APEX DYNAMICS

Installation Instruction
for
Rack and Pinion

Overview

Why it is so important?

Installation of rack onto the machine

1. **Installation and Connetction of racks**
2. **Installation of pinion onto the gearbox**
3. **Installation of gearbox with pinion onto the rack**

General Description

For Professional

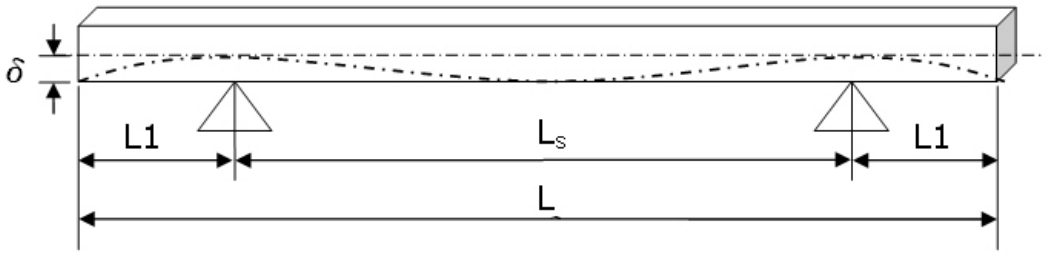
Respect the local accident prevention regulations and safety laws

For the maximal permissible driving force or torque of the rack

Switch off the power supply during installation, maintenance and transport

Apply sufficient lubrication during the operation

Storage

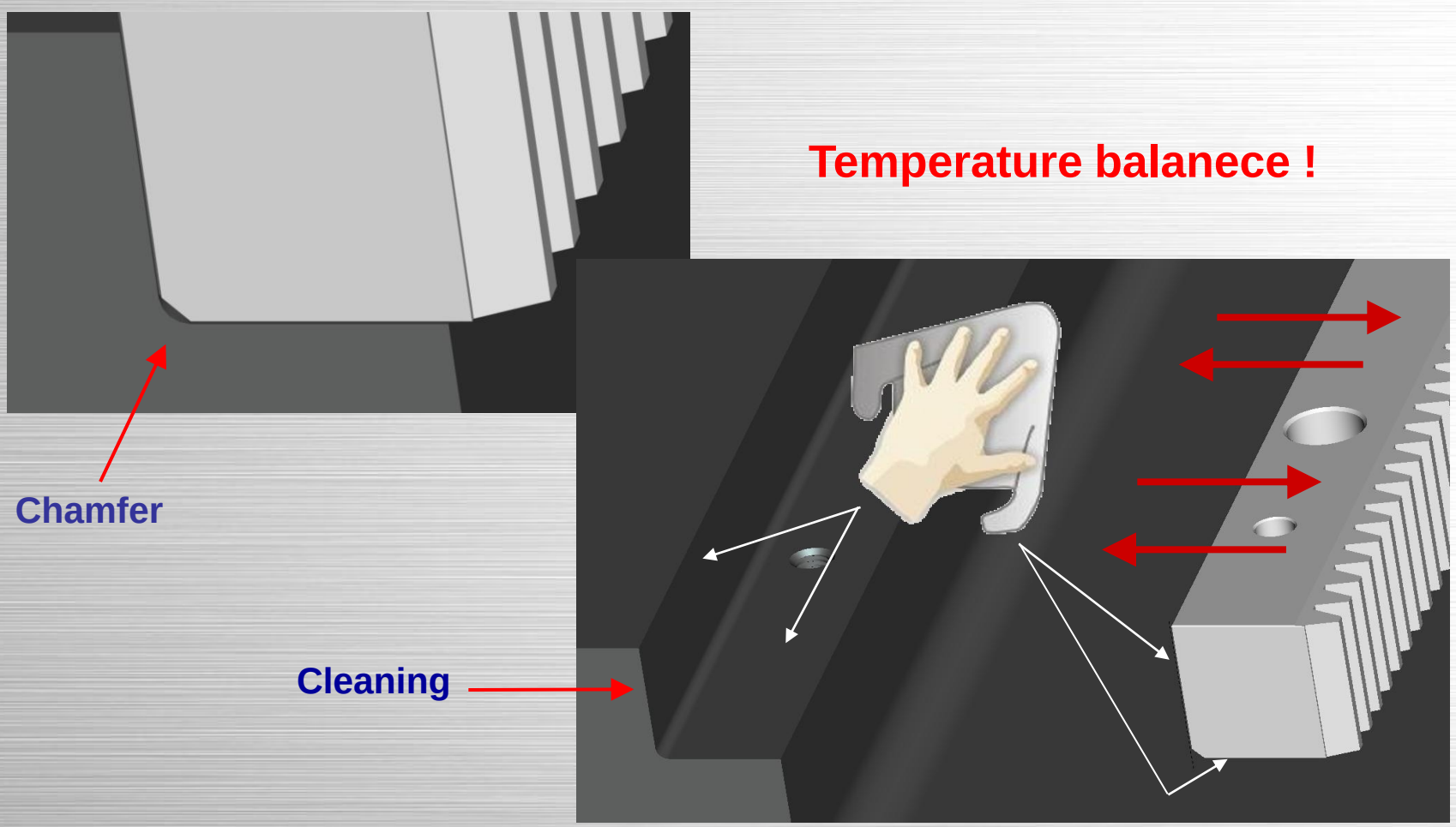


$$Ls = \frac{5}{9} L \qquad L1 = \frac{2}{9} L \qquad \delta = \frac{wLs}{384EI}(5Ls^2 - 24L1^2)$$

w = Weight of Rack

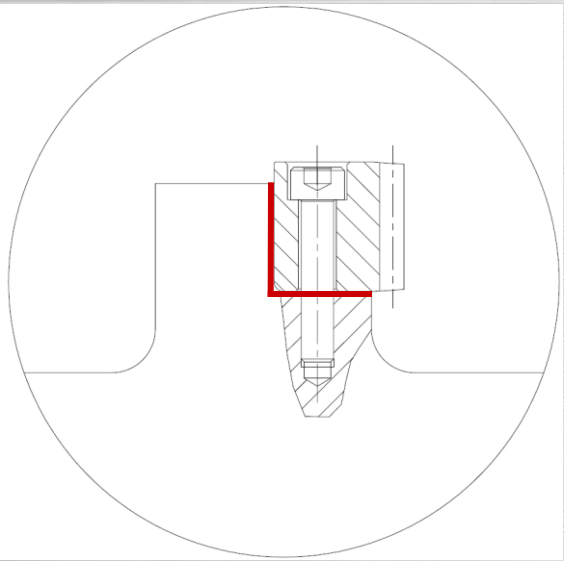
EI = Flexural rigidity (the best span for min. deformation in the center)

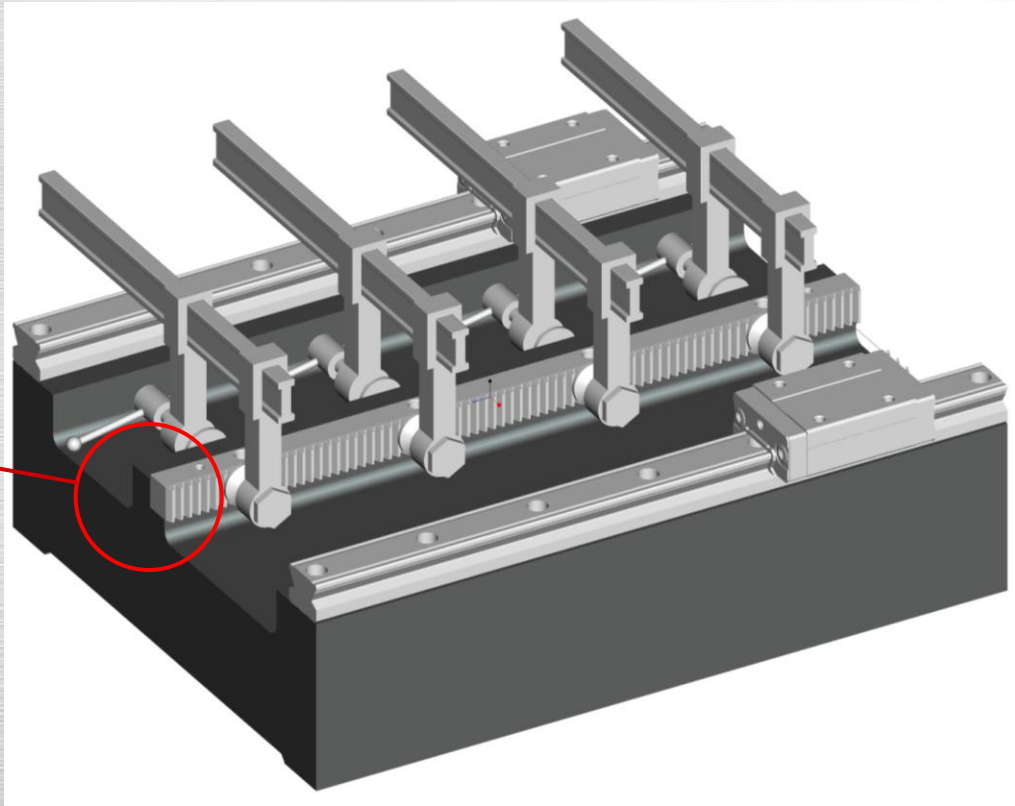
Check and Preparation before Installation



Installation of Rack

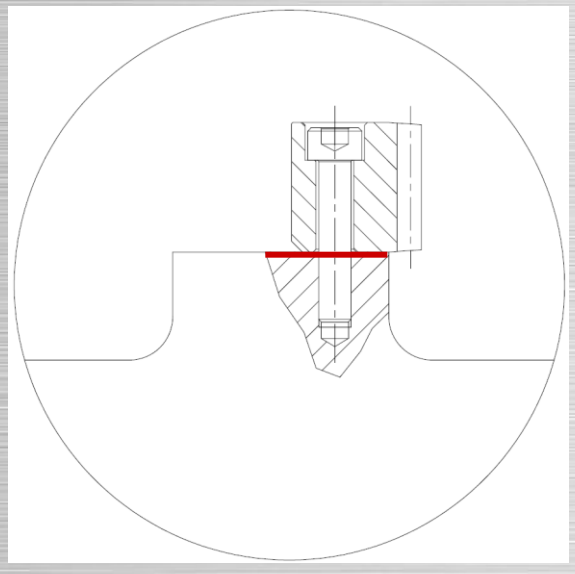
With or without Back-Support

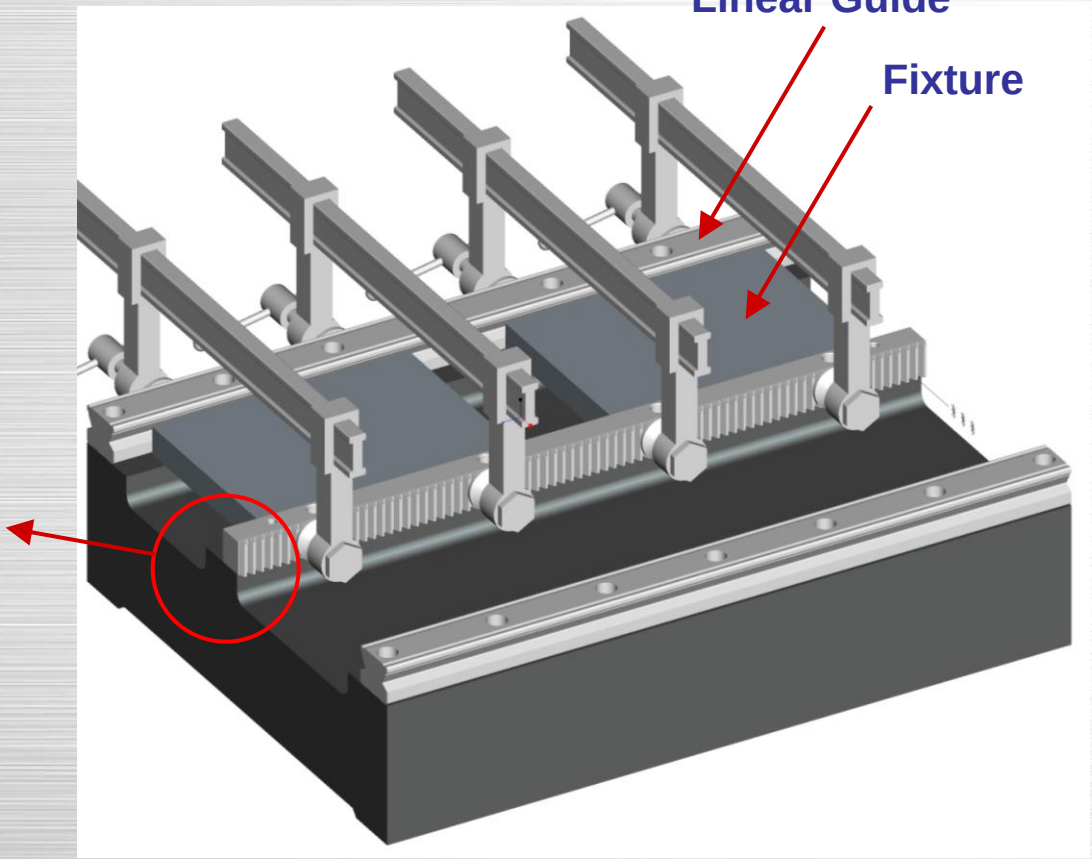




Installation of Rack

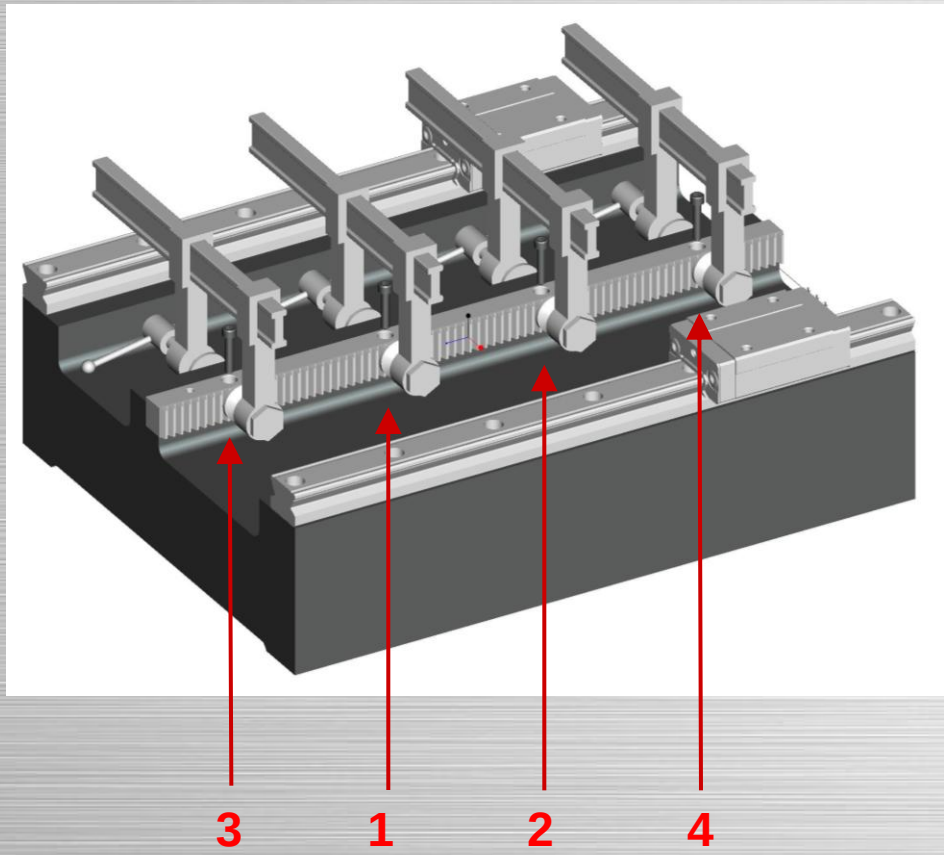
With or without Back-Support





Installation of Rack

Sequence for Screwing



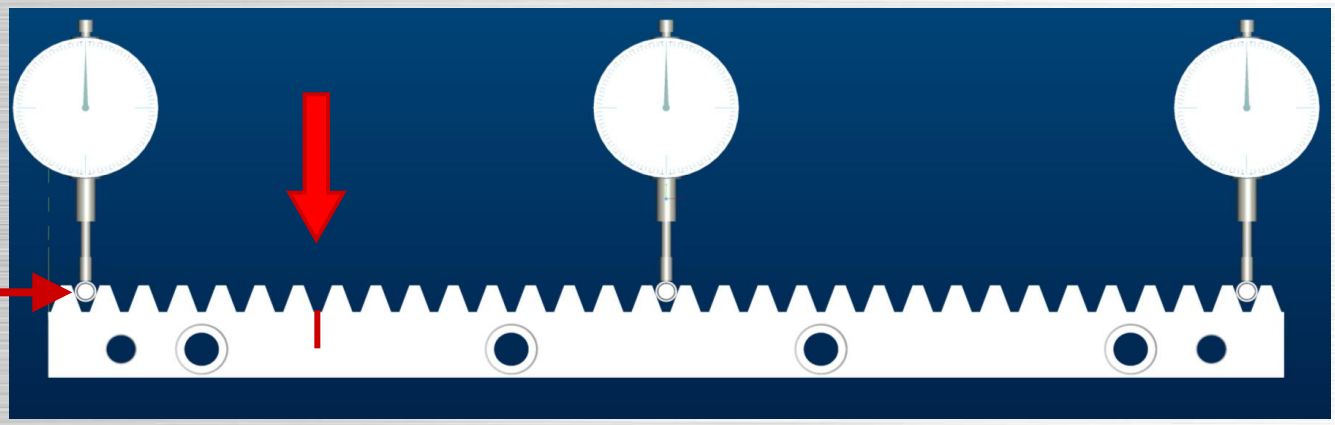
Sequence for Screwing

Screw Size	Dimension Hexagon Head	Rated Torque Class 12.9	
	[mm]	[Nm]	[Lbf-ft]
M4 x 0.7P	3	4.9	3.6
M5 x 0.8P	4	9.8	7
M6 x 1P	5	17	13
M8 x 1.25P	6	41	30
M10 x 1.5P	8	80	60
M12 x 1.75P	10	139	105
M14 x 2P	12	223	165
M16 x 2P	14	343	255
M20 x 2.5P	17	660	485
M24 x 3P	19	1140	840
M30 x 3.5P	22	2300	1695
M36 x 4P	27	4100	3025

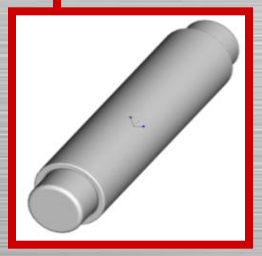
Screwing 10% → 100%

Identify the Highest Position

Give Mark !



Rack Quality	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Tolerance	0.019	0.020	0.030	0.044	0.066	0.086	0.123



Mn	1	1.5	2	3	4	5	6	8	10	12
D (mm)	2	3	4.2	5	6	9	10	14	18	20

Connecting Racks in Sequence

Better Connecting or a Long Rack?

ATLANTA Q6 / Total Pitch Error

GTf/1000 ≦ 0.036mm

GTf/1500 ≦ 0.043mm (≦ 0.029/1000mm)

GTf/2000 ≦ 0.047mm (≦ 0.024/1000mm)

1m + 1m →

2 x 36µm + 1 x 25µm = 97µm > 47µm

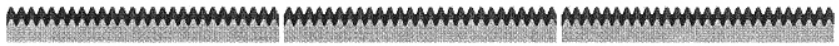
ATLANTA

ATLANTA Racks and Pinions

Advantages of Using Long, Ground Racks from ATLANTA

For mounted racks, the obtained accuracy and required installation time are important. With ATLANTA ground racks with lengths of 1,500 mm and 2,000 mm, the total pitch error per meter is reduced dramatically. Thus, the pitch error of the entire axis is correspondingly lower. By using long racks, the number of rack joints is reduced, which improves the accuracy of the entire axis and significantly reduces the installation time at the same time.

Ground racks have the advantage that the complete rack is more precise, the meshing takes place evenly and the pinion bearing stress is reduced unlike a milled tooth. The ground rack drives have lower friction which increase energy efficiency.



Accuracy: GT_f: 36µm (1000mm) **Maximum pitch error:** 6 x 36µm + 5 x 25µm = **341µm**

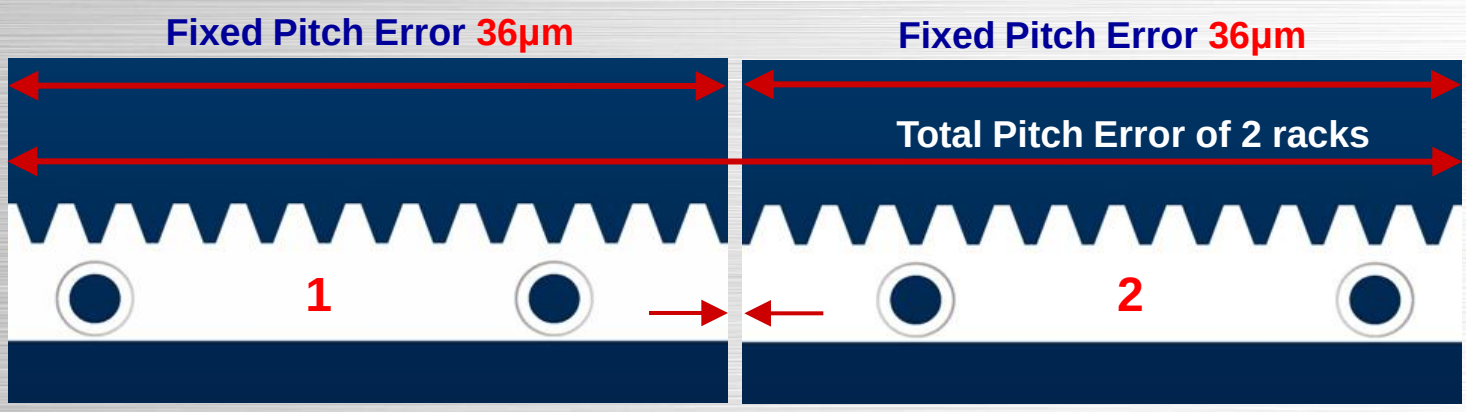
Time: 1 meter racks: Number of screws: 6 x 8 = 48 screws Number of joints: 5 Number of pins: 0

Accuracy: GT_f: 32µm **Maximum pitch error:** 12 x 32µm + 11 x 25µm = **659µm**

Time: 0.5 meter racks: Number of screws: 12 x 4 = 48 screws Number of joints: 11 Number of pins: 12 x 2 = 24

Connecting Racks in Sequence

Better Connecting or a Long Rack?

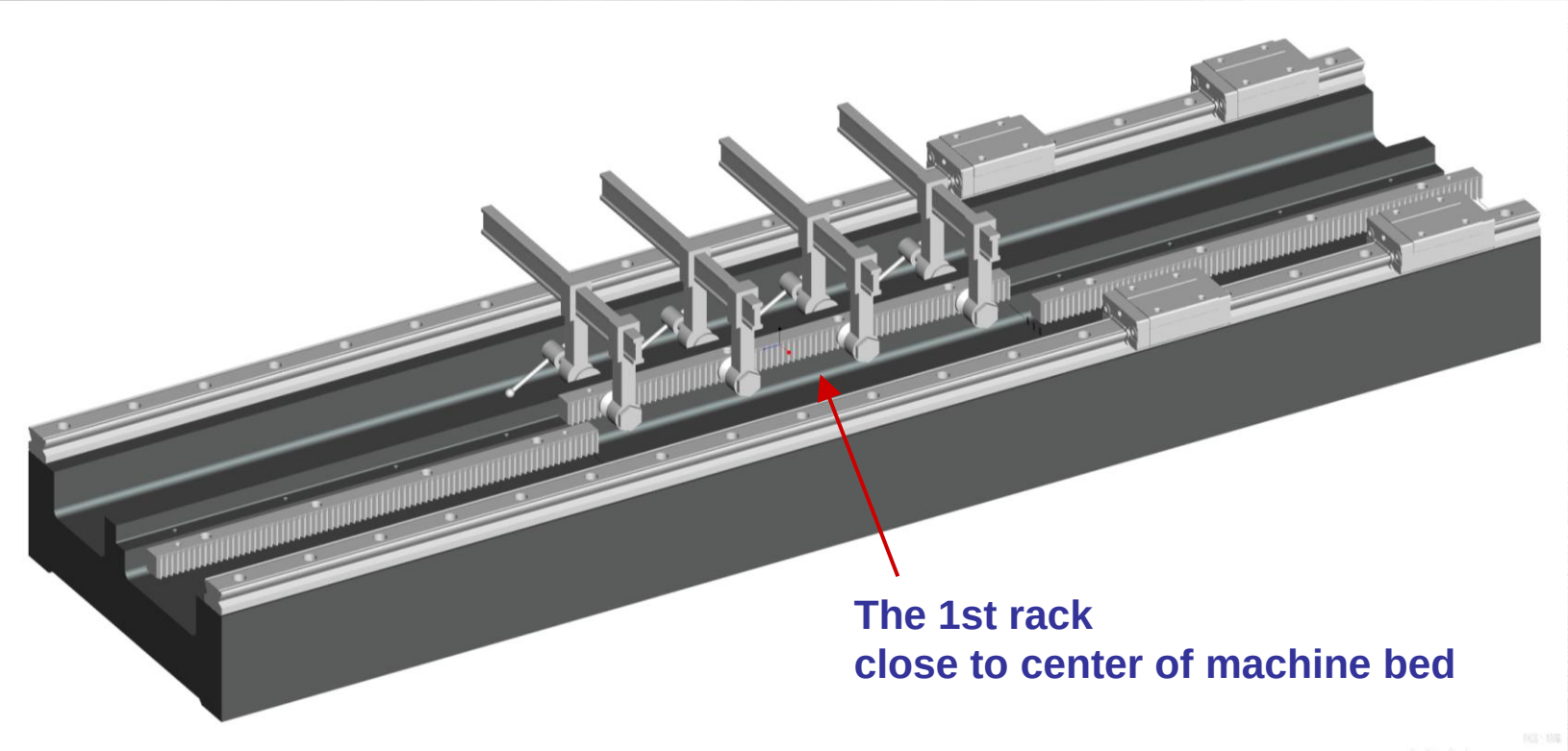


Gape = Adjustment

Disadvantage of 2m rack:

- Less geometrical accuracy
- Uneven thermal expansion
- Transport and handling problem

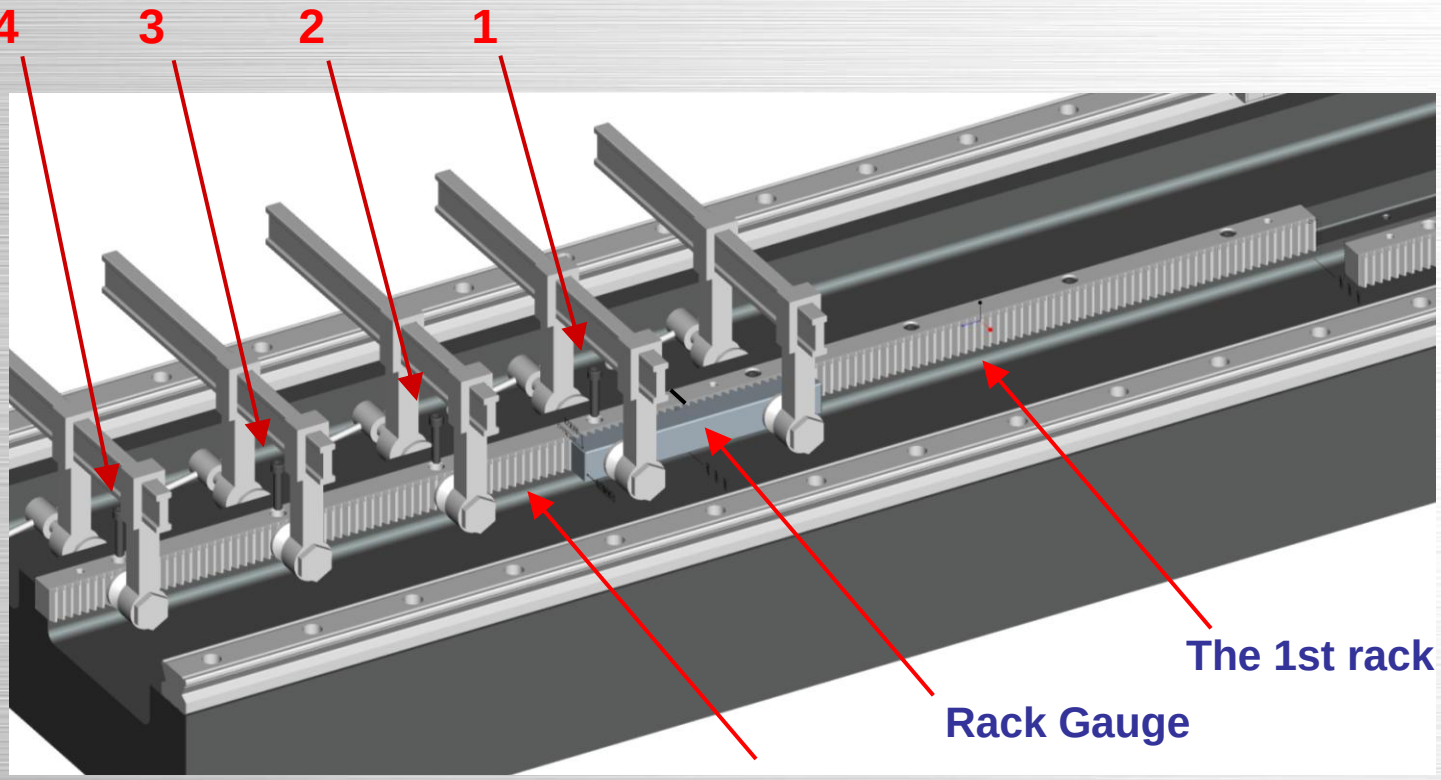
Connecting Racks in Sequence



Connecting Racks in Sequence

Sequence for Screwing

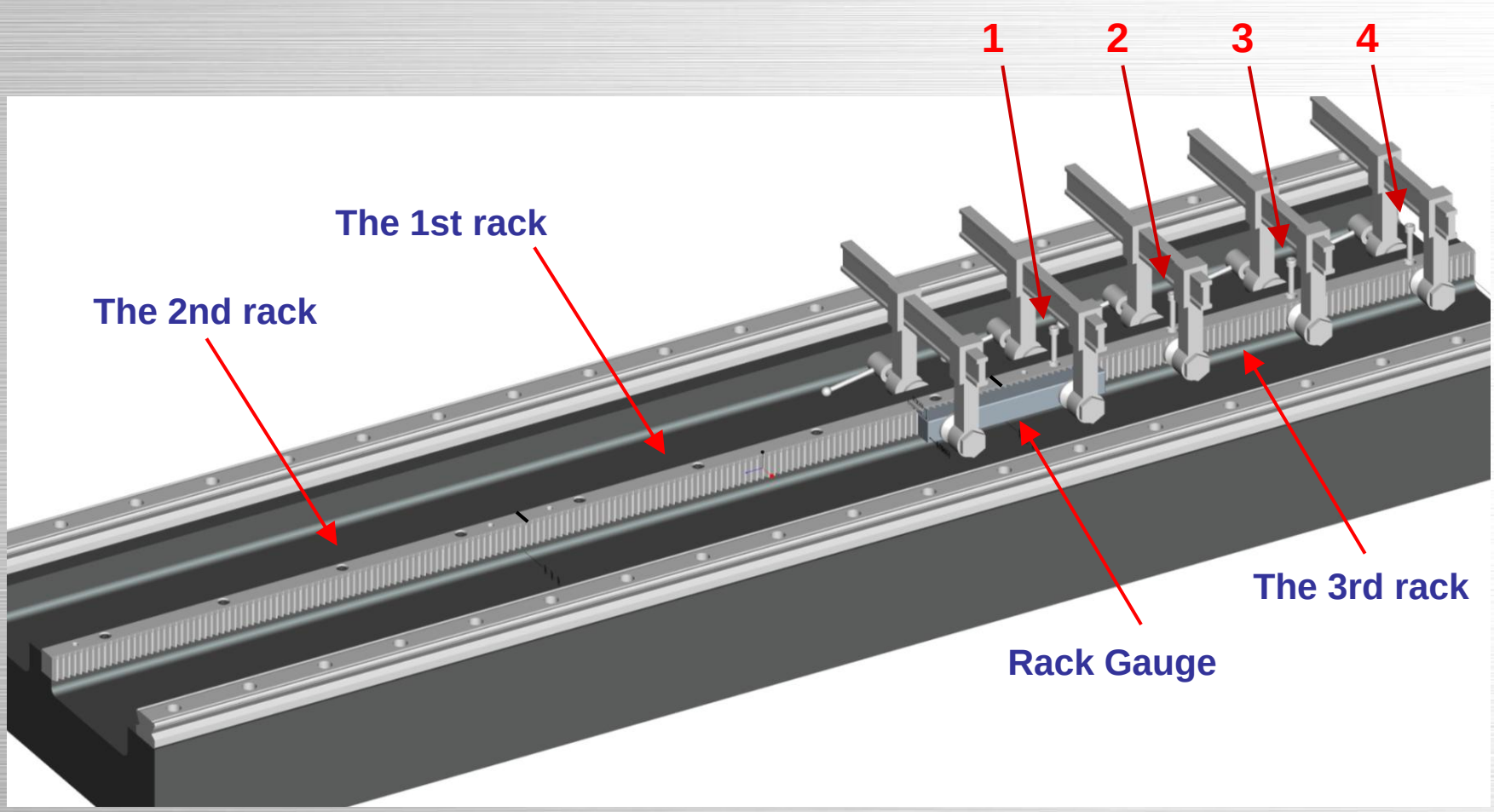
Screwing Torque 50% → 100%



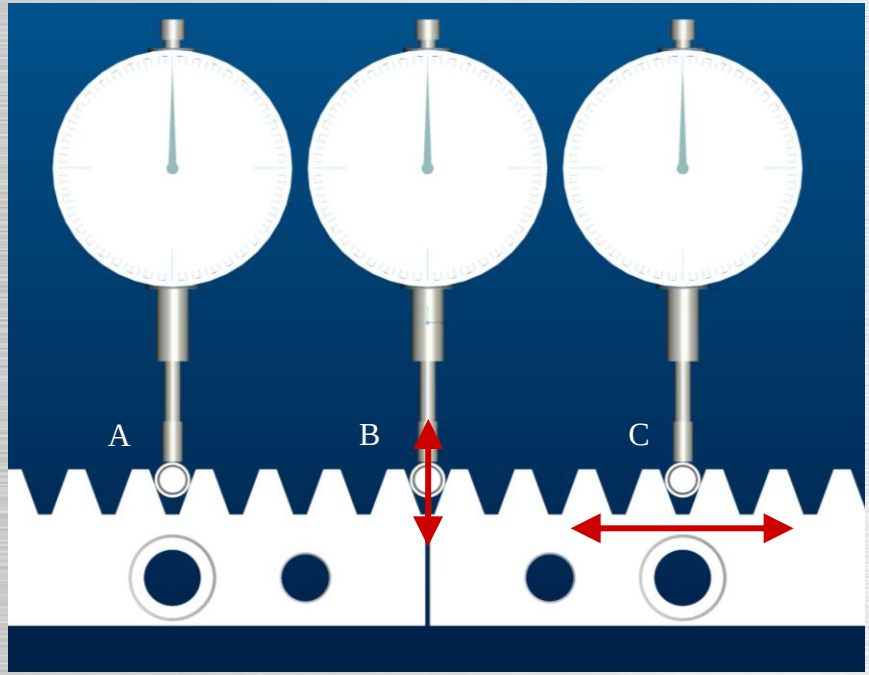
Connecting Racks in Sequence

Screwing Torque 50% → 100%

Sequence for Screwing



Connecting Racks in Sequence



Height B =

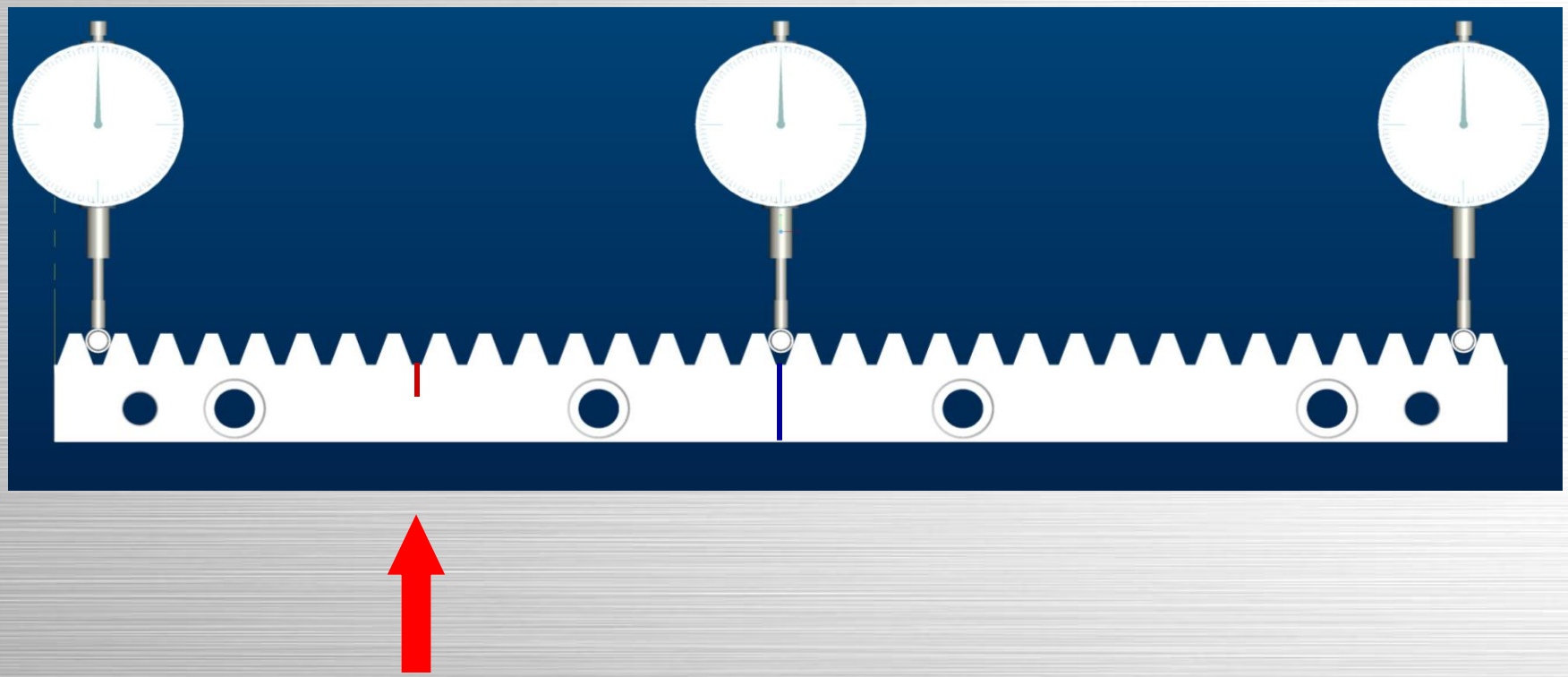
(Height A + Height C) / 2

(mm)

Rack Quality	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Tolerance	± 0.005	± 0.007	± 0.011	± 0.016	± 0.024	± 0.030	± 0.045

Connecting Racks in Sequence

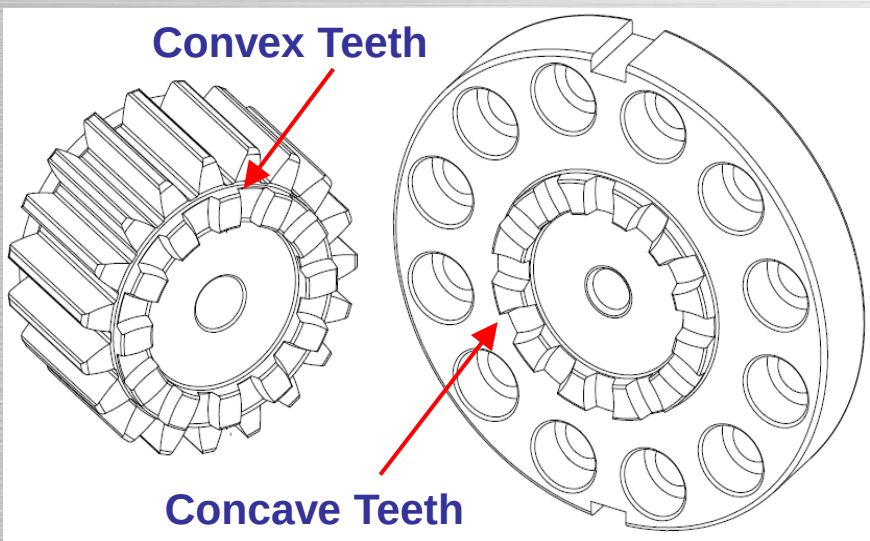
Identify highest position on the racks
in the whole operation range and give mark !

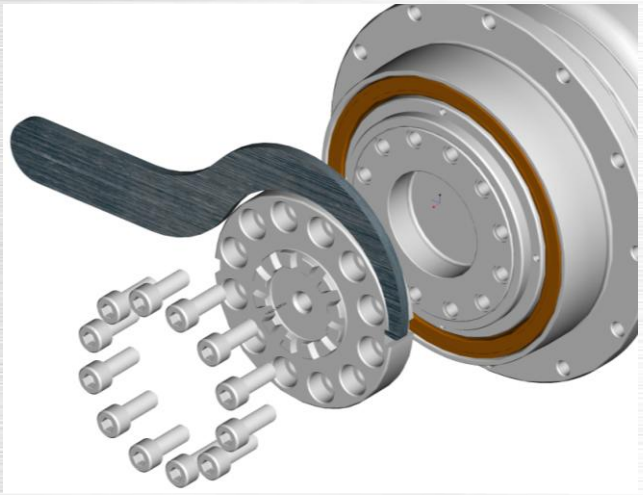


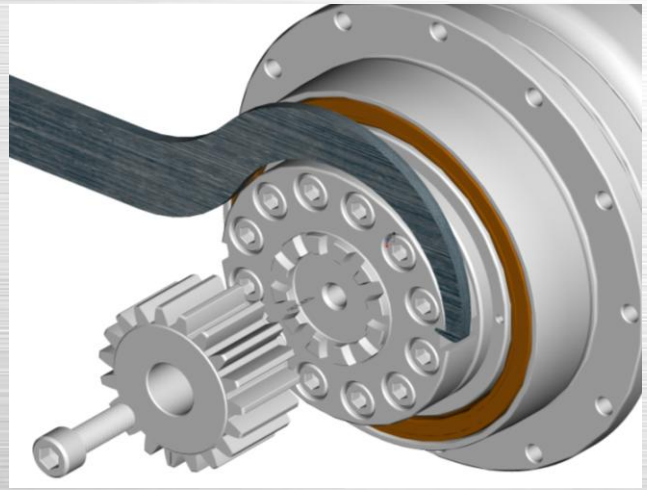
Installation of Pinion onto the Gearbox

Installation of Pinion onto the Gearbox

Pinion with Curvic Coupling / Quality : Q4

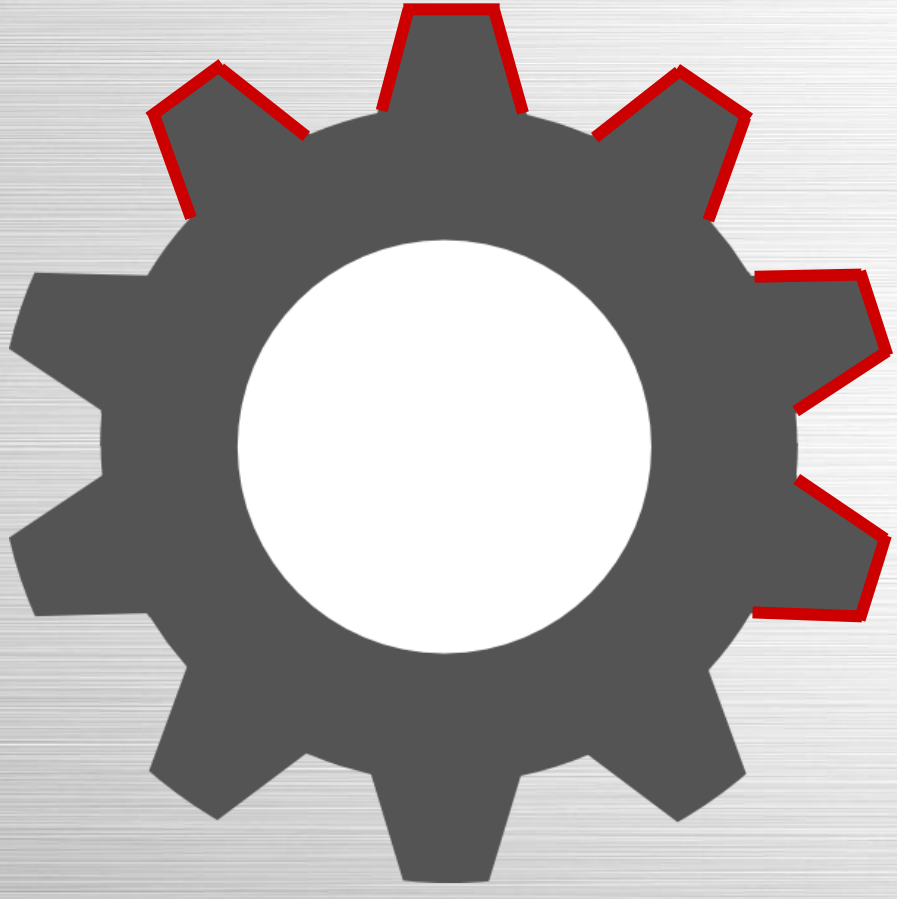






Installation of Pinion onto the Gearbox

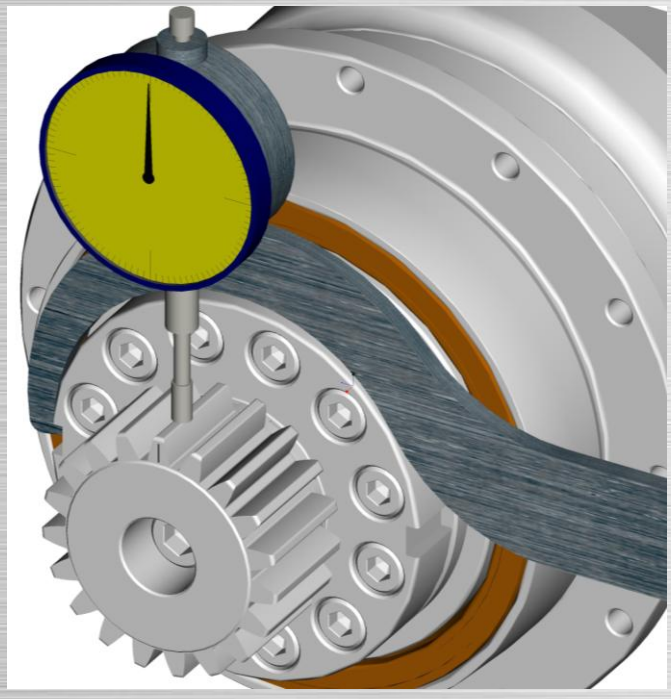
Top and Profile of Pinion Teeth of APEX are ground simultaneously !!

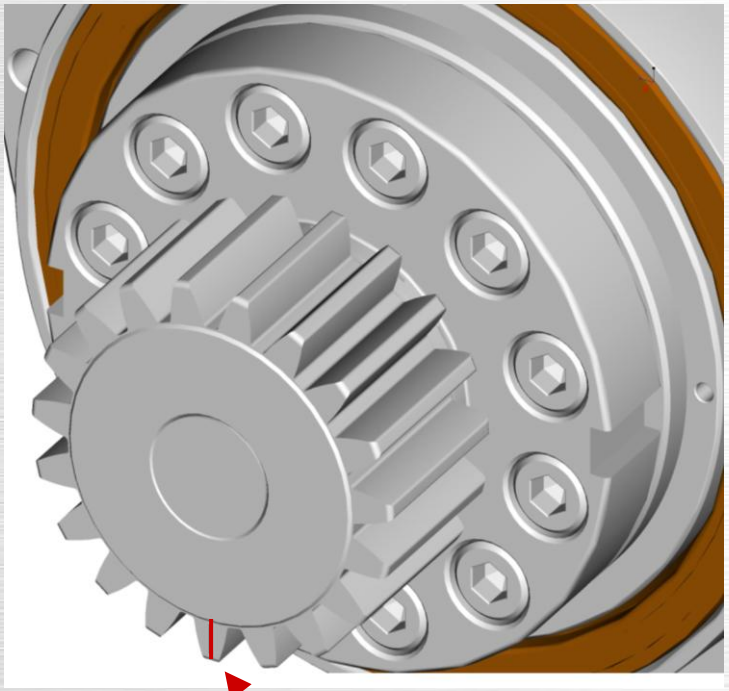


Installation of Pinion onto the Gearbox

Round-Out of Gear-Coupling (basing on Teeth-Profile)

= Round-Out of Pinion Teeth Top

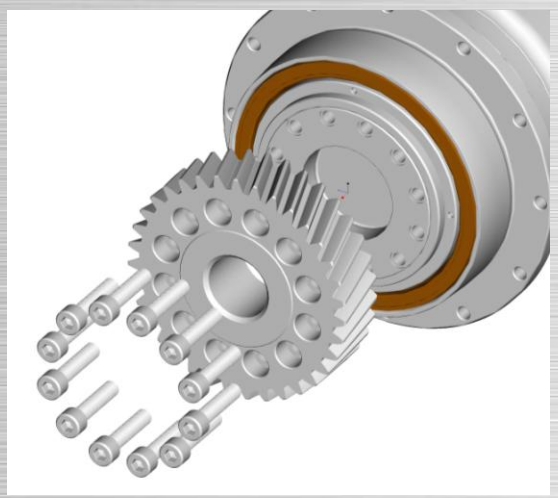


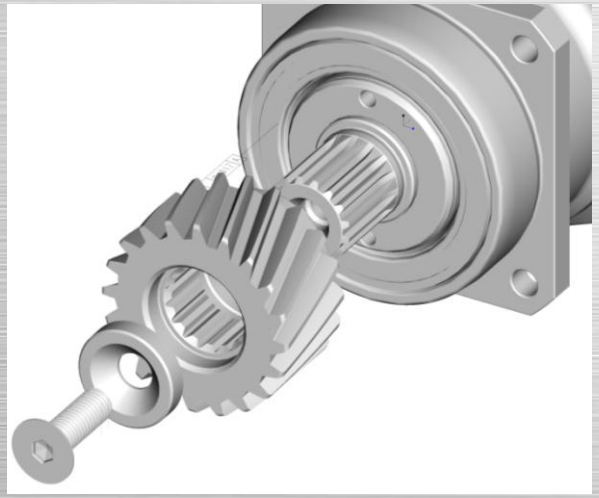


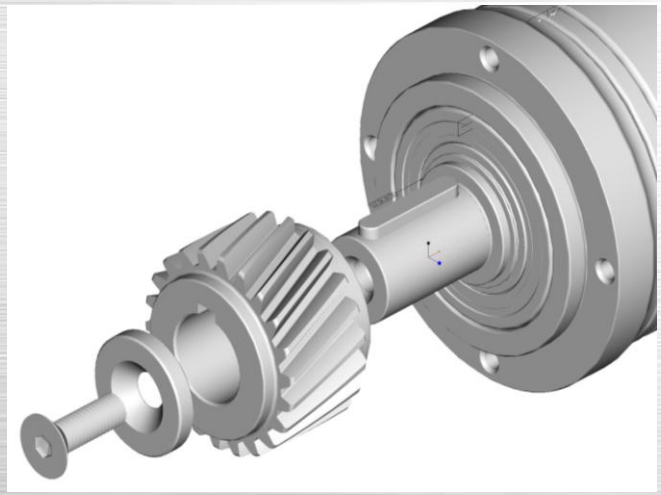
Mark max. Round-Out

Installation of Pinion onto the Gearbox

Mark max. Round-Out



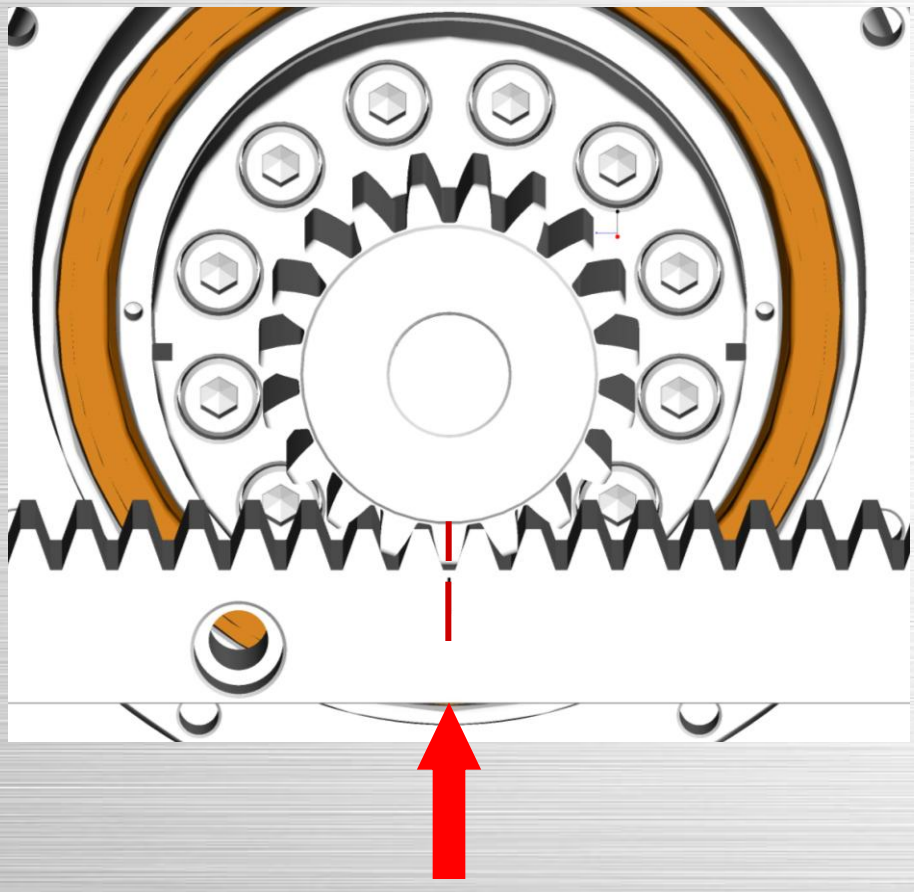




Install the Gearbox w. Pinion onto the Rack

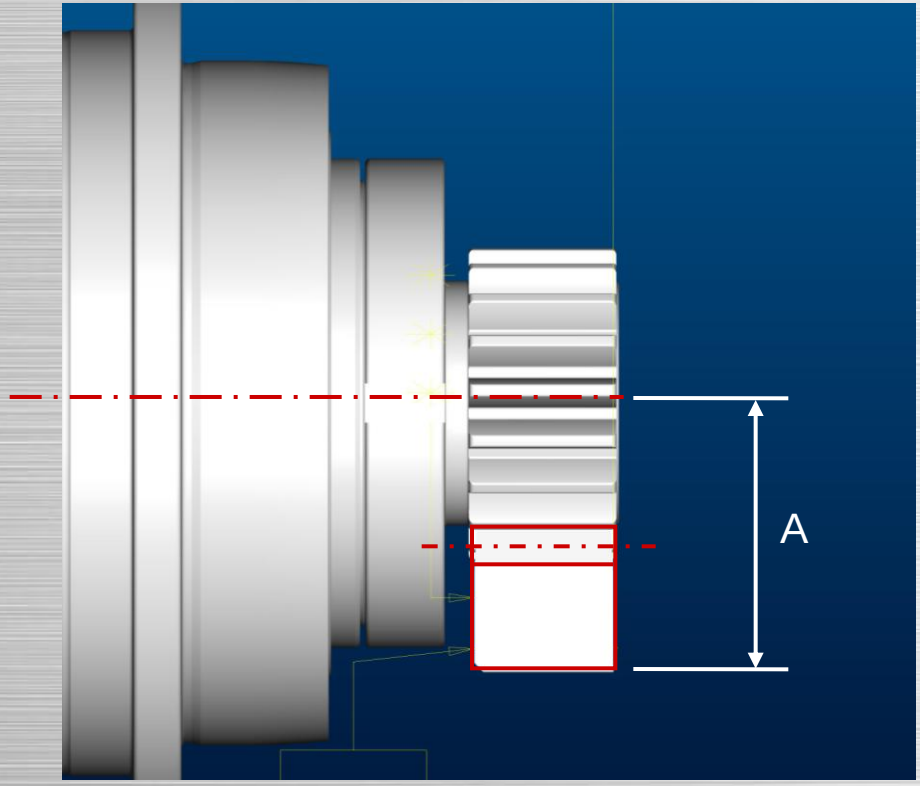
Install the Gearbox w. Pinion onto the Rack

Alignment



Install the Gearbox w. Pinion onto the Rack

Adjust the Center Height



Center Height

↓

Good Coupling

↓

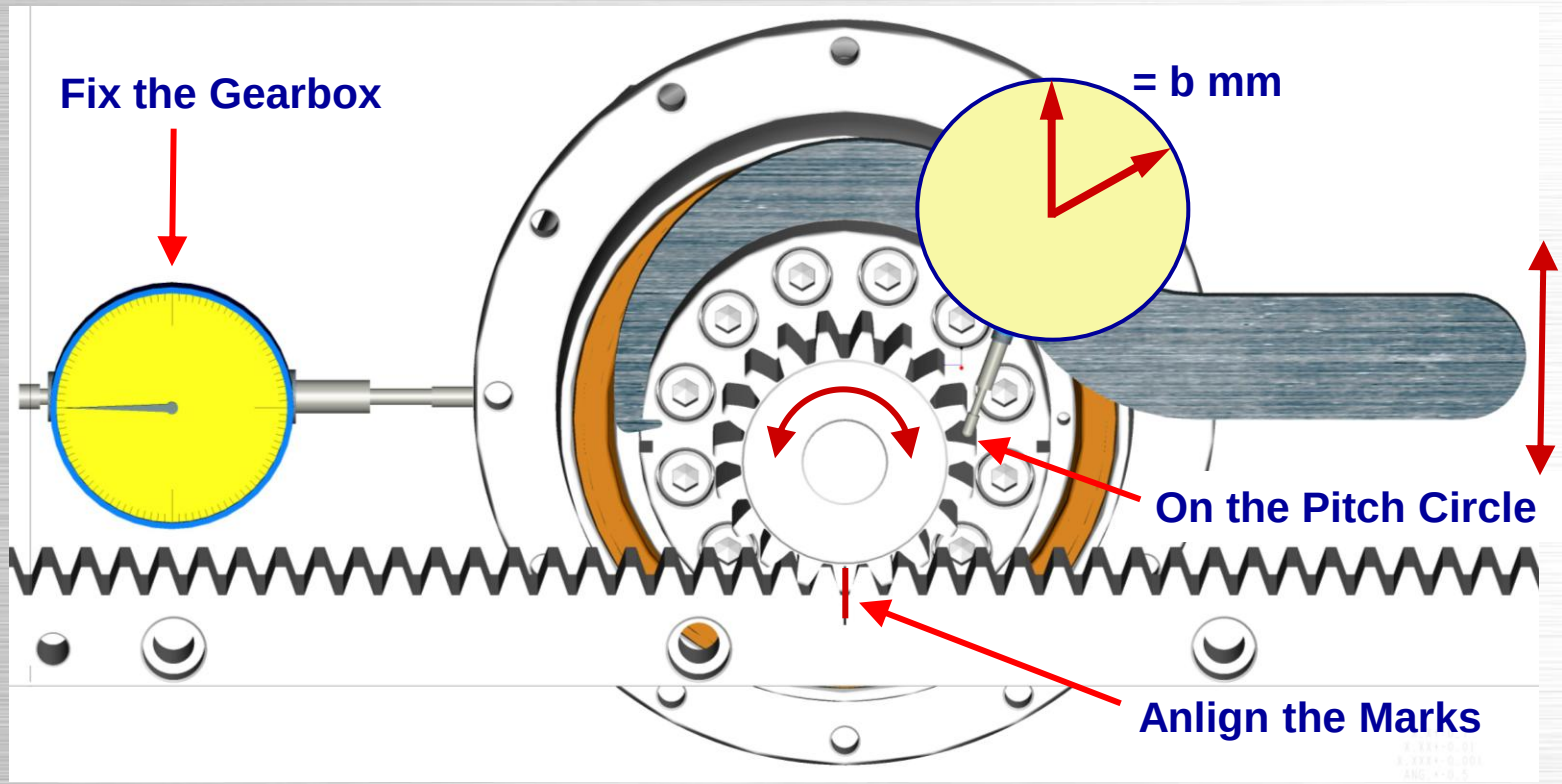
Backlash

↓

Torque / Noise / Wearing…

Install the Gearbox w. Pinion onto the Rack

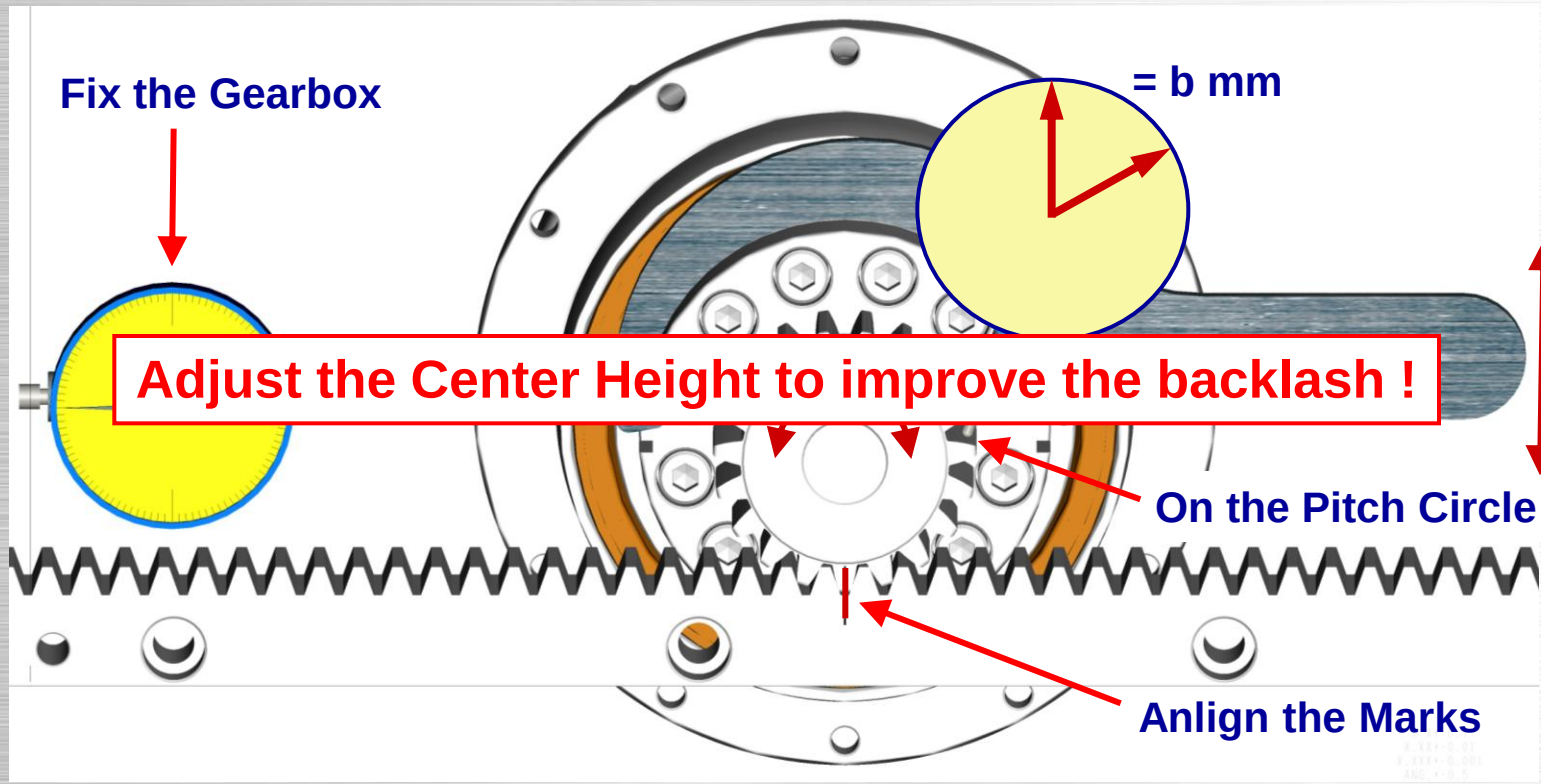
Measure the Backlash



Backlash (arcmin) = b / (0.000145 x Pitch Circle Diameter)

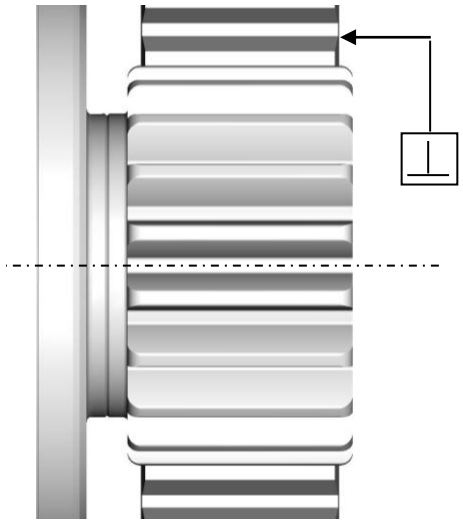
Install the Gearbox w. Pinion onto the Rack

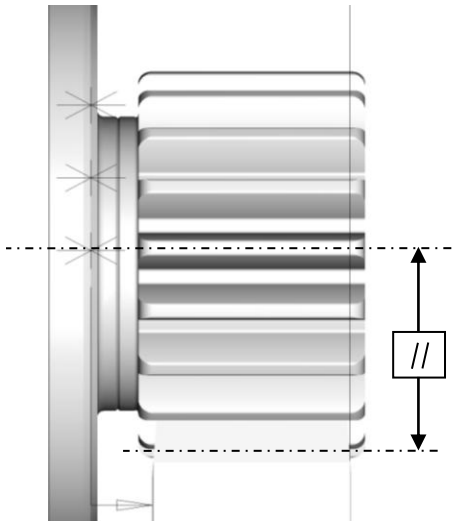
Measure the Backlash

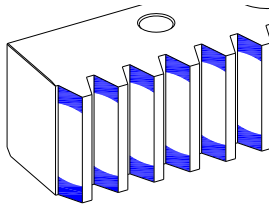
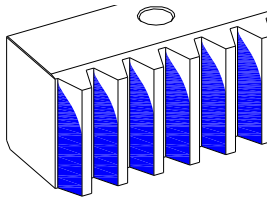
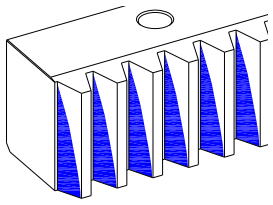
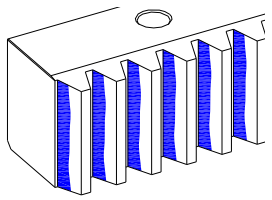


Rack Quality	Q4	Q5	Q6	Q7	Q8	Q9	Q10
min. Backlash (mm)	0.013	0.015	0.022	0.032	0.06	0.08	0.1

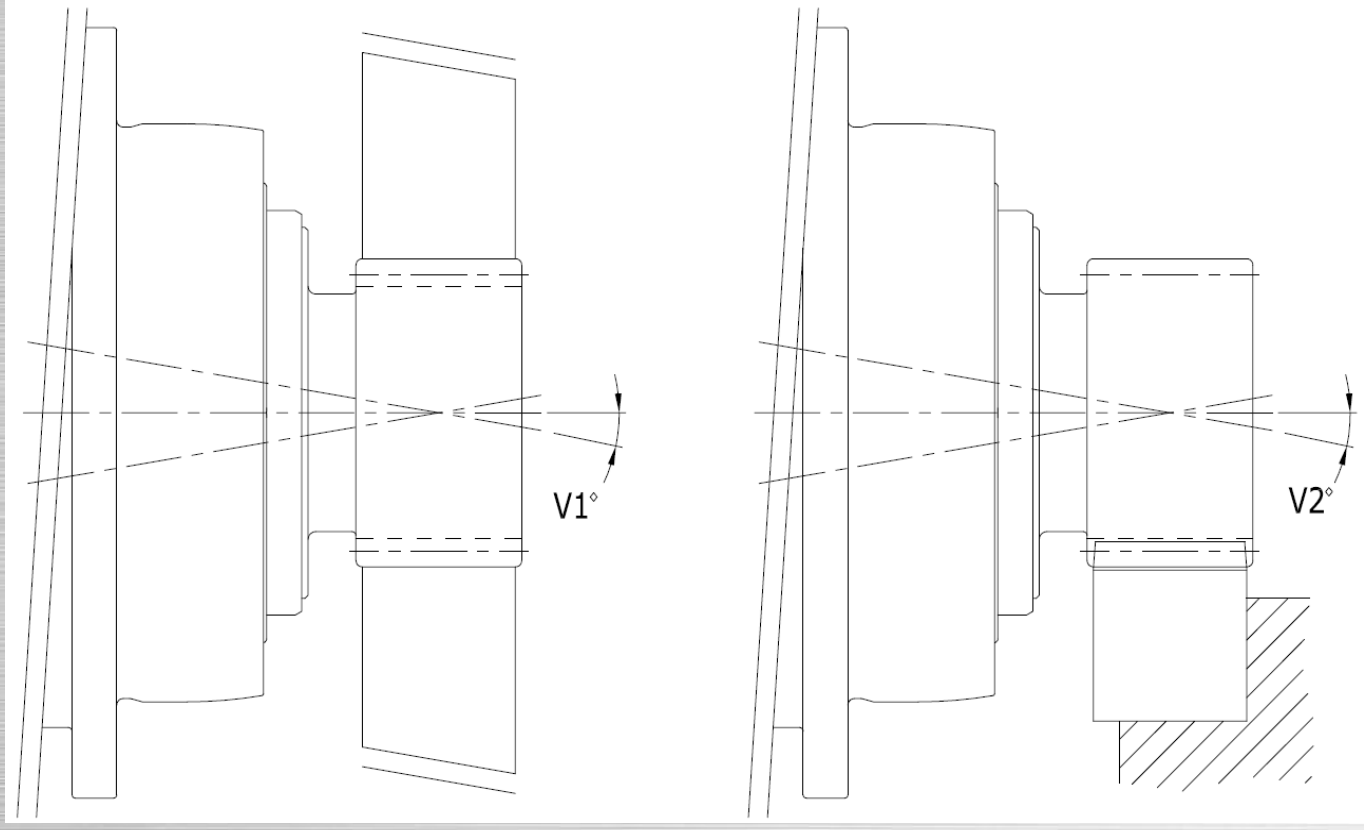
Check after Installation





Correct	Bad Perpendicularity	Bed Parallelism	In-correct Center Height
			

Special Design of APEX Pinion



Top View

Side View

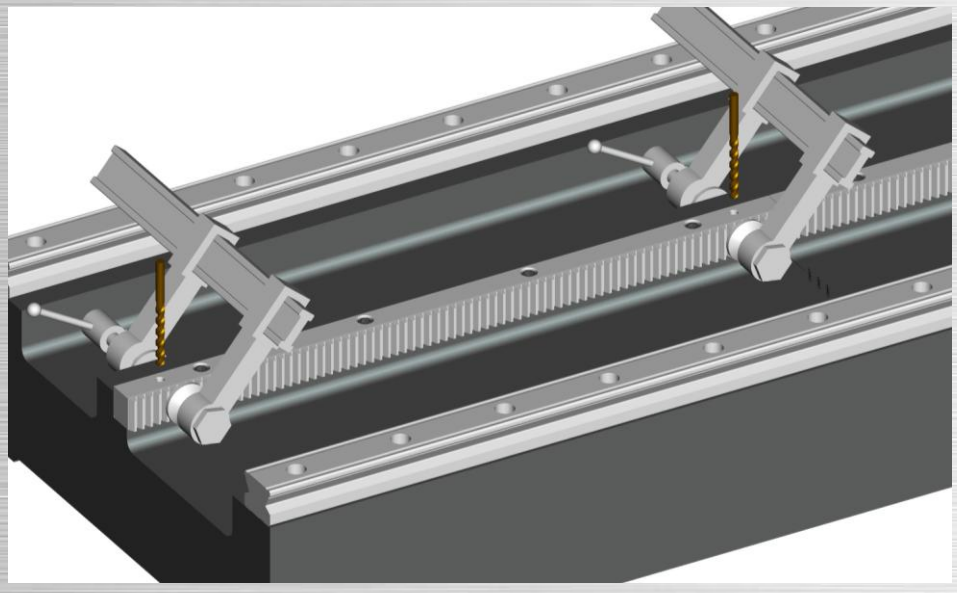
Special Design of APEX Pinion

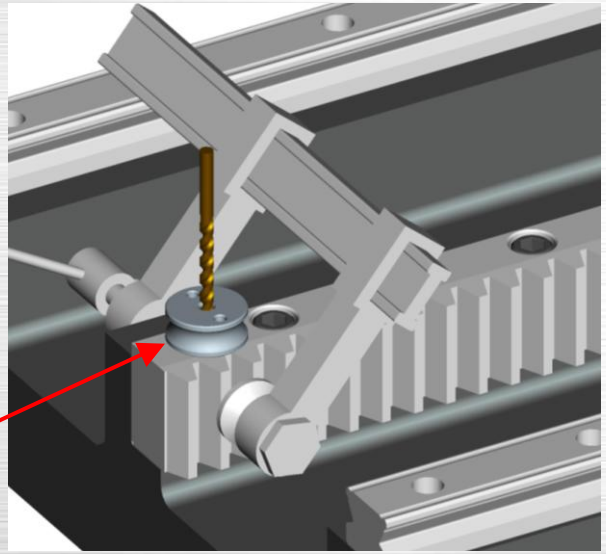
	Tolerance (in arcmin)	
Module No.	V1	V2
1.5	4.5	13.2
6	4.8	13.5
8	4.5	13.2
10	4.8	13.2
1.591（CP 5）	5.1	13.5
3.183（CP 10)	3.8	13.2
4.244（CP 13.33)	4.8	13.2

- **Tolerate larger machine bed error**
- **Easier Installation of pinion on the rack while achieving the accuracy!**

Re-Installation of Rack after Demounting

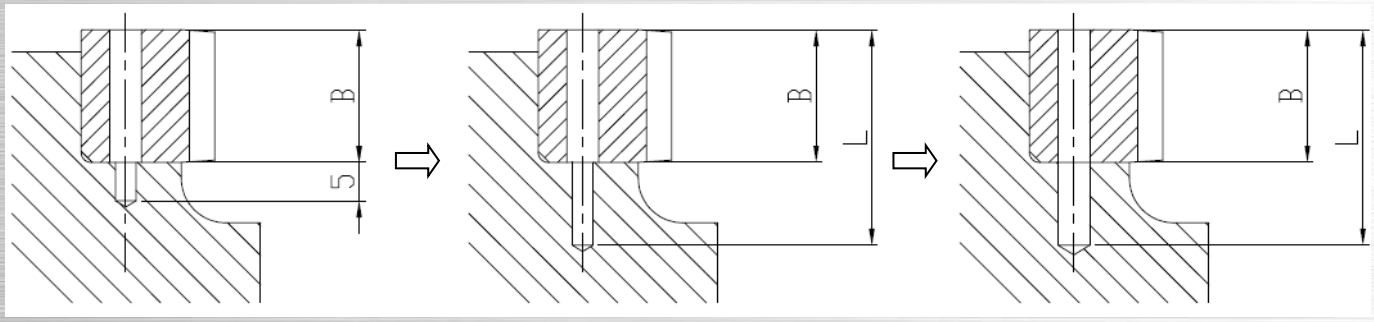
Drill the Pin Holes





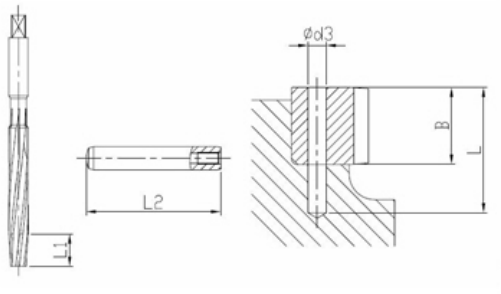
Re-Installation of Rack after Demounting

Drill the Pin Holes



(mm)

Module Number	Drill Hole Diameter on Rack	Pin Hole Diameter (H7)*
1	5.7	6
1.5	5.7	6
2	7.7	8
3	7.7	8
4	7.7	8
5	11.7 *	12
6	15.7 *	16
8	19.7 *	20
10	19.7 *	20
12	19.7 *	20



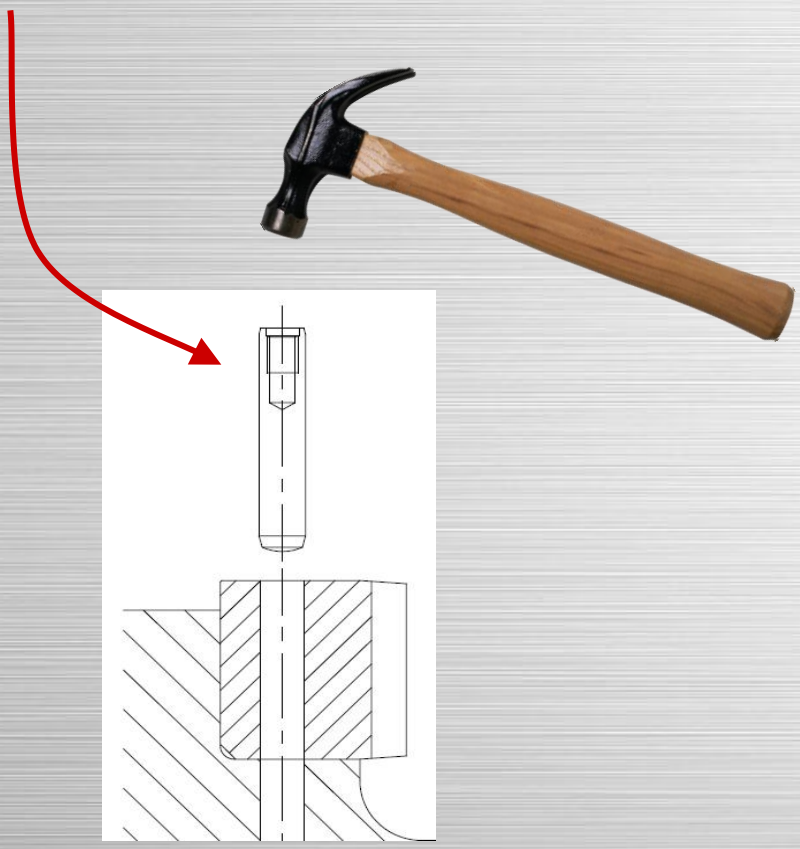
(mm)

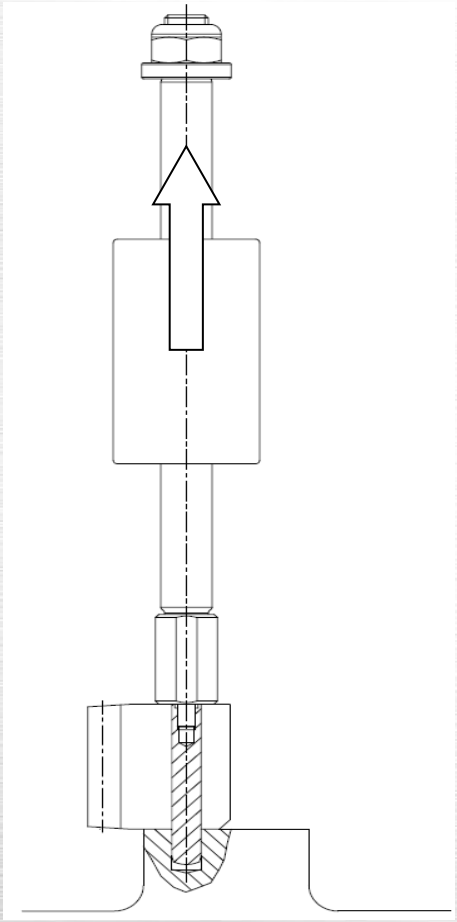
Module No.	Rack Width B	Pin Length L2	Drilling Depth L
3	29	40	L = L2 + L1 + 1
4	39	50	
5	49	70	
6	59	80	
8	79	100	
10	99	120	
12	120	140	

Re-Installation of Rack after Demounting

Install the Positioning Pins

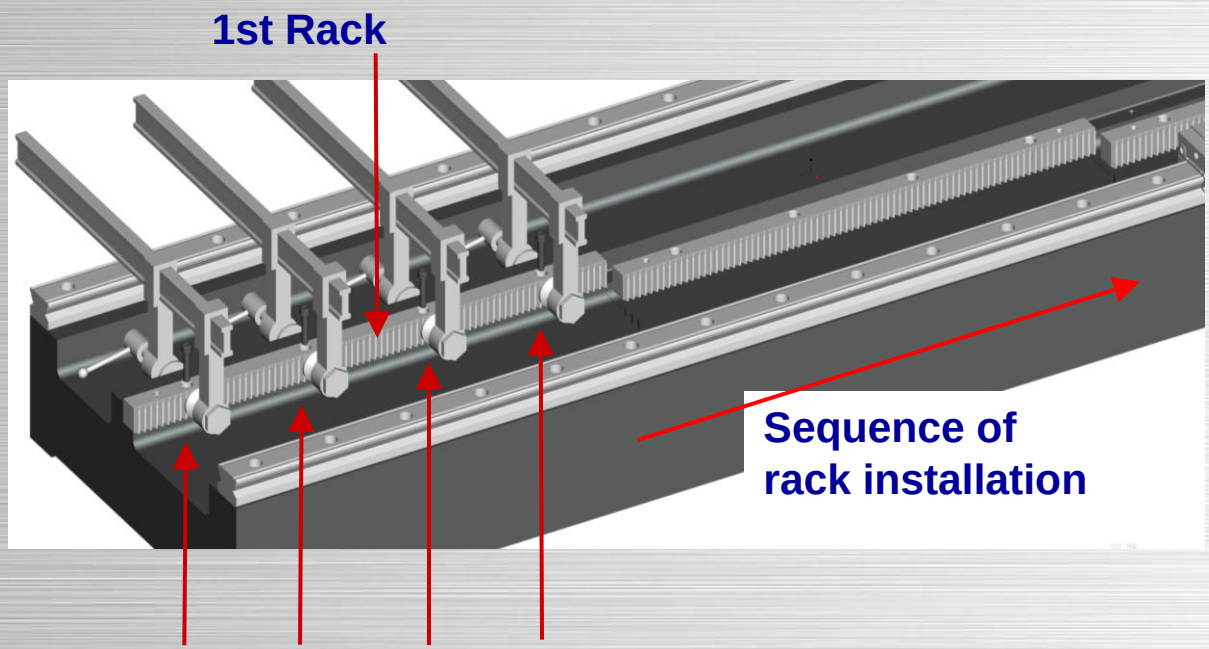
Pin: DIN 7979 / DIN EN, Type ISO 8735 A





Re-Installation of Rack after Demounting

The same Rack to the same Position + Pins



Re-Installation of Rack after Demounting

The same Rack in the same Position with the same Pins