	ATLANTA Documented Procedure		MPFZ 003 4100-001-04.93		
Department	TB	Assembly Plan Rack and Rail Combinations 90°Version	Page	1	1
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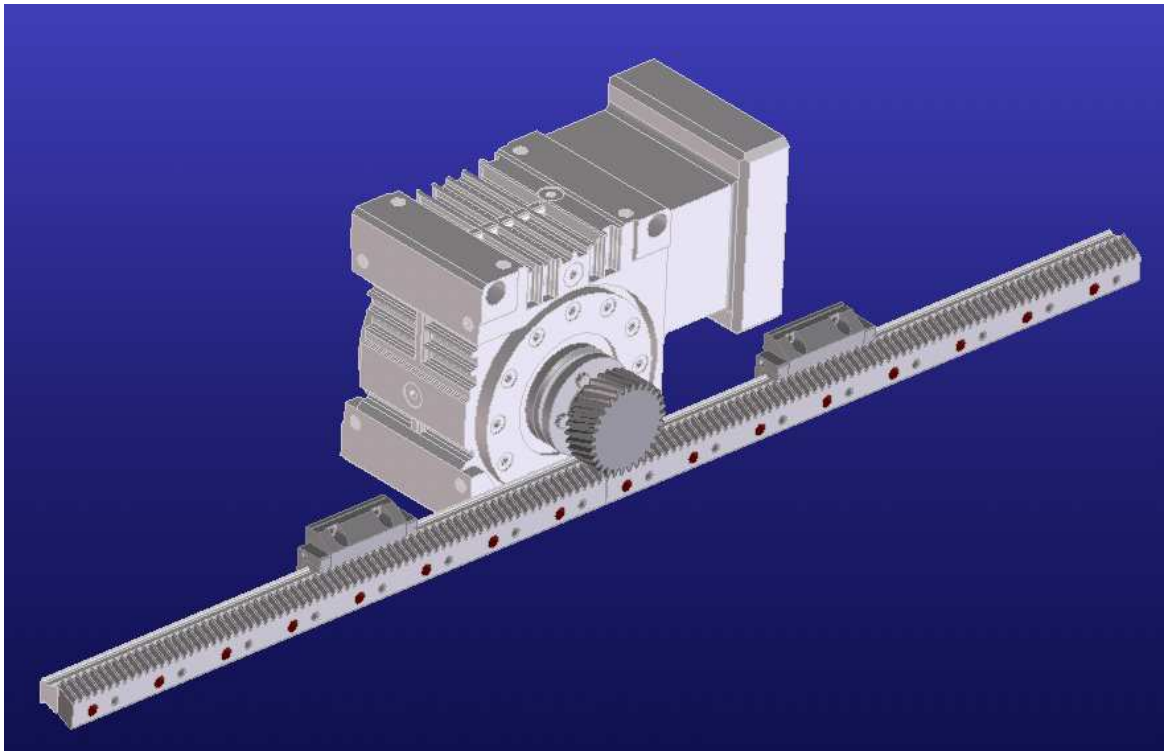

ATLANTA

Drive Systems

Rack and Pinion Drives
Rack and Rail Combinations

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CAUTION! The observance of the instructions in this documented procedure is prerequisite for the undisturbed operation and the contingent acceptance of liability on account of possible defects. Therefore study the operating instructions before starting the assembly. Make sure that this documented procedure is made accessible to the mounting personnel in legible condition.

Safety notes

The following signal symbols and words are used in the instructions to give you a warning or suggestion.

DANGER — warns you against high injury hazard.

WARNING — warns you against possible injury hazard.

CAUTION — warns you against minor injury and/or damage hazards.

Environmental hazard warns you of a pollution hazard for the environment.

Transport warns you of injury hazards during transport and handling of heavy and bulky objects.

Other signs and symbols used in the instructions:

☞ by a „handling instruction“ you are asked to do something.

☺ by a „suggestion“ you are informed of a possible simplification or improvement.

🛠 **Maintenance:** suggests optimal operation.

✍ **Identification:** shows the description of the rack.

🖂 **Storage:** informs about the correct storage of the racks.

Safety

WARNING

The racks may be assembled and installed only by skilled personnel having the necessary knowhow and experience.

WARNING

Always wear safety helmet, goggles, protective gloves, and safety shoes when lifting the rack out of its packing and handling it. For reasons of weight, a second person should be called in or a crane be used, if the weight exceeds 8 kg. Always have a second person lend a hand, if the length exceeds 1000 mm in order to prevent bending and injury due to false posture. The crane must always be operated by a crane driver. The rack to be carried must be properly secured and, if necessary, the ends of the rack marked in a clearly visible way.

☺ The table below shows the following masses:

Single racks without guide rail

mm	*Cross-section*	Mass of rack in kg					
Module		**2**	**3**	**4**			
Pitch					**5**	**10**	**13,33**
Length							
240	*39 x 39*	-	-	-	-	-	2,5
480	*19 x 19.5*	1.3	-	-	-	-	-
	24 x 24.5	2.1	-	-	-	-	-
	29 x 29.75	-	2.8	-	-	-	-
	39 x 39.75	-	-	5.2	-	-	-
	39 x 48.75	-	-	6.5	-	-	-
840	*49 x 58*	-	-	17.3	-	-	-
960	*19 x 19.5*	2.7	-	-	2.7	-	-
	24 x 24.5	4.2	-	-	4.2	-	-
	29 x 29.75	-	5.6	-	-	5.6	-
	39 x 39.75	-	-	10.5	-	-	10.5
	39 x 48.75	-	-	13.0	-	-	-
1920	*20 x 19.5*	5.4	-	-	5.4	-	-
	25 x 24.5	8.4	-	-	8.4	-	-
	30 x 29.75	-	11.2	-	-	11.2	-
	40 x 39.75	-	-	21.5	-	-	21.5

Rack and rail combinations

mm	*Cross-section Rack*	Guide rail	Mass of rack and guide rail combination in kg					
Module			**2**	**3**	**4**			
Pitch						**5**	**10**	**13,33**
Length		Size						
480	*19 x 19.5*	15	2.1	-	-	-	-	-
	24 x 24.5	20	3.25	-	-	-	-	-
	29 x 29.75	25	-	4.3	-	-	-	-
	39 x 39.75	30	-	-	7.35	-	-	-
	39 x 48.75	35	-	-	9.65	-	-	-
840	*49 x 58*	45	-	-	26.8	-	-	-
960	*19 x 19.5*	15	4.2	-	-	4.2	-	-
	24 x 24.5	20	6.5	-	-	6.5	-	-
	29 x 29.75	25	-	8.6	-	-	8.6	-
	39 x 39.75	30	-	-	14.7	-	-	14.7
	39 x 48.75	35	-	-	19.3	-	-	-
1920	*20 x 19.5*	15	8.4	-	-	8.4	-	-
	25 x 24.5	20	13.0	-	-	13	-	-
	30 x 29.75	25	-	17.2	-	-	17.2	-
	40 x 39.75	30	-	-	30.0	-	-	30.0
1680	*49 x 58*	45	-	-	53.6	-	-	-
2520	*49 x 58*	45	-	-	80.4	-	-	-
2400	*19 x 19.5*	15	6.3					
	24 x 24.5	20	9,75					

	29 x 29,75	25	-	12,9				
mm	*Cross-section Rack*	Guide rail	Mass of rack and guide-rail combination in kg					
Module			**2**	**3**	**4**			
Pitch						**5**	**10**	**13,33**
Length		Size						
2400	*39 x 39.75*	30			22.0			
	39 x 48.75	35			29.0			
2880	*19 x 19.5*	15	12.6			12.6		
	24 x 24.5	20	19.5			19.5		
	29 x 29.75	25	-	25.8			25.8	
	39 x 39.75	30	-		22.0			22.0
	39 x 48.75	35	-		30.0			

⚠WARNING

Mark the swivelling radius of the rack with a warning sign and a barring tape. This area must be blocked during transport and handling so that no persons may be endangered.

⚠WARNING

Before starting transportation, the path must be inspected for possible slipping hazards or other disturbing influences and, if necessary, made safe.

⚠CAUTION

Before starting transportation it must be ascertained that the overall dimensions of the rack permit safe handling. Possible obstacles are to be removed or bypassed.

⚠ DANGER

Always wear gloves when handling racks, because racks (especially those with helical teeth) have sharp edges!

⚠CAUTION

In order to avoid injury due to false posture the height of the assembly device must be chosen in such a way that it suits the height of the mechanic. An adjustable assembly device would be needed if mechanics of different height were to work at the same device.

⚠ DANGER

Suitable supports or trestles must be provided in order to prevent hand or fingers from being squeezed and bruised when depositing the unit onto the device or on a table.

⚠ DANGER

It is also important to consider the point of gravity of the rack when setting it down because otherwise the unit could tilt or fall. Consequences could be heavy contusions of the limbs. A suitable support should also be provided when displacing the elements in order to avoid bending.

⚠CAUTION

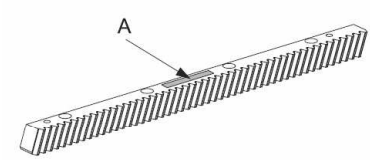
For fitting the screws, a suitable working height should be chosen for the mechanic. Furthermore it is important to choose a suitable screwdriver to avoid shocks within the wrist. The work surroundings must be perfectly prepared for this process in order to avoid becoming bruised while working.

⚠CAUTION

Whenever having touched the rack or the guide rail without gloves, wash your hands after work because the racks are oiled.

Item number

☺ The item number A) is on the rack



✍ **Identification**

☞ The rack is identified by item number and order code as well as the manufacturer's logo.

Description

Rack and pinion drives convert the rotary motion and torque of a gearwheel into the power-transmitting linear motion of a toothed rack. This takes place when the operating pitch cylinder of the gearwheel meshes with the common pitch surface of the rack without slipping. The rolling axis is thus the instantaneous axis of motion of the gearwheel in relation to the rack. In rack and pinion drives the motion is transmitted by positive connection. The teeth are therefore shaped in such a way that imaginary pitch cylinders can be inscribed in both functional partners rolling on one another without slipping. At the point of contact the peripheral speed of both operating pitch circles is identical. Racks are available in different quality grades to be chosen by the customer to suit the intended use.

Use

Toothed racks are used in applications where rotary motions are to be converted into linear motions. The advantage, as compared with other types of gear units with linear motion, is their high precision, speed, stiffness, and almost infinite length.

⚠CAUTION

Rack and rail combinations may be used exclusively for converting rotary motion with torque into power-transmitting linear motion in machine and plant construction applications under atmospheric conditions.

☞ The maximum torque values permissible are specified in our catalogue or on our web-site: http://www.atlantagmbh.de.

☞ The layout must be made strictly in accordance with our instructions. Any deviation requires written approval by Atlanta; otherwise this will be considered non-contractual use.

☞ Exceeding the permissible torque shall be considered non-contractual use and is therefore forbidden.

☞ Wrong alignment (see chapter „Final Inspection" on page 14) of the gearwheel with relation to the rack shall be considered non-contractual use and is therefore forbidden.

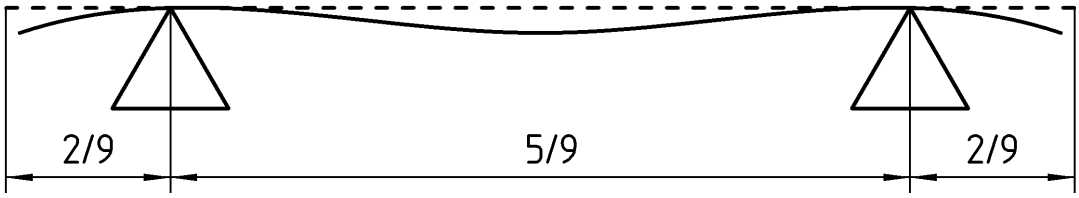
☞ Improper lubrication, e.g. lack of lubricant and/or use of a wrong lubricant, or insufficient protection against pollution shall be considered non-contractual use and is therefore forbidden.

☞ If several racks are linked in line, it must be assured that the pitch lies within the permissible individual pitch error tolerances also at the joints.

Transport and handling

CAUTION

- ☞ Observe all safety regulations applying to transport and handling with lifting gear.
- ☞ Make sure that the load is handled and set down slowly and carefully.
- ☞ Especially when transporting and handling long racks (≥ 2000 mm), avoid any leverage upon the rack. Favourable lever arm ratios are as shown in the following drawing:



- ☞ If necessary, have one or more persons lend a hand.

Storage

If the rack is not going to be installed immediately after delivery, the following measures should be taken:

- ☞ Protect the rack and rail combination against corrosion. The storerooms must be dry. Remove the anti-corrosive agent only immediately before the installation. When storing for a period of more than one month, renew the anti-corrosive coating.
- ☞ Avoid any unfavourable leverage on the rack during storage (for lever ratios see paragraph “Transport and handling”).
- ☞ Protect the rack against dust or other pollution.
- ☞ Do not damage the teeth or the supporting/contact surfaces.
- ☞ Avoid any metal-to-metal contacts between the racks during storage. Put a layer of protective foil or oil paper between them.

Preparing the installation

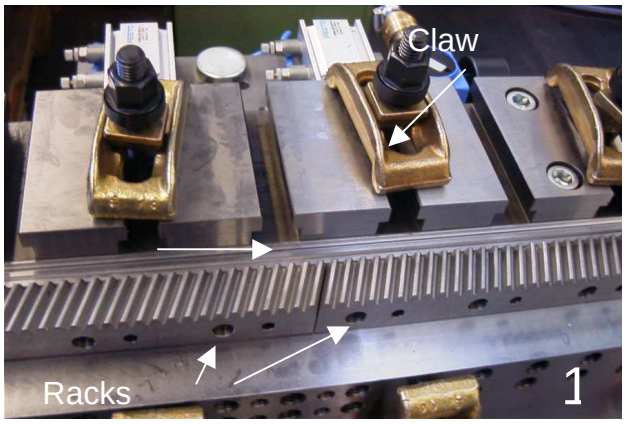
CAUTION

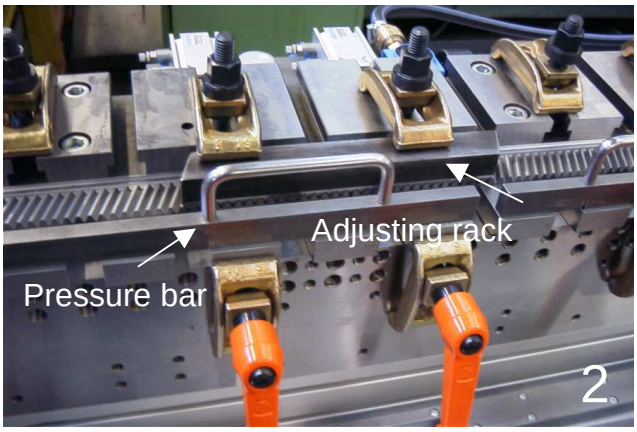
- ☞ Set your torque wrench and check its function.
- ☞ Wear gloves while assembling in order to avoid contact corrosion.
- ☞ Inspect the racks for external damage and soiling.
- ☞ A damaged or soiled rack must neither be mounted nor operated. The contact surfaces and, if necessary, supporting surfaces, are to be carefully wiped off with a clean rag. .

Assembly of racks and guide rail on the assembly device

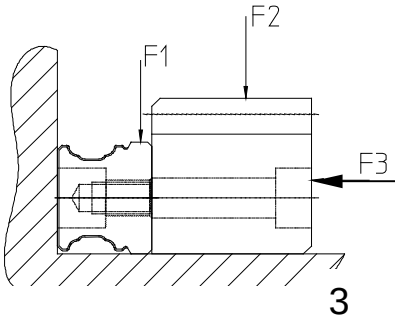
☺ We recommend to provide an assembly device and to use an auxiliary adjusting rack (mating companion piece).

☞ Before starting the assembly: Set your torque wrench and check its function.
Wear gloves while assembling in order to avoid contact corrosion.

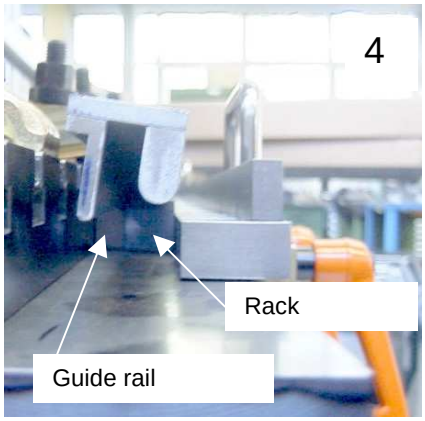


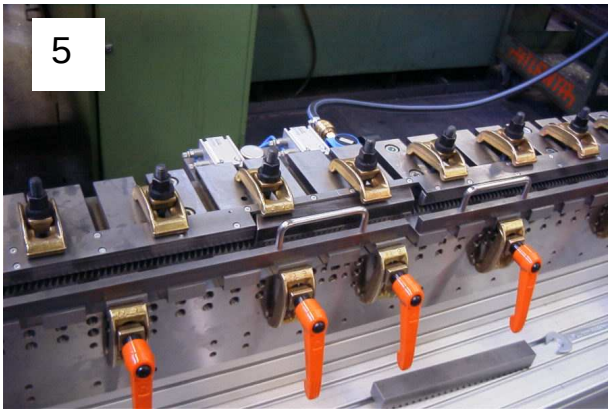


☞ 1. Thoroughly clean the device, especially the contact surfaces on the bench, with a clean rag.
☞ 2. Have the guide rail and racks ready. The inscription on the rack should be legible in the proper installation position. Clean the contact surfaces of guide rail and rack with a clean rag. Hold the guide rail and the racks in position with two screws, which, however, must not yet be fully tightened.
☞ 3. Push the rack with guide rail into the device until the joint of the rack reaches the middle of the device.
☞ 4. Set the pressure bar F3 against the side paying attention that the countersunk holes for the fixing screws remain unobstructed (picture 3).
☞ 5. Put the lateral clamps on the pressure bar starting from the middle of the device outwards. Rack and guide rail can still be moved.
☞ 6. Insert the auxiliary adjusting rack from above to match the pitch of the two racks, and take care that the overlap on both racks is equal (Picture 2). Now fit the claws for the adjusting rack.

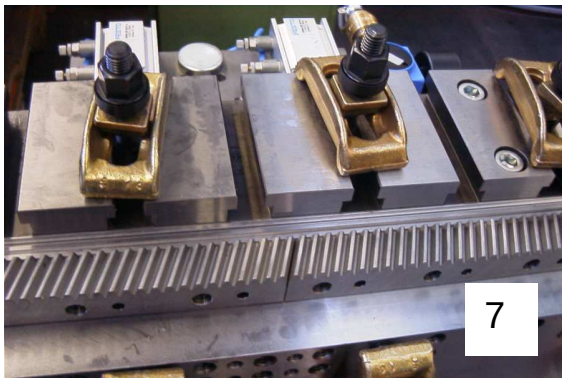


Countersunk holes for the fixing screws



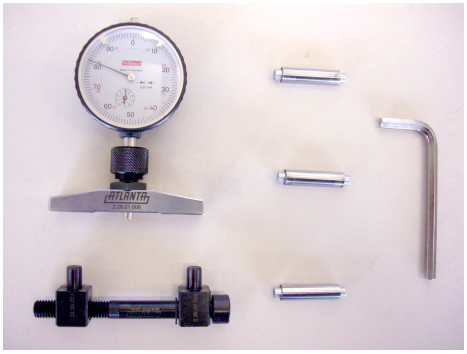


- ☞ 7. Mount the upper clamping rail (Picture 4) and pull it against the rack. Pay attention to the position of the upper clamping rail as the contact area between guide rail and clamping rail is rather narrow.
- ☞ 8. Firmly tighten the clamping claws on the auxiliary adjusting rack.
- ☞ 9. Center the guide rail in the screw holes with relation to the rack.
- ☞ 10. Mount the upper clamping claws F1 and F2 on the clamping rail working from the middle outwards (Picture 5).
- ☞ 11. Tighten the lateral clamping claws working from the middle of the device outwards (Picture 5).
- ☞ 12. Tighten the upper clamping claws from the middle of the device outwards (Picture 5).
- ☞ 13. Loosen the clamp claws on the auxiliary adjusting rack. Remove the adjusting rack. Check the roll dimension at the joint with out mounting set and adjust, if necessary, as described below.



- ☞ 14. Screw in the screws with a torque wrench starting in the middle of the device and continuing outwards (Picture 6).
- ☞ 15. Loosen the clamps (Picture 7) and displace the assembled unit by one rack length to the right.
- ☞ 16. Repeat the steps from step 3 without step 9.
- ☞ 17. When the third and/or fourth rack are mounted push the completely assembled unit onto the side table.
- ☞ 18. Using a dosing apparatus apply „red“ screw locking paint onto each screw. A paint bond must exist between screw and rack.
- ☞ 19. Upon completion of the assembling process check the roll dimension at the joint according to the illustration on page 11. We recommend to check this dimension with our mounting set described on the following pages. For suitable size and description see also our servo catalogue or web-site: http://www.atlantagmbh.de.

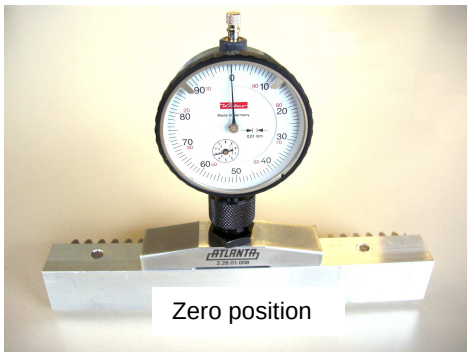
Checking the roll dimension with the mounting set



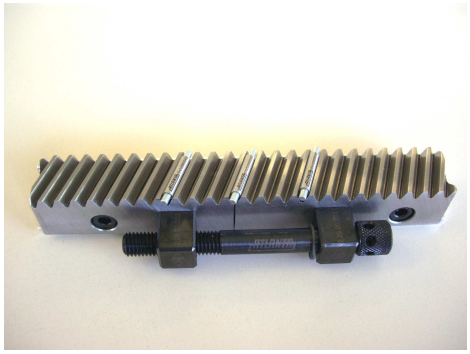
The mounting set consists of a displacement device, three magnetic measuring rolls and a measuring bridge with dial gauge as well as a hexagon wrench.

For a correct check and, if necessary, readjustment of the roll dimension at the joints between the continuously linked racks follow the steps described hereafter.

1. Put the measuring bridge on a smooth-ground surface and set the dial gauge to zero.



2. Plug the displacement unit into the countersunk holes at the joint of the two racks. One measuring roll is laid in the tooth gap at the joint and the other two in a tooth gap left and right of the joint. Position the measuring bridge on the rolls so that the feeler of the dial gauge can feel the medium roll. Now seek the high point by displacing sideways.

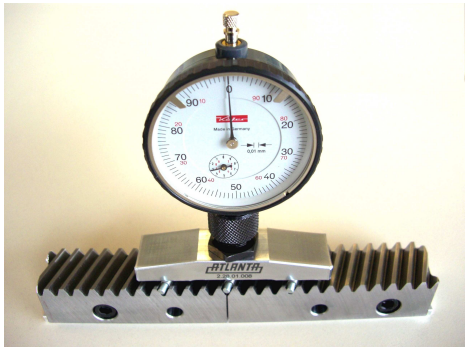


3. Using a hexagon wrench adjust the set-screw of the displacing unit in such a way that the rack, which is not yet firmly screwed, can be moved to the left or the right until the dial gauge reaches the zero position again.

Permissible deviations measured with the mounting set

m / Q	2	3	4	5	6	8	10
4	-	-	-	±0.004	±0.004	±0.004	±0.004
6	±0.01	±0.011	±0.011	±0.016	±0.016	±0.014	±0.015
7	-	-	-	-	-	-	-
8	±0.027	±0.03	±0.032	±0.033	-	-	-
9	±0.027	±0.03	±0.032	±0.033	±0.036	±0.038	±0.041
10	±0.041	±0.042	±0.045	±0.047	±0.049	-	-
11	-	-	-	-	-	-	-

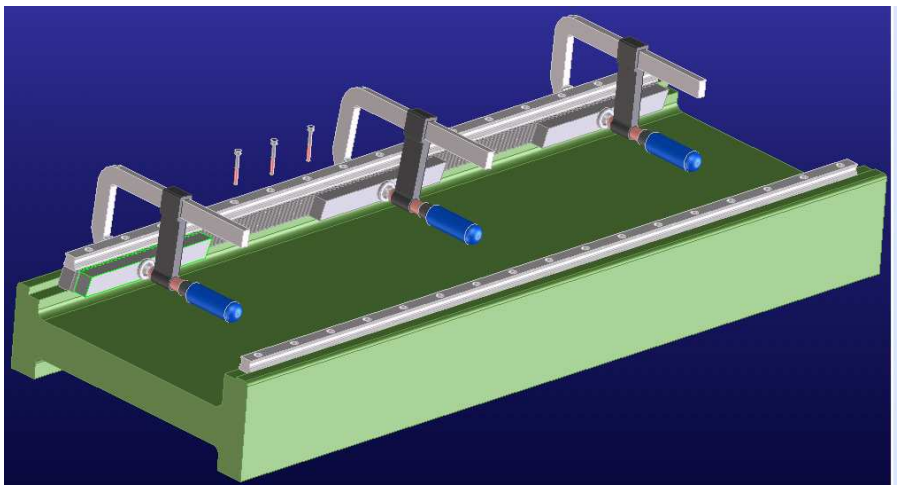
4. Slightly tighten the hexagon socket head screws on the not yet fully fixed rack and loosen the set-screws at the displacement unit. Remove the displacement unit from the countersunk holes of the racks.



5. Now tighten the hexagon socket head screws using a torque wrench according to the torque table below working from the middle outwards.

Hexagon socket head screws 12.9	M4	M5	M6	M8	M12
Tightening torque in Nm	4.8	9.5	16	39	135
Tightening torque in lbf in					

☺ Example for mounting a rack and guide rail combination on the machine bed

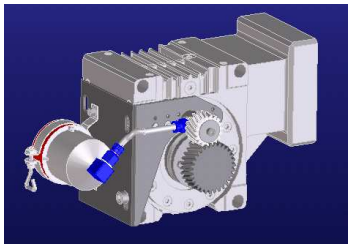


☞ Position the rack and rail combination on the supporting surface in the machine bed and adjust it according to the holes. Lay the companion pieces into the teeth of the rack and clamp them with screw clamps to the contact surface on the machine bed. Insert the hexagon socket head screws and tighten them with the torque specified in the table on page 11. Loosen the screw clamps and remove the companion pieces.

Mounting the gear unit

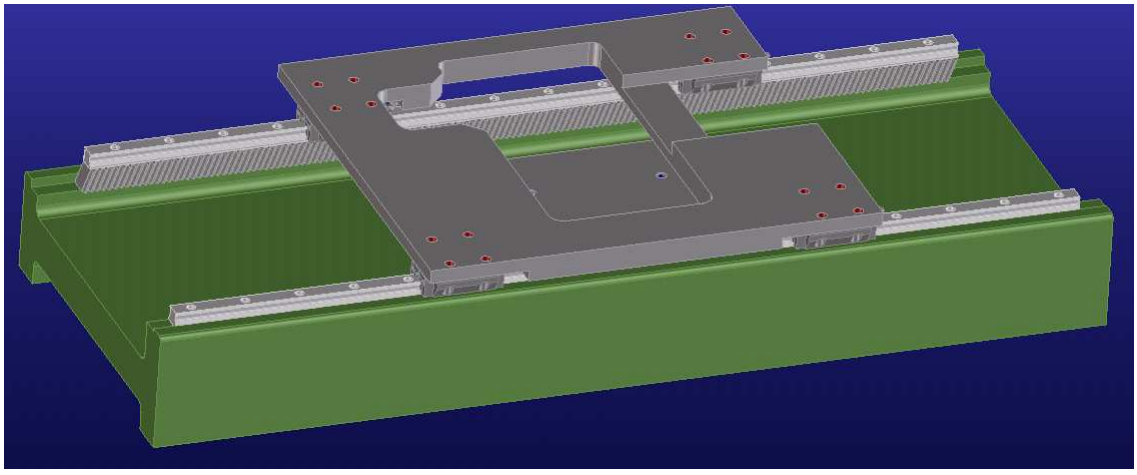
Before mounting on the machine bed the gear unit must be equipped with the pinion shaft and the lubricating unit (see separate instructions). If, for reasons of space, it is not possible to mount the lubricating unit on the gear unit, the lubrication can be assured in another way.

The example below shows the lubricating unit mounted on the gear unit.



The machine table must be designed in such a way that the gear unit can be readily mounted and adjusted.

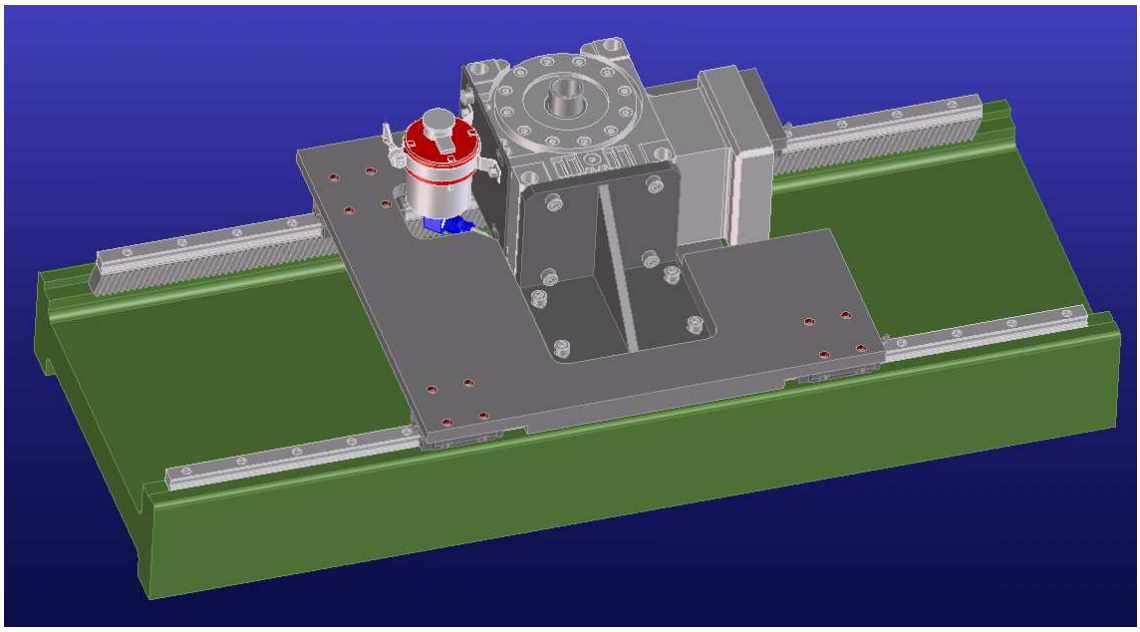
An example is shown on the picture below.



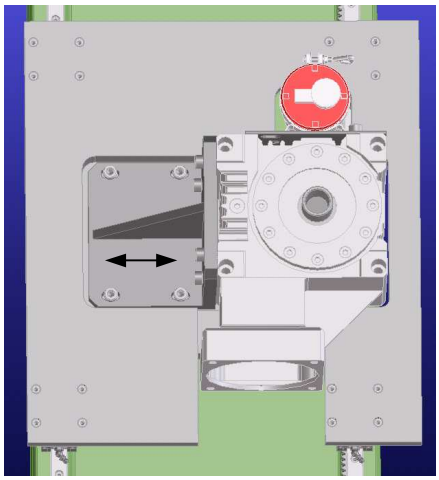
⚠ DANGER

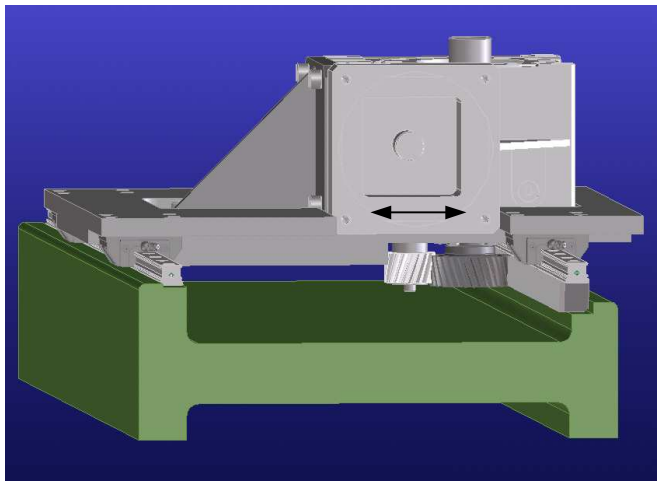
In the case of Z axes (vertical assembly) the machine table must be properly secured before positive connection with rack and gear unit because otherwise it could roll off due to its own weight and cause personal injury and material damage.

☞ Preassemble the gear unit on the machine table. Do not yet fully tighten the fixing screws. A mounting example is shown on the picture below.



Engaging the gear unit





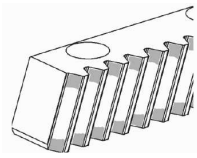
☞ Push the adjusting unit, consisting, for example, of the gear unit and two lateral angle irons, manually into the gearing until the pinion meshes with only little backlash with the rack. Then slightly fix the adjusting

unit with the screws. Move it over the travelling length and seek the high point. When the pinion is properly engaged in the rack, the adjusting unit can be fixed permanently; if not, it must be readjusted. At the low point of the traverse there will be a play of the tooth flanks the size of which depends upon the quality of rack and pinion. Depending upon the quality of the rack the circumferential backlash can vary more or less.

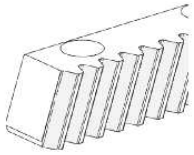
☺ In order to ensure a traversing movement free from play over the whole travelling length we recommend to replace the pinion shaft inside the gearbox by a pre-load pinion shaft. The mounting and adjusting instructions for this item as well as the torque to be transmitted can be seen from the pertinent operation description.

Final inspection

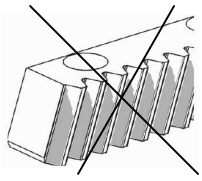
- ☞ Remove the grease from the tooth flanks.
- ☞ Coat the tooth flanks with marking paint.
- ☞ Shift the machine table several times so that the pinion runs over the paint coated tooth flanks.
- ☞ At the same time check the smooth operation of the gearing. The power required and the running noise must remain the same over the full distance. There must not be any bumps at the joints.
- ☞ Check the area where the paint has been rubbed off from the tooth flanks.
- ☞ Judge the adjustment of the gear unit by checking the tooth contact by means of the contact patterns shown on the following sketches.
- ☞ If necessary, correct the alignment of the gear unit.
- ☞ Check the racks at the joint for precision of pitch.



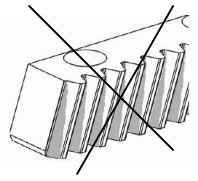
Correct



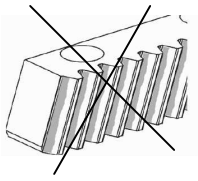
Correct



Not at right angles



Not parallel



Wrong center distance

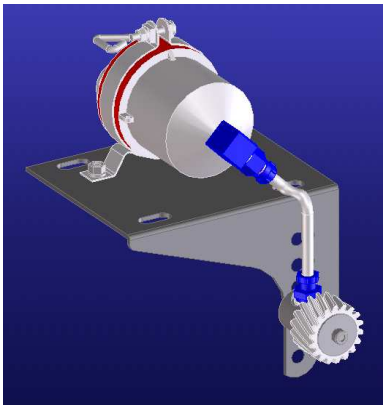
Operating conditions pinion / rack

⚠CAUTION

Lacking or insufficient lubrication leads to damage to the teeth.

- ☞ Ensure proper lubrication and timely replacement of the grease cup.
- ☞ Pay attention to the correct meshing of pinion and rack.
- ☞ In the case of X and Y axes (horizontal installation without gearbox) it should be possible to move the freewheeling machine table by hand uniformly over the full travelling length (while checking for tension-free installation). In the case of Z axes the machine table must be properly secured.

Starting up the lubricating unit



☺ The lubricating unit consists of a mounting bracket, an electronically controlled lubricator, a set of connecting hoses, a mounting axle, and a felt gearwheel. Depending upon the mounting position on the gearbox, the felt gearwheel can be fixed on the mounting bracket in various positions.

☞ When mounting the lubricator on the gearbox, make sure that the teeth of the felt gearwheel mesh perfectly with the teeth of the pinion shaft. Due to the rectangular slots provided in the mounting bracket the lubricating unit can be displaced on the gear unit.

☞ Before switching on the lubricator, make sure that the hose is filled without any air bubbles and that the felt gearwheel is filled with suitable lubricant.

☺ Information as to the mounting dimensions, possible mounting positions, and type of lubricant can be seen from our catalogue or our web-site http://www.atlantagmbh.de

☺ If due to restricted space conditions the lubricator cannot be installed as shown above, the individual components can also be used without the mounting bracket. In this case the attachment of the mounting axle with the felt gearwheel and the supply of the lubricant from the grease cup by means of the set of connecting hoses must be adapted to the existing mounting conditions.

☞ Please be aware that in the case of grease lubrication the hose must not be longer than 1.5 m. There must not be any kinks, and before starting up the lubricator, the hose must be filled with the suitable lubricant without air bubbles. Furthermore the felt gearwheel must also be soaked with the suitable lubricant.

☞ The center distance „a“ between pinion and felt gearwheel is calculated by the following formula:

$$a = \frac{d_R + d_F}{2}$$ d_R – pitch circle of pinion; d_F – pitch circle of felt gearwheel

☞ The center distance „a“ between rack and felt gearwheel is calculated by the following formula:

$$a = h_0 \times \frac{d_F}{2}$$ h_0 – pitch height of rack; d_F – pitch circle felt gearwheel

☺ Further suggestions as to the proper start-up of the whole lubricating system are contained in the operating instructions BKI 101; BKI 102; BKI 104, and BKI 105.

🛠 Maintenance

Putting out of operation, preparations

☞ Mind the instructions in the chapter **„Safety“**

☞ The machine into which the rack and pinion drive is installed must be shut down.

☞ Cut off the power supply before starting any maintenance work.

☞ In the case of Z axes (vertical installation) the machine table must be properly secured.

⚠ DANGER When disassembling racks and gear unit, the positive connection to the machine table is interrupted. If, in the case of Z axes the machine table is not properly secured, it can roll off due to its own weight thus causing personal injury and material damage.

Visual check

☞ The entire drive system must be visually checked for external damage and leakage.

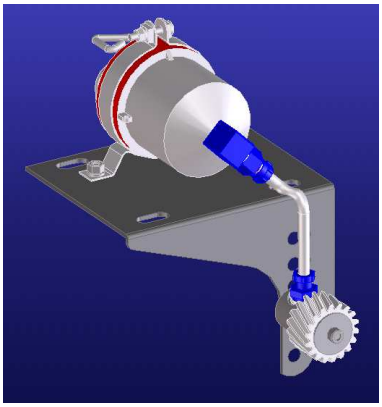
☞ Any defective or leaking components are to be repaired immediately. In this connection please also observe the following operating and maintenance instructions:

☺ HT servo high-performance gear units	BWS 113
☺ HP servo high-performance gear units	BWS 107-10
☺ E servo wormgear units	BWS 110
☺ B servo wormgear units	BWS 112

☞ Clean pinion and rack.

☞ Product-related information regarding maintenance questions can be ordered from the ATLANTA technical department.

Inspection of the lubricating system



☺ The filling level can be seen through the transparent housing.

☞ Thorough visual check for externally visible damage such as loosened, kinked or defective hose, worn or soiled felt gearwheel, and for proper functioning of the lubricator.

☞ Any defective, soiled or non-functioning components are to be replaced immediately.

The service life of the felt gearwheel depends upon the ambient conditions.

☺ When working under polluted ambient conditions, we recommend to shorten the inspection intervals.

☺ The felt gearwheel must never be exposed to ambient temperatures of >70℃.

Please also observe the operating and maintenance instructions BKI 101; BKI 102; BKI 103; BKI 104; BKI 105, and BKI 106 for the lubricator.

<u>Restarting the operation after maintenance</u>

☞ Reinstall all safety devices.

☞ In the case of Z axes check the connection between machine table, rack and gear unit and unlock the machine table.

☞ Before releasing the machine again for operation perform a test run.

☞ Look for any forgotten screws and tools and remove them.

<u>Error list (troubleshooting)</u>

☞ React immediately whenever you detect unusual lubricant losses, increased running noises, or unusually high gear temperatures.

Error	Possible cause	Remedy
Increased temperature of gear unit	Layout too weak	Check technical data
	Heat transmission from the motor	Check the motor, replace, cool
	Ambient temperature too high	Provide adequate cooling
	Insufficient lubrication	Check quantity of lubricant, remedy cause of leakage, refill
Increased running noise	Untrue running of the clutch on the motor shaft	Check the clutch for true running, loosen, and adjust
	Bearing damage	Contact the technical department of ATLANTA
	Gearing damage	
	Wrong installation pinion/rack	See “Final Inspection”
	Insufficient lubrication	See „Inspection of Lubricating System“
Loss of lubricant	Too much lubricant	Wipe off leaking lubricant, keep an eye upon gearbox and lubricator
	Leakage	Contact the technical division of ATLANTA

Disassembly

Improper performance of the work may cause personal injury and material damage.

☞ The disassembly of rack and gear unit may be carried out only by skilled personnel with the necessary knowhow and experience.

Preparation

☞ The machine into which the drive system is installed must be shut down.
☞ It must be ensured that the drive system can be removed without danger of damage to the machine .
☞ Before starting the work cut off the machine from the power supply.
☞ In the case of Z axes (vertical installation) the machine table must be properly secured.

When disassembling the racks and the gear unit the positive to the machine table is interrupted. If, in the case of Z axes, the machine table is not properly secured, it can roll off due to its own weight thus causing personal injury and material damage.

Disassembling the rack and rail combination

☞ Loosen all fixing screws. Then remove the rack and rail combination from the machine bed. Be careful not to damage the drive system or any adjacent components when taking off the rack.

Lubricants

Lubrication of rack and pinion drives:

For the continuous lubrication of rack and pinion drives we recommend to use electronically controlled lubricators. Together with the electronically controlled lubricator you can use the felt gearwheel or the sliding brush.

Item numbers and descriptions are contained in our catalogue or the web-site http://www.atlantagmbh.de.

Recommended are the following lubricants::

☺ Klüber Microlube GB 0
Bestell-Nr. 65 90 002 (1 kg)

☺ Klüber Structovis AHD
Bestell-Nr. 65 90 003 (1 kg)

The following lubricants have also been tested with good results:

☺ Oest Langzeitfett LT 200

☺ BP Energrease LS EP 00

☺ DEA Glissando 6833 EP 00

☺ Fuchs Lubritech Gearmaster ZSA

☺ Molykote G-Rapid plus 3694

Disposal

Lubricants

 **Environmental hazard**

Lubricants are hazardous substances susceptible to pollute soil and water.

☞ Dispose of the lubricants as required by national regulations.

☞ Never mix polyglycolic substances with mineral oils which are intended for recycling.

Seals

☞ Sealing rings are to be disposed of as compound materials (metal/plastics).

Metal

☞ The drive components are to be separated as follows:

- Iron
- Aluminium (housings, covers)
- Non-ferrous metal (worm gears; motor windings)

Hoses

☞ Hoses are to be disposed off as plastic material

Felt gearwheels

☞ Felt gearwheels can be disposed off as residual waste.