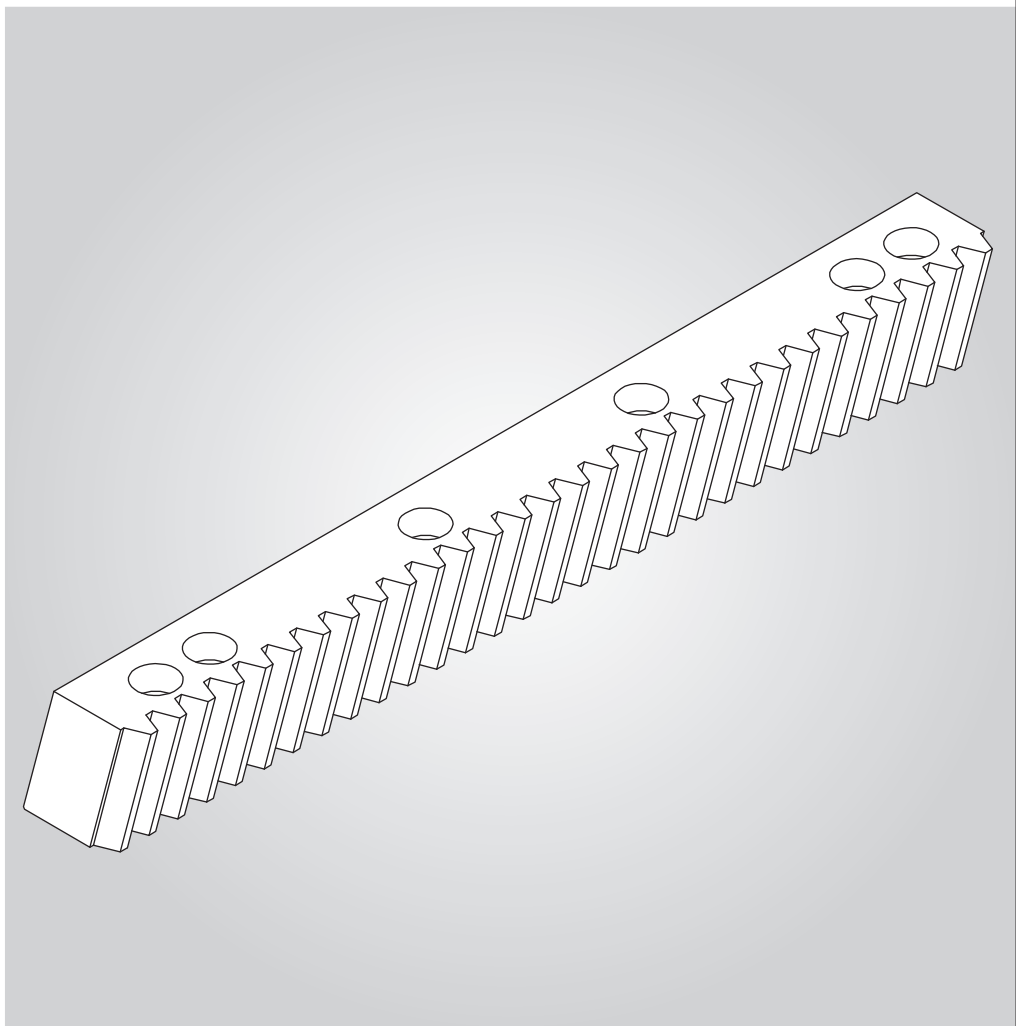


## OPERATING INSTRUCTIONS

### Rack



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# I General

## I.1 Purpose of the document

This operating manual describes the proper handling of Güdel racks:

- Transport
- Assembly
- Maintenance

The operating manual contains the required information on how to handle the rack in the intended manner.

### NOTE



**Read the entire operating manual before working with the racks! It contains important information for your personal safety. The operating manual must be read and understood by all persons who work on the rack in any of the product life phases.**

## I.2 Target readership

This operating manual is aimed at the following target readership:

- Specialists
  - Technician
  - Forwarding agent
- Operating company
- Operating personnel
- Service personnel

## 1.3 Characters / Explanation of abbreviations

The following symbols and abbreviations are used in this operating manual:

Symbol/ Abbreviation	Use	Explanation
	For cross-reference	Page
Fig.	Designates drawings	Figure
Tab.	Designates tables	Table

Tab. 1-1 Explanation of symbols/abbreviations

## 1.4 Torque tables

### 1.4.1 Tightening torques for screws

#### NOTE



**Screw connections on moving parts have to be secured with Loctite medium strength 242. The adhesive has to be applied onto the nut thread, not onto the screw!**

If no other specifications have been made, the following tightening torques apply for zinced screws lubricated with Molykote(MoS<sub>2</sub>) grease or secured with Loctite 242:

Thread size	Tightening torque [Nm]		
	8.8	10.9	12.9
M3	1.1	1.7	2.0
M4	2.6	3.9	4.5
M5	5.2	7.6	8.9
M6	9	13	15
M8	22	32	37
M10	42	62	72

Thread size	Tightening torque [Nm]		
	8.8	10.9	12.9
M12	74	108	126
M14	117	172	201
M16	180	264	309
M20	363	517	605
M22	495	704	824
M24	625	890	1041
M27	915	1304	1526
M30	1246	1775	2077
M36	2164	3082	3607

Tab. I-2 Torque table for zinced screws lubricated with Molykote(MoS<sub>2</sub>) grease

If no other specifications have been made, the following tightening torques apply for black oiled and unlubricated screws, or screws secured with Loctite 242:

Thread size	Tightening torque [Nm]		
	8.8	10.9	12.9
M4	3	4.6	5.1
M5	5.9	8.6	10
M6	10.1	14.9	17.4
M8	24.6	36.1	42.2
M10	48	71	83
M12	84	123	144
M14	133	195	229
M16	206	302	354
M20	415	592	692
M22	567	804	945
M24	714	1017	1190
M27	1050	1496	1750

Thread size	Tightening torque [Nm]		
	8.8	10.9	12.9
M30	1420	2033	2380
M36	2482	3535	4136

Tab. I-3 Torque table for black oiled and unlubricated screws



## 2 Product description

### 2.1 Purpose

#### 2.1.1 Intended use

Güdel Rack are intended exclusively for transmission of linear movements.

Any other or additional use is not considered to be use in the intended manner. The manufacturer assumes no liability for any resulting damages. All risks are carried solely by the user!

#### 2.1.2 Non-intended use

Any other use shall be considered improper use and is prohibited!

Do not modify the racks in any way.

### 2.2 Technical data

Technical data is to be found with the corresponding order. Depending on the configuration, special operating conditions are to be observed.

*Temperature ranges* The following temperature ranges apply in general:

Transport	-10 to +60°C
Operation	+10 to +60°C
Storage	0 to +40°C

*Tab. 2-1 Temperature ranges*

For temperatures below 0°C, we recommend Duralloy coated racks and pinions as well as zinc plated fastening screws.

## 3 Safety

For general information on safety, refer to the corresponding instructions relating to the use of the racks.


### NOTE



**Read this chapter prior to working with the rack! It contains important information for your personal safety. This chapter must be read and understood by all persons who work on the rack in any of the product life phases.**

### 3.1 Fundamentals of safety

#### 3.1.1 Intended use

The intended use is described in chapter 2.1.1 'Intended use',  9.

### 3.1.2 Product-specific hazards

#### Danger from falling axles/workpieces

##### WARNING

##### Suspended loads



Improper handling of suspended loads can lead to severe injuries or death!

Observe the following:

- Use appropriate lifting units
- Wear appropriate protective clothing
- Always keep sufficient distance to suspended loads
- Never enter the area below a suspended load

##### WARNING

##### Heavy components



Components can be very heavy. Improper handling can cause severe or fatal injuries!

Use appropriate lifting units!

## 4 Transport

The racks are transported by air, land or water. The packaging depends on the means of transport.

Truck = Shipped on a transport pallet or case

Aircraft = Shipped in a crate

Ship = Shipped in a case or container

### NOTE



#### Improper transport

Improper handling of the package can lead to transport damage!

Do not tip over the package. Avoid heavy vibrations and shocks. Observe the symbols on the packaging.

*Packaging symbols* Depending on the contents, the packaging units are marked with the symbols shown below. Observe these at all times.

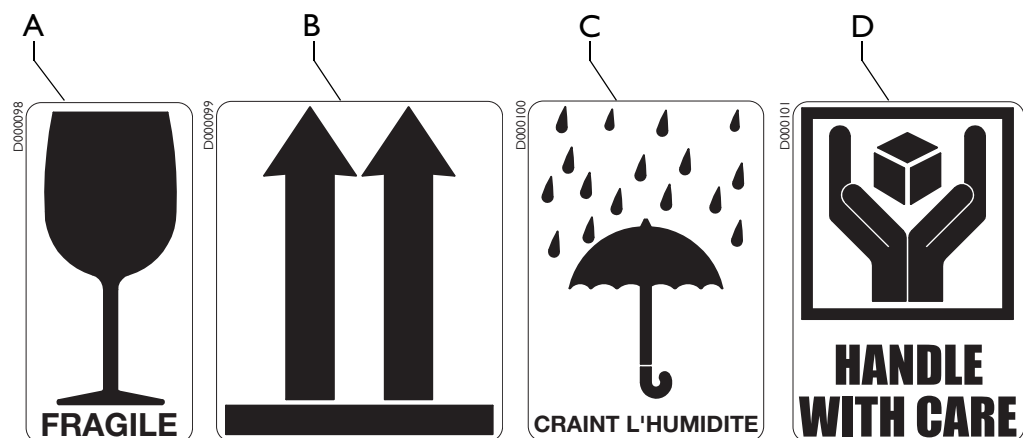


Fig. 4-1 Packaging symbols

- A Fragile
- B This side up
- C Keep dry
- D Handle with care

Remove the packaging only to the degree necessary for company-internal transport.

Transport the pallet, crate or case to the planned installation location. Use appropriate transport devices.

## 4.1 Unpacking

Accessories and small parts are packaged in a separate case or directly with the rack itself.

The racks have been treated with anti-rust oil (spray) and wrapped in oil paper. Remove packaging carefully.



### Note

**The anti-rust oil protects the racks. It is recommended to completely lubricate the racks again after assembly.**

Dispose of the packaging in accordance with the local disposal regulations.

*Checking the  
delivery*


Check the content of the delivery by comparing it with the accompanying papers.  
Check the racks for damage. Report transport damage immediately.

## 5 Assembly

### 5.1 Introduction

Racks are available in numerous versions. This chapter provides information on several available models.

#### 5.1.1 Safety

Only perform the tasks described in this chapter after you have read and understood chapter 3 'Safety',  10. It concerns your personal safety!

### WARNING

#### Suspended loads



Improper handling of suspended loads can lead to severe injuries or death!

Observe the following:

- Use appropriate lifting units
- Wear appropriate protective clothing
- Always keep sufficient distance to suspended loads
- Never enter the area below a suspended load

#### 5.1.2 Personnel qualification

Only appropriately trained and authorized personnel are allowed to maintain the Rack.

## 5.2 Special tools, testing and measuring instruments

For assembly, ensure that you have the following special tools, testing and measuring instruments at hand:

Tool	Use
Dial gauge or Micrometer	Inspection of the rack transition
Measurement bolt	Inspection of the rack transition (Measurement bolt-diameter $D=2 \cdot m$ / accuracy: Tolerance class I according to DIN 2269)
Screw clamps	Assembly of the racks
Mounting aid	Assembly of the racks (see following table)

Tab. 5-1 Special tools, testing and measuring instruments

Article no.	Pitch [p]	Module [m]
902410	3.142	1.0
902411	4.712	1.5
902412	6.283	2.0
902413	7.854	2.5
902414	9.425	3.0
902415	12.566	4.0
902416	15.708	5.0
902417	18.850	6.0
902418	25.133	8.0
902419	31.416	10.0

Tab. 5-2 Mounting aid for straight-tooth racks, listed according to module

Article no.	Pitch [p]	Module [m]
902400	2	0.637
902401	5	1.592
902402	7.5	2.387
902403	10.0	3.183
902404	12.5	3.979
902405	16.0	5.093
902406	20.0	6.366
902407	25.0	7.958

Tab. 5-3 *Mounting aid for straight-tooth racks, listed according to pitch*

Article no.	Pitch [p]	Module [m]
902280	4.712	1.5
902281	6.283	2.0
902282	7.854	2.5
902283	9.425	3.0
902284	12.566	4.0
902285	15.708	5.0
902286	18.850	6.0
902287	25.133	8.0
902288	31.416	10.0

Tab. 5-4 *Mounting aid for inclined-tooth racks*



## 5.3 Installation

### 5.3.1 Prerequisites

*Lifting units* Lifting units can be required for assembly of the racks. Make sure that appropriately dimensioned devices (crane etc.) are available.

*Mounting aid* The start and end of the rack form a half tooth gap. For precise and low-noise transition, we recommend using a mounting aid geared in the opposite direction (see chapter 5.2 'Special tools, testing and measuring instruments', 15).

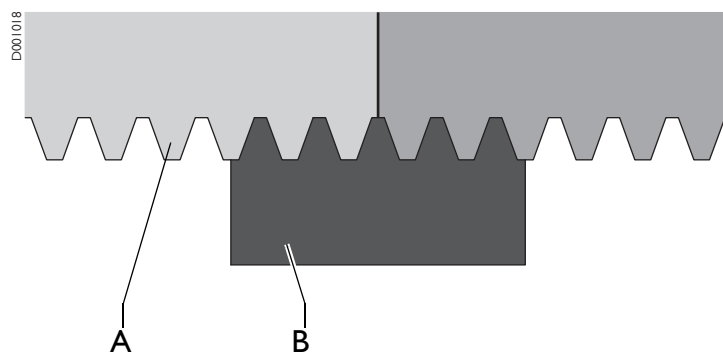


Fig. 5-1 Mounting aid for rack assembly

A Rack

B Mounting aid

*Bevel* In general, the racks have a chamfer of 0.5 mm or greater. For securing the rack, the opposing radius  $r$  should be max 0.42 mm.

We recommend a height  $H$  of the limit stop edge of at least 2.4 mm.

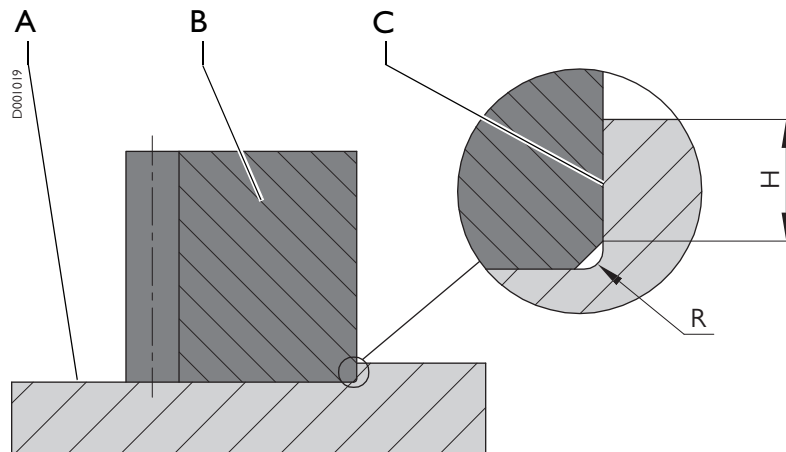


Fig. 5-2 Opposing radius for rack assembly

- A Base surface
- B Rack
- C Shoulder

## 5.3.2 Assembly

*Assembling racks* This section describes the steps for installing the racks.



### NOTE

**For the assembly of combinations of three or more racks, always start at the rack in the middle.**

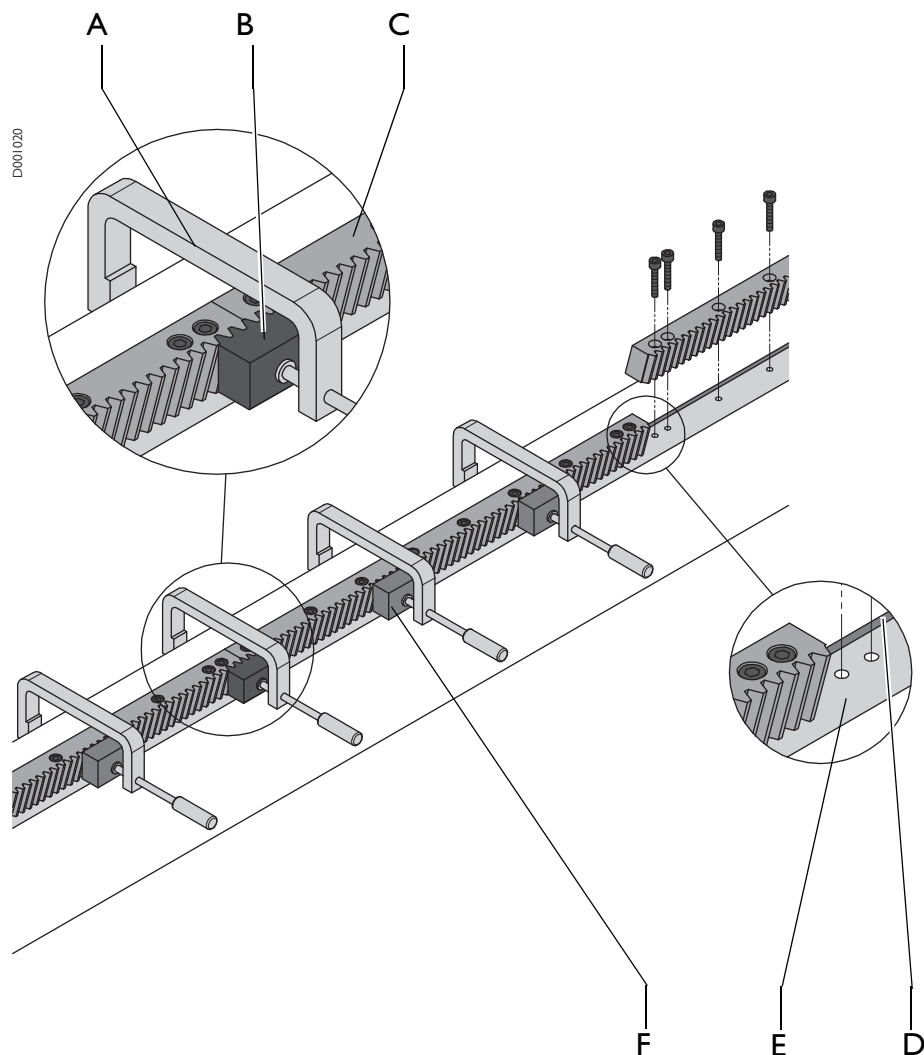


Fig. 5-3 Assembling racks

- A Screw clamp
- B Mounting aid
- C Rack
- D Limit stop edge
- E Base surface
- F Wood block

Install the racks as follows:

- 1** Clean the base surface and the shoulder thoroughly and rub an oil stone across them
- 2** Clean the racks thoroughly and rub an oil stone across them
- 3** Use the screw clamps to clamp the rack against the shoulder
- 4** Tighten all screws  
(at the height of the to tightening screw has to be a screw damp)
- 5** Inspect rack transition according to Section " ", 17
- 6** If deviations occur:
  - 6.1** Remove screws and racks
  - 6.2** Repeat the procedure

The rack is assembled.

*Inspecting rack transition*

This section describes two methods for inspecting the rack transition.

*Method 1*

This method will be used for straight-and helical-tooth racks.

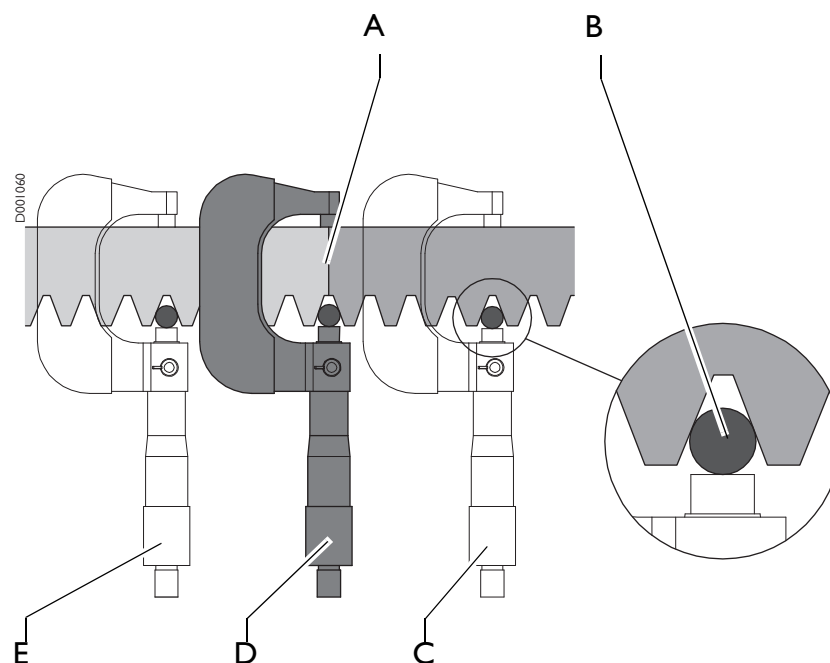


Fig. 5-4 Inspect rack transition with micrometer

- A Rack transition
- B Measurement bolt

C Micrometer position C  
 D Micrometer position D  
 E Micrometer position E

Rack quality	Permissible deviation [mm]		
	Module $m \leq 3$	Module $3 < m \leq 8$	Module $8 < m \leq 12$
Q4 h21	0.014	0.016	0.022
Q5 h22	0.022	0.027	0.034
Q6 h23	0.034	0.041	0.055
Q7 h25	0.082	0.110	0.137
Q8 h27	0.220	0.275	0.343
Q9 h27	0.220	0.275	0.343

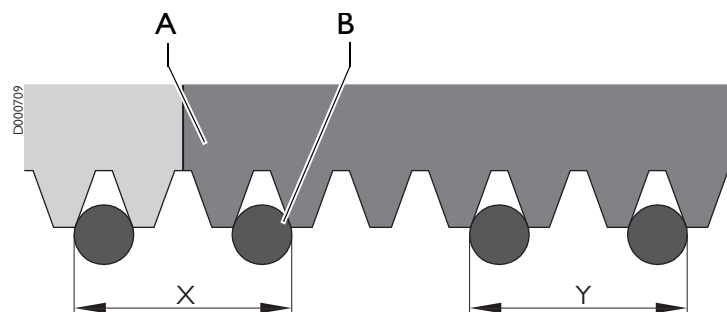
Tab. 5-5 Deviation

Inspect the rack transition as follows:

- 1 Position the measurement bolt as shown in the illustration
- 2 Inspect the deviations in the height of positions C and E to position D via micrometer  
 (Permissible deviation of position C and E to D, refer to table above)

The rack transition has been inspected.

*Method 2* This method will be used only for straight-tooth racks.



D0001256

Fig. 5-5 Inspect rack transition

A Rack transition  
 B Measurement bolt (Diameter  $D = 2 \cdot m$ )

D000992b

Rack quality	Permissible deviation [mm]	
	Module $m \leq 3$	Module $3 < m \leq 8$
Q4 h21	0.006	0.010
Q5 h22	0.008	0.012
Q6 h23	0.012	0.012
Q7 h25	0.016	0.016
Q8 h27	0.016	0.016
Q9 h27	0.016	0.016

Tab. 5-6 Deviation

Inspect the rack transition as follows:

- 1 Calculate the measure  $X$  ( $X = 2 \cdot m \cdot (\pi + 1)$ )
- 2 Position the measurement bolt as shown in the illustration
- 3 Measure the distance  $X$   
(Permissible deviation between the calculated and the measured distance  $X$  refer to table above)
- 4 The rack transition has been inspected.

### 5.3.3 Setting the tooth flank backlash

Set the tooth flank backlash after each rack, roller or gearbox change.



#### NOTE

**Always set the roller backlash and tooth flank backlash with load attached and at operating temperature!**

The effect and determination of the tooth flank backlash can be found in DIN 3967. The tooth flank backlash is set by selective provision of a drive element.

Select the backlash of the application accordingly.

Benchmarkes are:

Racks hardened or soft, ungraded	0.05mm
-------------------------------------	--------

Racks hardened, graded	0.02mm
---------------------------	--------

The sliding carriage or carriage must run uniformly smooth-running when pushed over the entire length repeatedly.

For high stresses, the contact pattern under load should be checked.

### 5.3.4 Final inspection

This section describes the final inspection of the rack assembly.

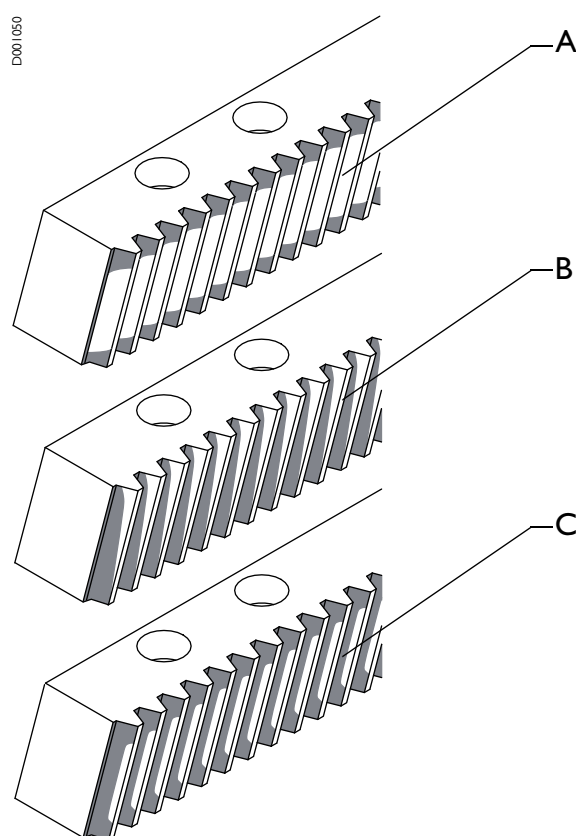


Fig. 5-6 Rack assembly final inspection

- A Correct
- B Not parallel
- C Wrong axle spacing

Inspect the rack assembly as follows:

- 1** Clean and degrease the tooth flanks and racks
- 2** Coat the tooth flanks with a paste or water-resistant felt pen
- 3** Move the components of the pinion numerous times so that the pinion moves over the coated areas
- 4** According to the illustration, evaluate the color (ink) that has been removed
- 5** If not correct: Realign the components with the pinion (e.g. gearbox)

The rack assembly has been inspected.



## 6 Maintenance

### 6.1 Introduction

This chapter describes all maintenance tasks.

*Work* Observe the lubrication intervals. Perform the described tasks at the specified times. This ensures a long service life for your racks.

*Original spare parts* Use only original spare parts. For information on spare parts and wear items, refer to chapter 7 'Spare part supply', 29.

#### 6.1.1 Safety

Only perform the tasks described in this chapter after you have read and understood chapter 3 'Safety', 10. It concerns your personal safety!

### ⚠ WARNING

#### Automatic startup



When work is being performed on the product, there is danger of the machine starting up automatically. This can cause severe or fatal injuries!

Before working in the danger area:

- Secure vertical axles (if equipped) against falling
- Switch off the main power supply and secure it against being switched on again (main switch of complete plant)
- Before switching on the plant again, make sure that no one is in the danger area.

**⚠ WARNING****Falling axles/workpieces**

Falling axles or workpieces can cause severe or fatal injuries!

Observe the following:

- Secure suspended axles using the stipulated equipment and deposit any workpieces before working in the danger area
- Never enter the area below suspended axles and workpieces
- Check the belts of the telescope axes for signs of breakage and tears

**⚠ WARNING****Heavy components**

Components can be very heavy. Improper handling can cause severe or fatal injuries!

Use appropriate lifting units!

**6.1.2 Personnel qualification**

Only appropriately trained and authorized personnel are allowed to maintain the Rack.

**6.2 Consumables and auxiliary agents****NOTE****Unsuitable lubricants**

Using unsuitable lubricants can lead to machine damage!

Only use the lubricants listed below. If uncertain, please contact our service departments!

## 6.2.1 Cleaning agents

For cleaning tasks, have a grease-dissolving cleaning agent (e.g. acetone) at hand.

## 6.2.2 Lubricants

### Oils

*Oil types* The following types of oil are recommended:

Mobil	Glygoyl	460
-------	---------	-----

The following types of oil can be used alternatively:

Aral	Degol	GS 460
BP	Energol	SG-XP-460
Texaco	Pinnacle	460
Shell	Tivela	S 460
Klüber	Klübersynth	GH6-220

### Greases

*Grease types* The following types of grease are recommended:

Mobil	Mobilux	EP 2
-------	---------	------

The following grease types can be used alternatively:


Aral	Aralup	HLP 2
BP	Energol	LS-EP 2
Texaco	Multifak	EP 2
Shell	Alvania	EP-2
Klüber	Centoplex	EP-2

## 6.3 Maintenance tasks


### 6.3.1 General prerequisites

*Lubrication* Racks are to be regularly greased with lubricant. For oil lubrication, a felt pinion is used, for grease lubrication a plastic pinion. For the automatic supply of the lubrication points, a complete set with lubrication dispenser, piston distributor, screwed connections and hose connections can be purchased. This chapter describes the steps for manually lubricating the machine. If your machine is equipped with an automatic lubrication system, these tasks do not have to be performed.

Prior to performing maintenance tasks, do the following:

- If vertical axles are present, secure them against falling
- Switch off the machine and padlock it to secure it against being switched on again
- Make sure that all spare parts and wear items are at hand.  
(For information on spare parts and wear items, refer to chapter 7 'Spare part supply',  29.)

### 6.3.2 Maintenance tasks every 150 hours

For more information on the lubricants, refer to chapter 6.2 'Consumables and auxiliary agents',  26.

#### **Cleaning / Lubrication**

Clean all racks every 150 hours.

Lubricate all racks every 150 hours.

#### **Replacing the rack**

Replace the racks as soon as the surface shows signs of wear.

## **7 Spare part supply**

### **7.1 Service departments**

If you have questions on service, please use the service form at [www.gudel.com](http://www.gudel.com) or contact the offices in the appropriate country:

Germany: +49 6291 6446 41

Great Britain: +44 24 7669 5444

India: +91 20 5622 7165

Italy: +39 0292 170920

South Korea: +82 2168 98 00

Taiwan: +88 635 97 8808

USA: +1 734 214 0000

All other countries and Switzerland: +41 62 916 91 91

For urgent service requests, our Helpdesk provides after-hour assistance (24-hour support):

Europe/Asia: +41 62 916 9170

USA: +1 248 456 0440

Please have all necessary information ready.