed rack tight at all pin holes with vises so that no deformations can occur (Fig. 6.15).
- Ü Drill pin holes into the machine base according to the toothed rack bores.
- Ü Grind open the bores together to the corresponding fit size for the cylinder pin for the cylinder pin (see Table 6.1 in Chapter 6.1.2).
- J Remove the accumulating chips with a suction tube.



- J For an easier disassembly, we recommend the cylinder pins with internal treads (Fig. 6.14).
- Ü Fixate the toothed racks finally with cylinder pins.
- Ü If a pinning of the toothed racks is not possible from the assembly point of view, consult our Customer Service department (see 1.1).

Fig. 6.14

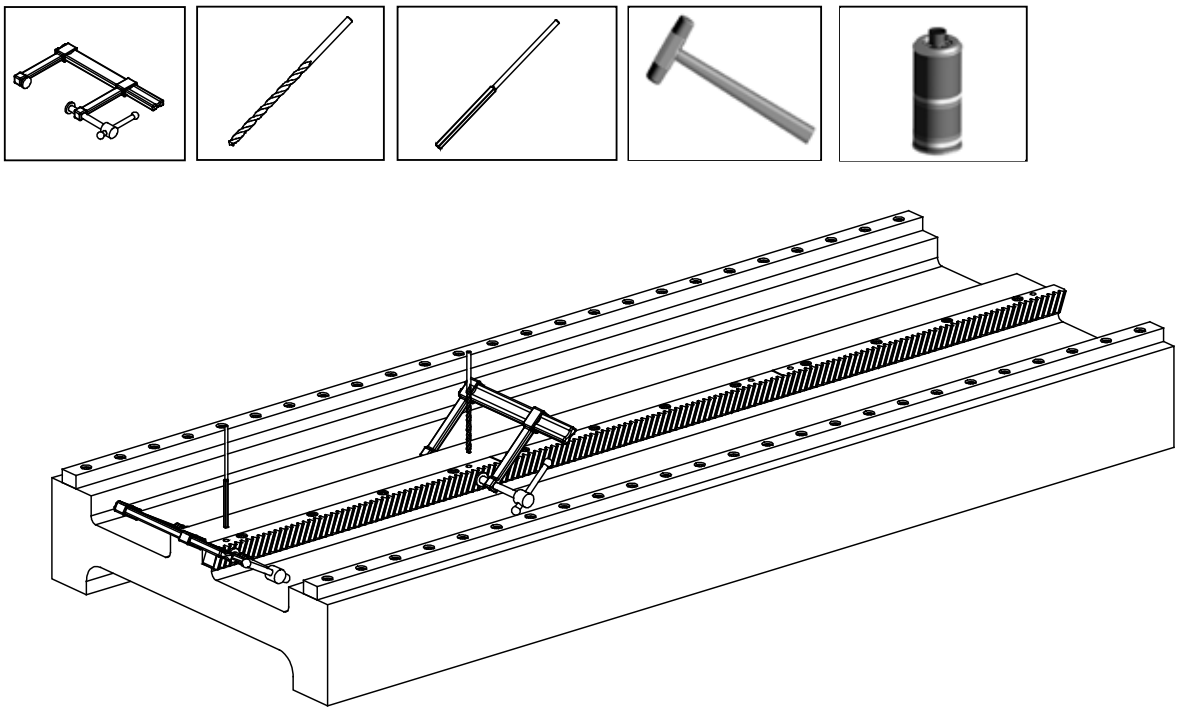


Fig. 6.15

6.2 Mounting the gearhead

The gearhead is delivered complete with the mounted pinion. To ensure an easy assembly procedure, we recommend not mounting the motor until you have checked the running characteristics (Chapter 6.2.1).
The machine table should be constructed in such a way that assembly and aligning (e.g. with an adjustment device) should be easy.

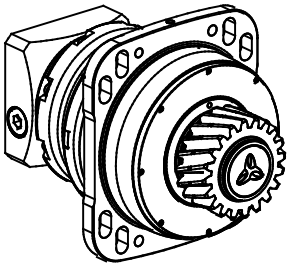


Fig. 6.16 RP+

When employing an RP+ gearhead no additional adjustment is necessary. In order to ensure a proper setting of the gearing, carry out the following steps.

J Further information on the assembly and connection construction of the RP+ gearhead can be found in the "Operating manual RP+".

Check for right angularity

Ü Depending on the mounting position, check the right angularity between the sled and the toothed rack back or otherwise the tooth crests.

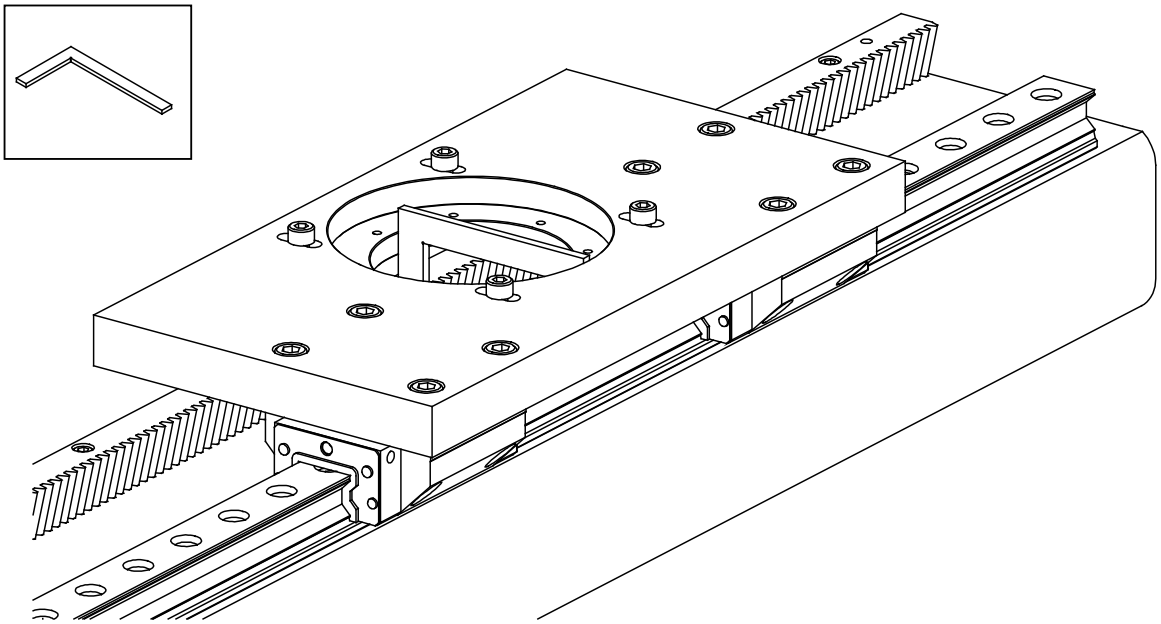


Fig. 6.17

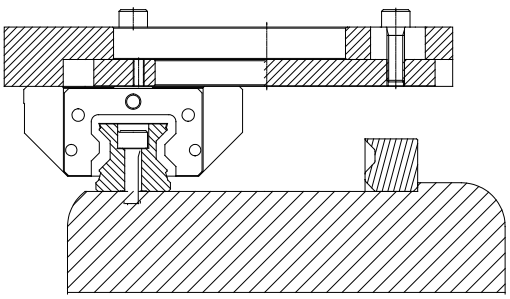
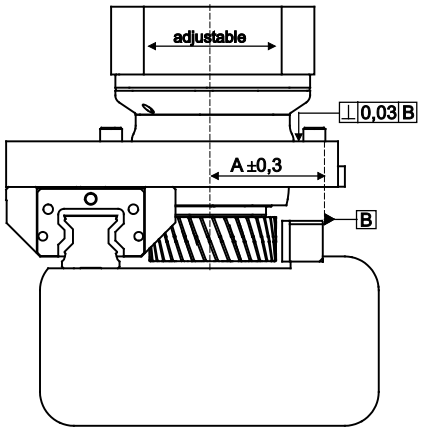


Fig. 6.18 Cross-section of the adjustment device



Refer to our catalogue or our Internet page for the added measure "A": www.wittenstein-rack-pinion.com.

Fig. 6.19

Inserting the gearhead at the highest point

The gearhead can be installed in any mounting position without adjusting the lubricant quantity. On Premium Class / Value Class / Performance Class pinions, the highest point has been marked in the factory.

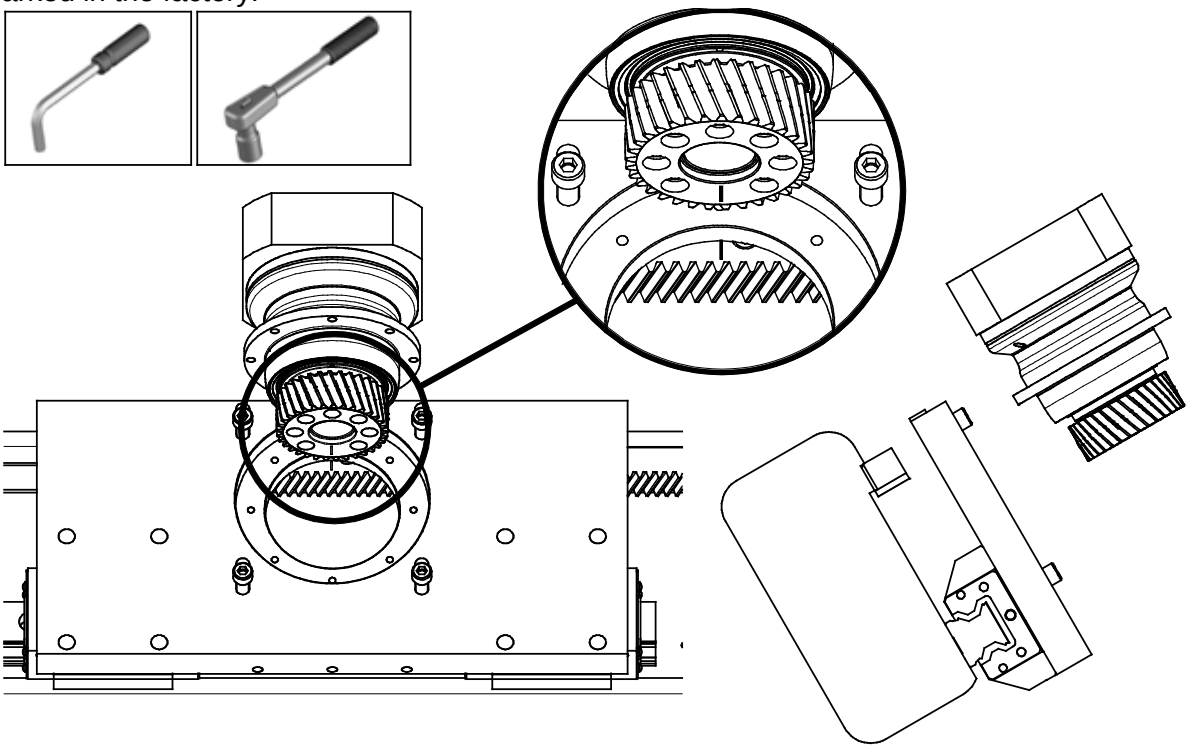
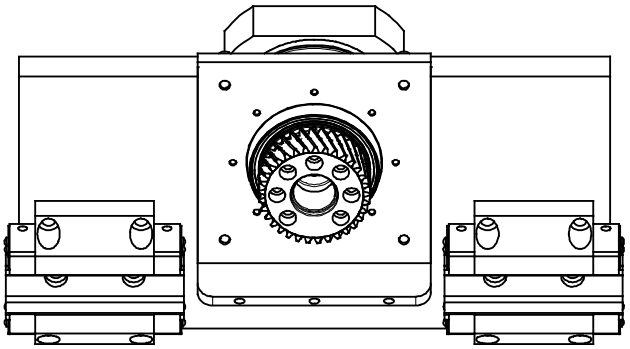


Fig. 6.20

- Ü Align the "highest point" markings of the toothed rack and pinion to each other.
- Ü Insert the gearhead into the adjustment device at the sled.
- Ü Coat the screws with threadlocker and screw the gearhead to the adjustment device.

Example for the feed mechanism



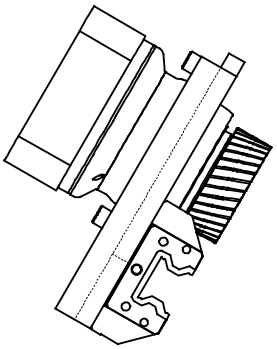
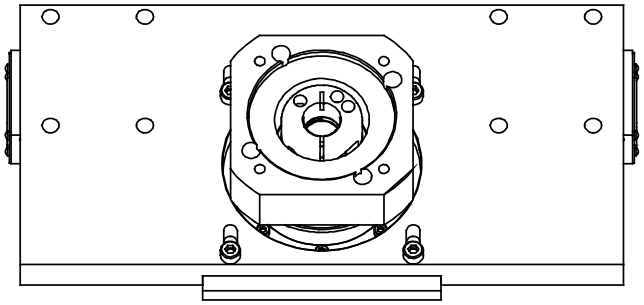


Fig. 6.21



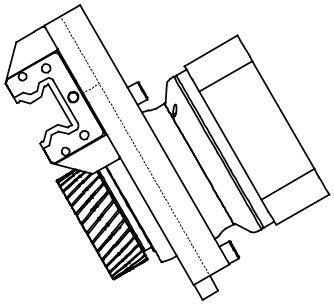
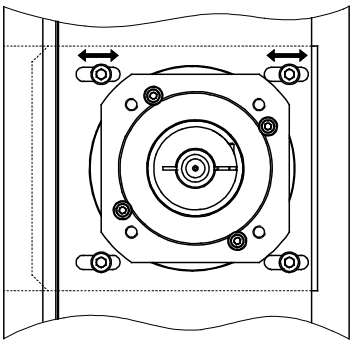
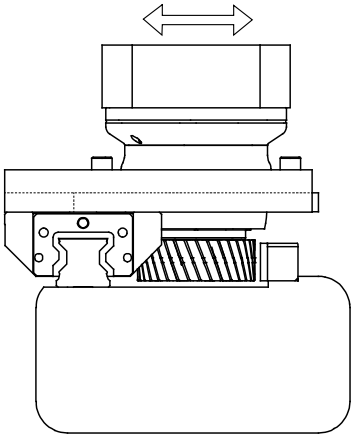


Fig. 6.22

Feed in the gearhead





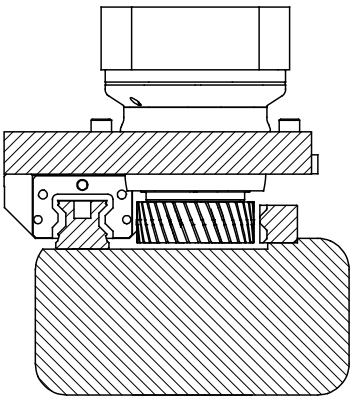


Fig. 6.23

Ü Press the adjustment device or otherwise the pinion-gearhead unit manually into the gearing until the pinion fits into the toothed rack without backlash.

Ü Fixate the position of the adjustment device or otherwise the pinion-gearhead unit.

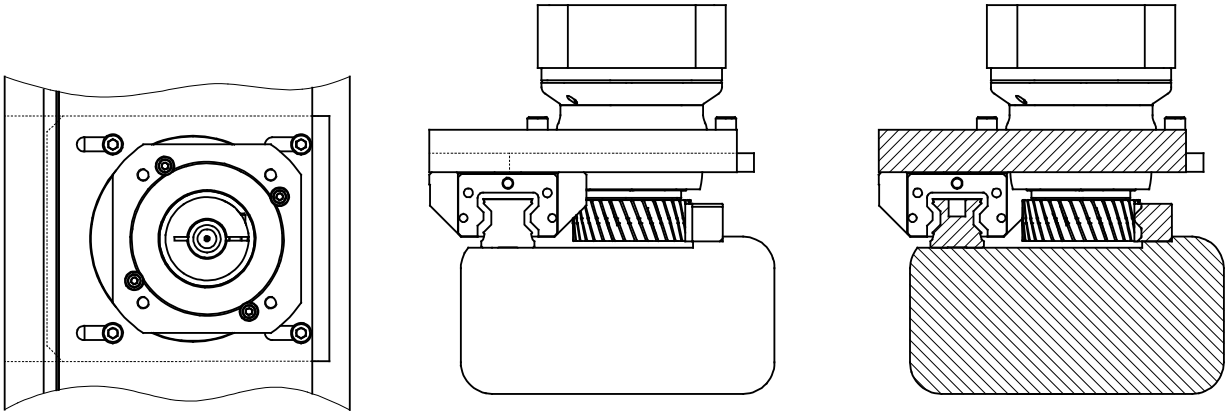


Fig. 6.24

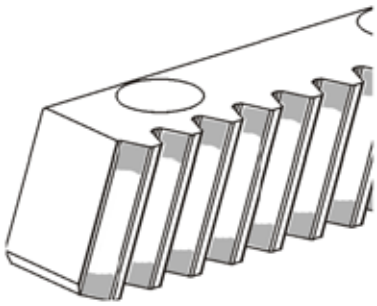
With this hand-tight pretensioning, a flank play is possible in some segments of the travel path.

Final inspection

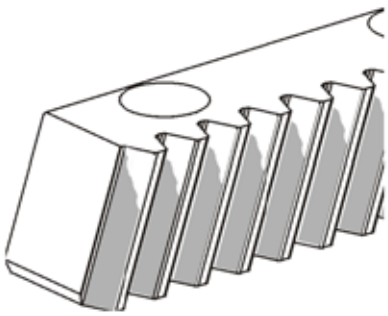
Ü Observe the safety and processing instructions of the cleaning agents to be used.

Fig. 6.25

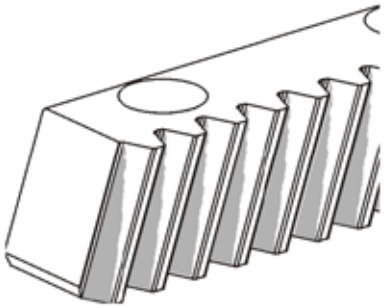
Ü De-grease the tooth flanks of the toothed rack (e.g. with Aceton).
Ü Coat the tooth flanks with gear marking compound or with a water-proof pen.
Ü Move the sled several times so that the pinion runs over the coated tooth flanks.
Ñ Check thereby that the gearing runs smoothly.
Ñ Check in which range the color is removed from the tooth flanks.
Ñ Evaluate the alignment of the gearhead based on the following illustrations.
Ü It necessary, correct the alignment of the gearhead.
J Oil or grease all blank parts with a cloth against corrosion.



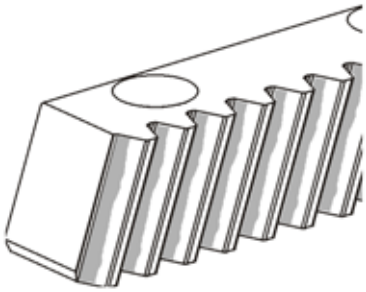
Correct



Not right-angled



Not parallel



Wrong center distance

6.2.1 Check the running characteristics after assembly

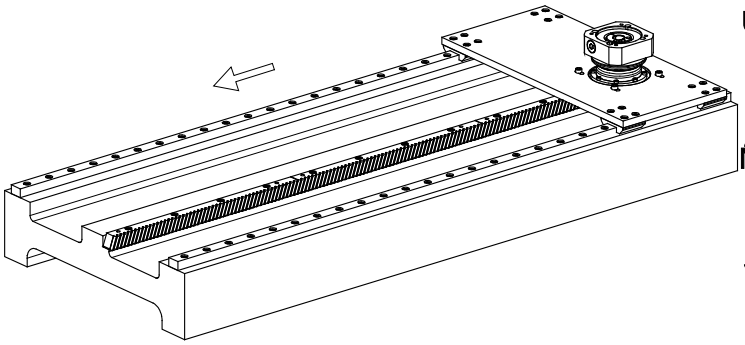


Fig. 6.26

Ü Move the sled several times across the entire movement range so that the pinion runs over the tooth flanks.

Ñ The exerted force and the running noise need to remain the same.

J Use a hand wheel or crank for that that you connect to the clamping hub in the gearhead. Consult our Customer Service department (see 1.1) to receive further information.

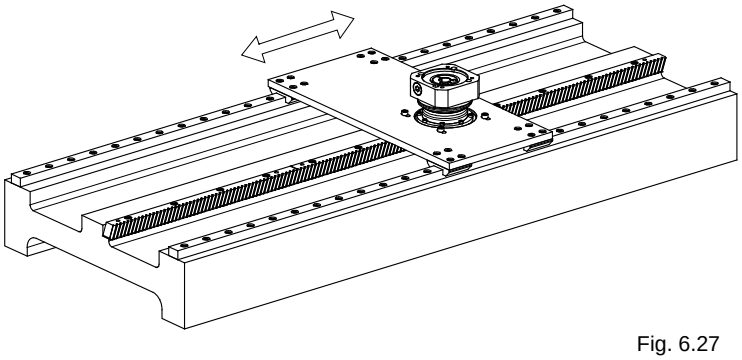


Fig. 6.27

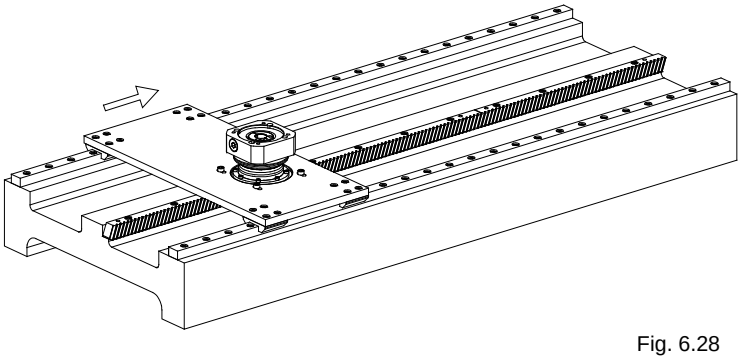


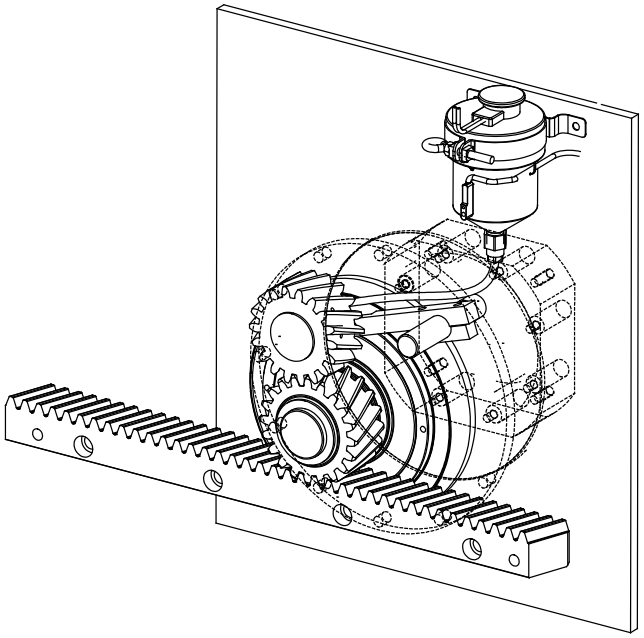
Fig. 6.28

6.3 Mounting the lubricator

Ü Observe the instructions of the lubricator and in the Chapter 3.3.1 „General safety instructions“.

The lubricating system consists of an automatic lubricator (grease cup), a lubricating felt pinion, with fastening axis, and a prefilled plastic hose. Additionally a sensor kit provides the fill-level monitoring.

J Further information for on the lubricator can be found in the instructions of the lubricator.



6.29

J The fastening axis of the lubricating felt pinion has a threaded tenon on the back side. Position the lubricating felt pinion so that it meshes into the pinion / the toothed rack and fasten it.

J Refer to our catalogue or our Internet page for specifications on the installation dimensions: www.wittenstein-rack-pinion.com.

CAUTION

Unlubricated startup of the drive system damages the gearing.

Ü Grease the toothed rack and the pinion before startup.

Ü For some time before the startup, thoroughly grease the lubricating felt pinion, because the lubricating felt pinion is not steeped in grease. Use the same grease for that as that of the lubricator.

A prefilled plastic hose serves as a lubricant line. The maximum supplied length may not be exceeded. For grease lubrication, the hose may have a maximum length of 2 meters.

J Specifications for lubricants and operating temperatures can be found in Chapter 4.3.

Divergent operating conditions may make different lubricant quantities and different lubricants necessary.

Ü In such cases consult our Customer Service department (see 1.1).

Ü Mount the lubricator at a suitable location; keeping the maximum hose length in mind.

Ü Use the filled plastic hose or fill your feed line bubble-free with our lubricant.

Ü Mount the filled plastic hose between the lubricator and the lubricating felt pinion. Position the filled plastic hose so that it cannot be kinked during operation.

Ü Observe the center distance between pinion and lubricating felt pinion.
The following formula is used for calculating the center distance:

$$\text{Center distance} = \frac{\text{d lubricating felt pinion} + d_W \text{ pinion}^{a)}}{2}$$

or

$$\text{Center distance} = \frac{\text{d lubricating felt pinion}}{2} + \text{h toothed rack}$$

[a)] d_W pinion = d pinion + 2 * x * m

d pinion = Reference circle diameter pinion [mm]
x = Profile shift factor
m = Normal module [mm]

7 Operating conditions for rack&pinion system

CAUTION

Too little lubrication damages the gearing.
Ü Always make sure that there is sufficient lubrication and exchange the lubricator in time.

Ü Observe the correct alignment between gearhead unit and toothed rack.
Ü The guide sled (horizontal) should be movable by hand in idle (brake lifted and no power to the controller) evenly across the travel length.
Ü Should any jamming occur, the distance between toothed rack and guide should be measured again with a dial gauge.

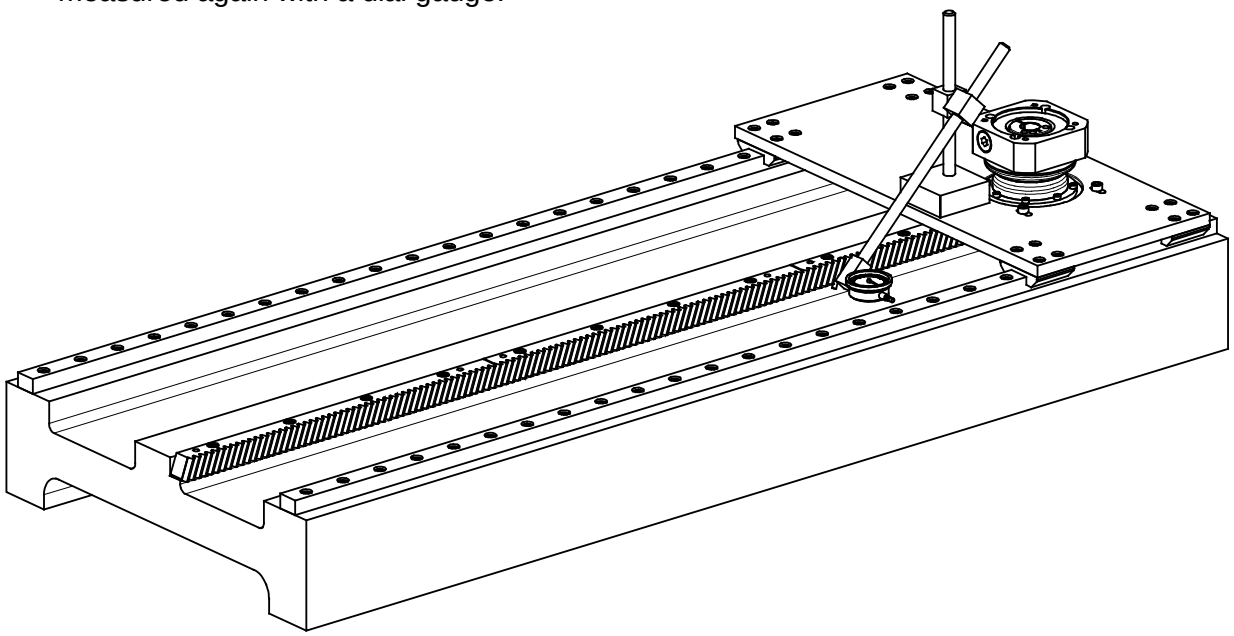


Fig. 7.1

8 Maintenance

DANGER!

Improperly executed work can lead to injury and damage.

Ü Ensure that the drive system is only installed, maintained, and dismantled by trained technicians.

8.1 Shutdown, preparation

Ü Observe the instructions in the Chapter 3.3.1 „General safety instructions“.
Ü Shut down the machine that contains the drive system.
Ü Disconnect the machine from the mains before starting maintenance work.

8.2 Inspection schedule

Maintenance work / see Chapter...	Maintenance periods		
	At startup	After 500 operating hours or 3 months	Every 3 months
Visual inspection / 8.3.1	**X**	**X**	**X**
Checking the lubrication system / 8.3.2	**X**	**X**	**X**
Checking the lubricating felt pinion / 8.3.3	**X**	**X**	**X**

Table 8.1

8.3 Maintenance work

8.3.1 Visual inspection

Ü Check the entire drive system by carrying out a thorough visual inspection for exterior damage and lubricant leakage.
Ü Repair or replace defective or leaky parts immediately.
J For special information on maintenance-related issues, contact our Customer Service department (see 1.1).

8.3.2 Checking the lubrication system

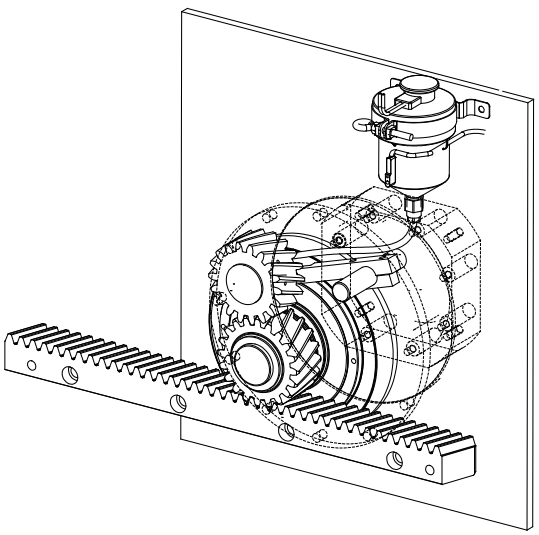


Fig. 8.1

Ü Check the entire lubrication system by carrying out a thorough visual inspection for exterior damages such as loosened or defective hoses and worn or soiled (plugged) lubricating felt pinions.
Ü Replace damaged or soiled parts immediately to ensure a continuous lubrication.
J The service life of the lubricating felt pinion depends on the ambient conditions. In case the lubricating felt pinions wear down or get soiled quicker during their application, the inspection intervals need to be shortened accordingly.

Ü Check the fill level in the lubricator. If necessary, replace the lubricant immediately.
Ü Even when the control light of the battery is still flashing, the lubricator ought to be replaced after two years for the sake of process reliability.

8.3.3 Checking the lubricating felt pinion

Ü Check the lubricating felt pinion by carrying out a thorough visual inspection for exterior damage.

8.4 Replacing the toothed rack

WARNING

Risk of injury!
Sharp edges can cause cutting injuries.
Ü Wear protective gloves during assembly.

CAUTION

Avoid heat transfer to the toothed racks during assembly.
Ü Use suitable safety equipment (e.g. gloves) during assembly.

CAUTION

Improper replacement of a toothed rack can cause damage to the drive system and the neighboring parts.
Ü Make sure that the toothed rack is replaced only by trained technicians.

8.4.1 Disassembling the toothed rack

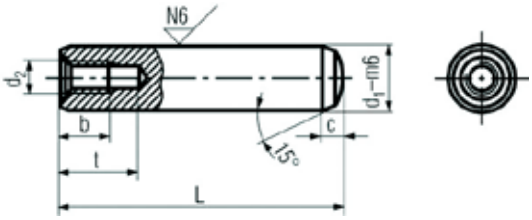


Fig. 8.2

Ü Loosen all fastening screws and remove the toothed rack with a suitable tool (see example, Fig. 8.2) out of the pinned fitting.
Ü Remove the toothed rack with care, so as to safeguard the drive system and adjacent parts against damage.

8.4.2 Mounting the toothed rack

Ü Use only toothed racks with the same ordering code for the same application. Observe the same identification for helix angle and height tolerance.
Ü Carry out the assembly of the new toothed rack as described in Chapter 6.1.
Ñ During the assembly of the toothed rack, check the transfers to the adjacent toothed racks.

8.4.3 Pinning the mounted and aligned toothed rack

Ü Clamp the toothed rack tight at all pin holes with vises so that no deformations can occur (Fig. 6.15).
Ü Drill pin holes into the machine base according to the toothed rack bores.
Ü Select the next larger cylinder pin than specified in Chapter 6.1.2, Table 6.1.
J Only the standard sizes are specified in Table 6.1.
Ü Grind open the bores together to the corresponding fit size.
J For an easier disassembly, we recommend the cylinder pins with internal treads (Fig. 6.14).
Ü Fixate the toothed racks finally with cylinder pins.
Ü If a pinning of the toothed racks is not possible from the assembly point of view, consult our Customer Service department (see 1.1).

8.5 Startup after maintenance work

- Ü Clean and grease the toothed racks and the pinion.
- Ü Attach all safety devices.
- Ü Do a test run before re-releasing the machine for operation.

8.6 Malfunction list (troubleshooting)

- Ü Take action immediately in case of lubricant loss, increased operating noise, increased operating temperatures, frictional corrosion on tooth flanks, broken teeth or position deviations become noticeable within the travel path.

Fault	Possible cause	Solution
Increased operating temperature	Dimensioning insufficient	Check the technical specifications.
	Motor is heating the gearhead	Check the wiring of the motor, replace the motor or provide adequate cooling
	Ambient temperature too high	Ensure adequate cooling.
Increased operating noises	Distorted motor/gearhead unit	Consult our Customer Service department.
	Damaged bearings	
	Gearing damage	
	Distorted rack&pinion unit	
Loss of lubricant	Lubricant quantity too high	Change the settings on the lubricator and wipe away excess lubricant. Information for setting the automated lubrication amount/duration can be found in the instructions of the lubricator.
	Seals not tight	Consult our Customer Service department.
Formation of bubbles in the lubricant feed line	Lubricant quantity too low	Change the settings on the lubricator. Information for setting the automated lubrication amount/duration can be found in the instructions of the lubricator. As an alternative, the use of a check valve is possible. Contact our Customer Service department for this.
Frictional corrosion on tooth flanks	Defective lubrication	Mount a lubricating felt pinion to the output pinion or the toothed rack. Make sure on short travel paths that output pinion / toothed rack are lubricated sufficiently. Information for setting the automated lubrication amount can be found in the instructions of the lubricator.
	Ambient influences	The toothed rack always has to be installed in a clean and dry environment and protect the toothed rack against outer influences (e.g. chips, cleaning agents).
	Wrong lubricant	Use only lubricants that have been approved by us.

Fault	Possible cause	Solution
Broken teeth	Overload	Check the specifications and emergency off parameters.
	Machine collision	
	Foreign medium	Check the output pinion / toothed rack for possible foreign medium (e.g. chips, forgotten assembly tools)
	Lubrication faults	Always make sure that there is sufficient lubrication and exchange the lubricator in time. Information for setting the automated lubrication duration can be found in the instructions of the lubricator.
	Pittings	
	Missing parallelism	Check the parallelism of the linear guide to the stop angle
	Wrong alignment between output pinion and toothed rack	Correct the alignment of the gearhead.
Position deviation or great flank backlash within the travel path	Wrong alignment between output pinion and toothed rack	Correct the alignment of the gearhead.

Table 8.2

9 Disassembly

DANGER!

Improperly executed work can lead to injury and damage.

Ü Ensure that the drive system is only installed, maintained, and dismantled by trained technicians.

J The disassembly of the gearhead is described in the operating manual of the gearhead.

9.1 Preparation

Ü Shut down the machine that contains the drive system.

Ü Ensure that it is possible to dismantle the drive system without constituting a damage hazard for the whole machine.

Ü Before starting work, disconnect the machine from the mains.

9.2 Disassembling the toothed rack

Ü Carry out the disassembly of the toothed racks as described in Chapter 8.4.1.

10 Disposal

This section provides some instructions for the safe disposal of this product when it is no longer used.
If you have questions concerning environmentally safe disposal, please contact our Customer Service department (see 1.1).

J If you need additional information (e.g. disassembly or disposal) concerning the gearhead, consult our Customer Service department (see 1.1)

10.1 Lubricants

Environmental hazard

Lubricants (oils and greases) are hazardous substances that can contaminate soil and water.

Ü Dispose of the lubricant according to the valid national directives.
Ü Do not mix polyglycols with mineral oils that are meant for recycling.

10.2 Sealing rings

Ü Dispose of the sealing rings as composite material (metal/plastic).

10.3 Metal

Ü Divide up the drive system, if possible, into:
- iron
- aluminum (e.g. adapter plate), and
- non-ferrous heavy metal (e.g. motor windings).

11 Appendix

11.1 Assembly accessories

11.1.1 Assembly feeler gauge

Module	Designation
2	ZMT 200-PD5-100-004-L1
3	ZMT 300-PD5-100-004-L1
4	ZMT 400-PD5-100-004-L1
5	ZMT 500-PD5-100-004-L1
6	ZMT 600-PD5-100-004-L1
8	ZMT 800-PB6-240-008-L1

Table 11.1

11.1.2 Needle roller

Module	Diameter [mm]	Order number
2	$3.5\ ^{0}/_{-0,002}$	20001001
3	$5.0\ ^{0}/_{-0,002}$	20000049
4	$7.0\ ^{0}/_{-0,002}$	20038001
5	$9.0\ ^{0}/_{-0,002}$	20038002
6	$10.0\ ^{0}/_{-0,002}$	20038003
8	$14.0\ ^{0}/_{-0,002}$	20052298

Table 11.2

11.2 Tightening torques for common thread sizes in general mechanics

The specified tightening torques for headless screws and nuts are calculated values and are based on the following conditions:

- Calculation acc. VDI 2230 (Issue February 2003)
- Friction value for thread and contact surfaces μ=0.10
- Exploitation of the yield stress 90 %

Property class	Tightening torque [Nm] for threads...												
	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
8.8	1.15	2.64	5.24	8.99	21.7	42.7	73.5	118	180	258	363	493	625
10.9	1.68	3.88	7.69	13.2	31.9	62.7	108	173	265	368	516	702	890
12.9	1.97	4.55	9	15.4	37.3	73.4	126	203	310	431	604	821	1042

Table 11.1

WITTENSTEIN alpha GmbH
Walter-Wittenstein-Straße 1
97999 Igersheim

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www.wittenstein.de