# 13 Construction and installation guidelines

## 13.1 The connecting structure and its influence on service life

Linear guideways are high-precision components. The requirements for theconnecting structure are also high to ensure the accuracy of the guideways are maximized.

The quality of the reference and supporting surfaces as well as the rigidity of the connecting structure must meet the most stringent requirements. If this is not the case, smoothness, precision and service life of the guideway will be significantly affected.

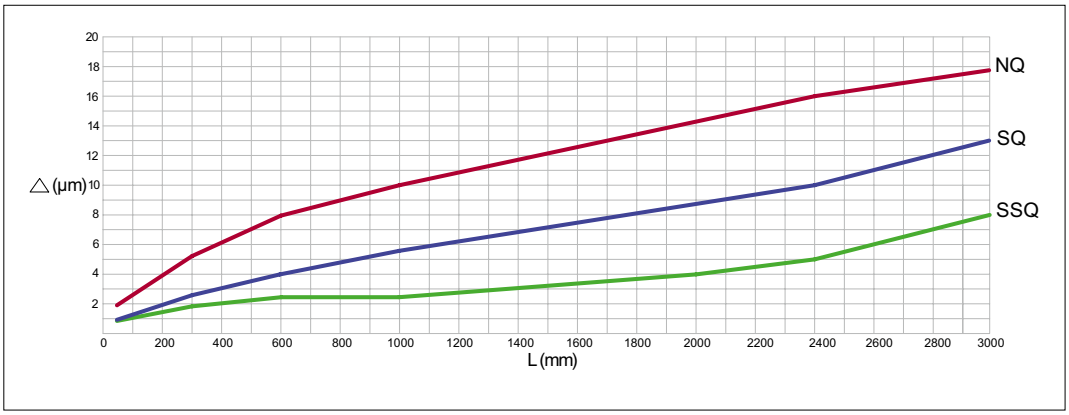
To exploit the full potential of the linear guideways, assembly on a rigid and ground substrate is recommended. Connecting structures made of light metal are only suitable in certain instances - due to their lower rigidity and limited machining accuracy.

## 13.2 Configuration of the connecting structure

**Parallelism of the reference and locating surfaces**

They must be compatible with those of the linear guideway (also applies when using linear guideways with recirculating units):

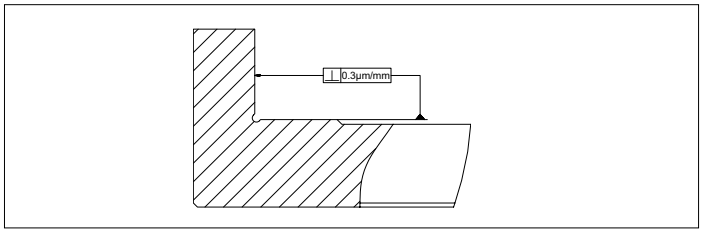
NQ Normal quality
SQ Special quality
SSQ Super special quality




**Surface quality**

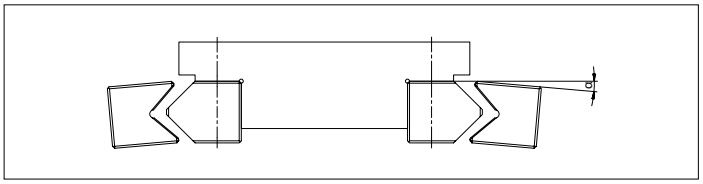
The accuracy of the application critically determines the required surface quality of the reference and locating surfaces. For high-precision applications they must demonstrate a maximum Ra value of 0.4. An Ra value of 1.6 may not be exceeded for standard applications.

### Angular error




The angular errors for the supporting and locating surface should not exceed 0.3 µm/mm.

### Height offset for linear guideways

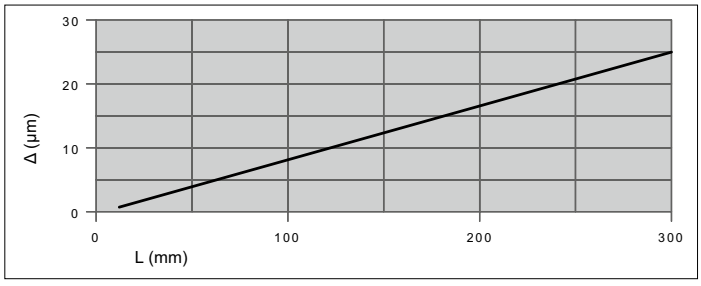


The angular errors resulting from height offset and/or elastic deformations may not exceed the following values:

| | |
|---|---|
| Balls or rollers: | 0.3 µm/mm |
| Needles | 0.1 µm/mm |

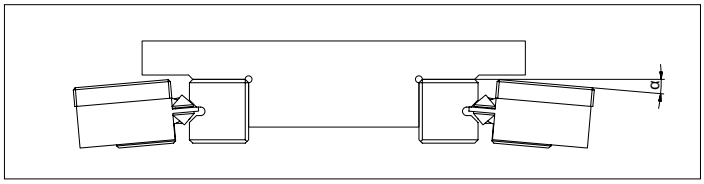
### Parallelism of the supporting and locating surfaces in the case of the recirculating unit

The parallelism of the supporting and locating surfaces in relation to the mating track can be derived from the diagram below:



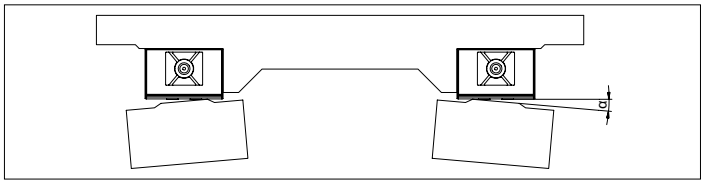
# 13 Construction and installation guidelines

### Height offset for recirculating units



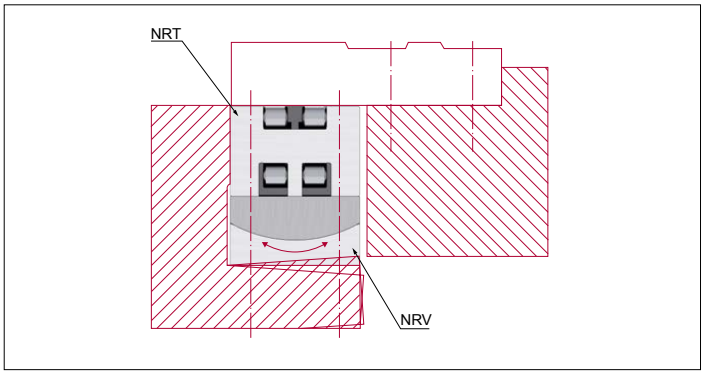

The angular errors results from height offset and/or elastic deformations may not exceed the following values:

| | |
|---|---|
| For types SK, SKD and SKC | 3.0 µm/mm |
| For types SR | 0.3 µm/mm |




| | |
|---|---|
| For types NRT | 0.3 µm/mm |

### Combination of recirculating unit NRT with preload wedge NRV




So that straight run-off is guaranteed, the recirculating unit NRT must always be oriented against the locating surface. The preload wedge NRV should be aligned opposite the recirculating unit and compensates for angular errors.

# 13 Construction and installation guidelines

## 13.3 Installation methods

SCHNEEBERGER linear guideways are not designed to be load-bearing structural components, but as guideway components.

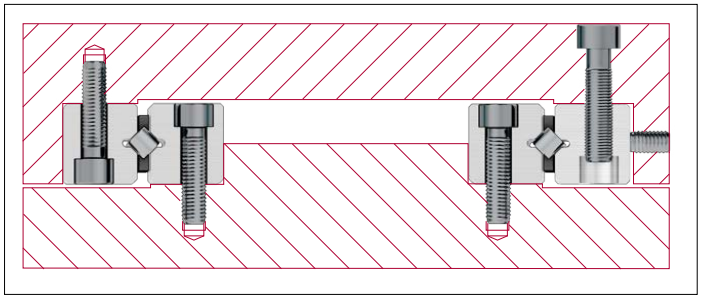
Horizontal installation indicates direction of movement runs horizontally. Likewise, vertical installation indicates direction of movement deviates from the horizontal plane.

### Enclosed configuration

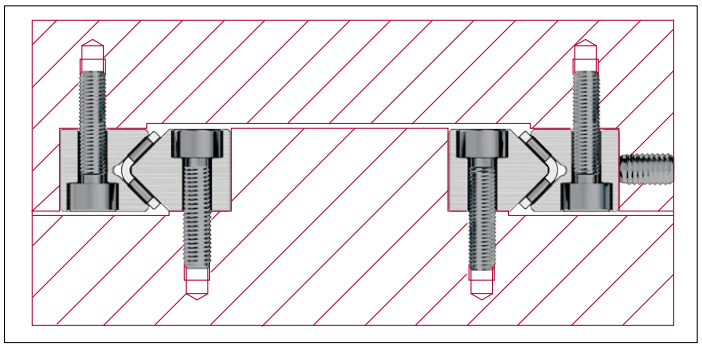
The enclosed configuration is a fixed/fixed bearing. It can be loaded by moments and forces in any direction. Rigidity and running accuracy can be influenced by a change in the preload.

The advantages and characteristics of an enclosed configuration:
- Supports any operation position, load direction and moment load
- Supports a small guideway base
- Must be preloaded. Consequently, rigidity and accuracy are increased.

**An example involving linear guideways of type R, RN or RNG**

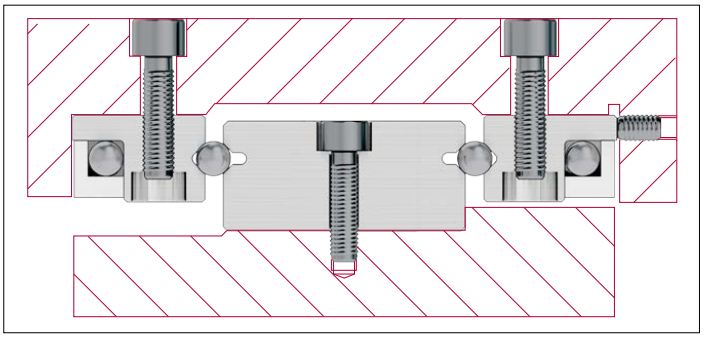


**An example involving linear guideways of type N/O or M/V**

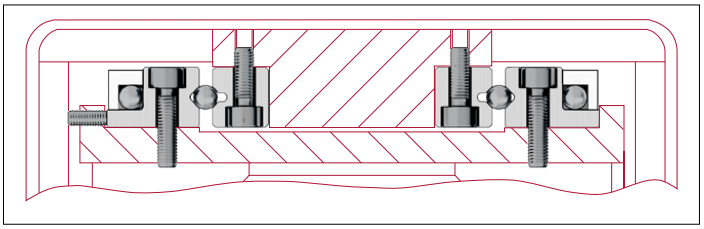


## 13 Construction and installation guidelines

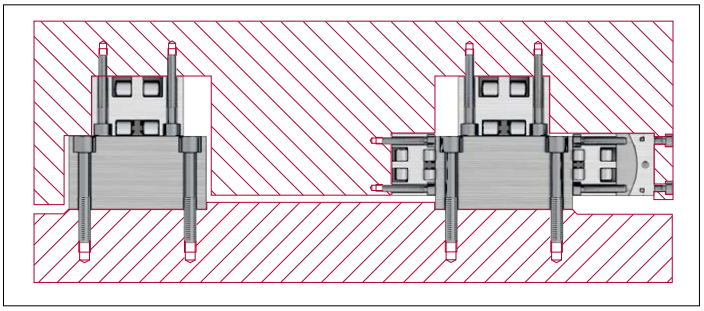
Example with recirculating units of type SK, SKD, SKD or SR combined with the double V-shaped guide RD



Example involving recirculating unit of type SK and linear guideways of type R



Example involving recirculating unit of type NRT and surface guideways of type E

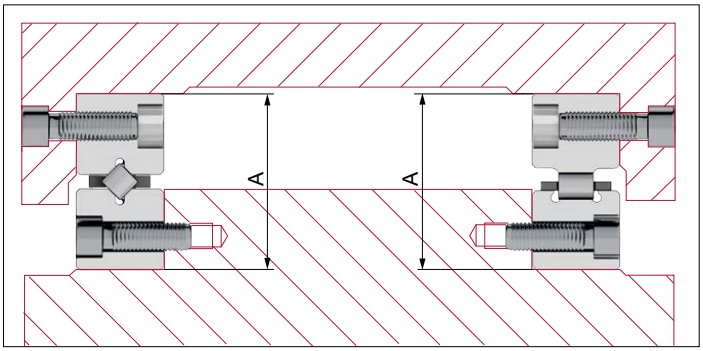


**Open configuration**

The open configuration is a fixed/loose bearing offering the following advantages and characteristics:

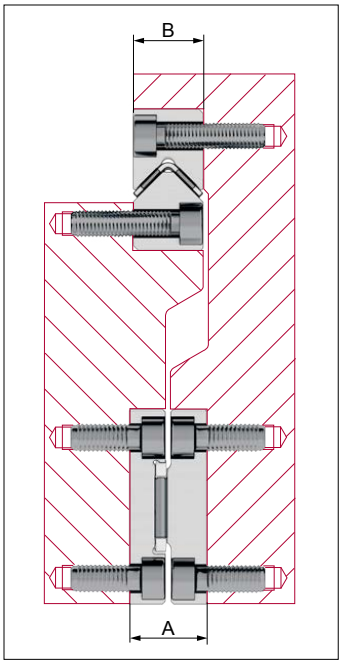
- Is mainly used when the load acts centrally and vertically on to the guideway plane and no deformations may occur by tensioning the surrounding structure.
- Thermal lateral variations are evened out
- Large bearing spans can easily be bridged
- Requires a large guideway base
- Very installation-friendly as the machine component can easily be seated and/or lifted off

**Example involving linear guideways of type R, RN or RNG combined with a surface guideway of type W/Z. In the case of open configurations, the height A for both pairs of guideways must be height-matched (see chapter 7.5).**

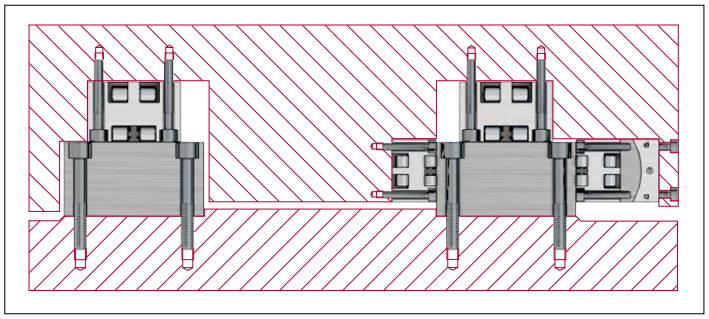


# 13 Construction and installation guidelines

Example of a suspended linear guideway of type N/O or M/V combined with a surface guideway of type L/M. The dimensions A and B must be height-matched.

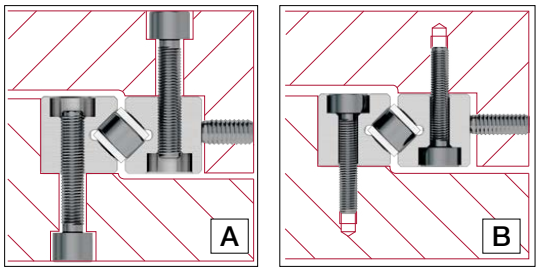



Example involving recirculating unit of type NRT and surface guideways of type E. The vertical load is born by height-matched NRT



## 13.4 Fastening

### Linear guideways




### Fastening variants

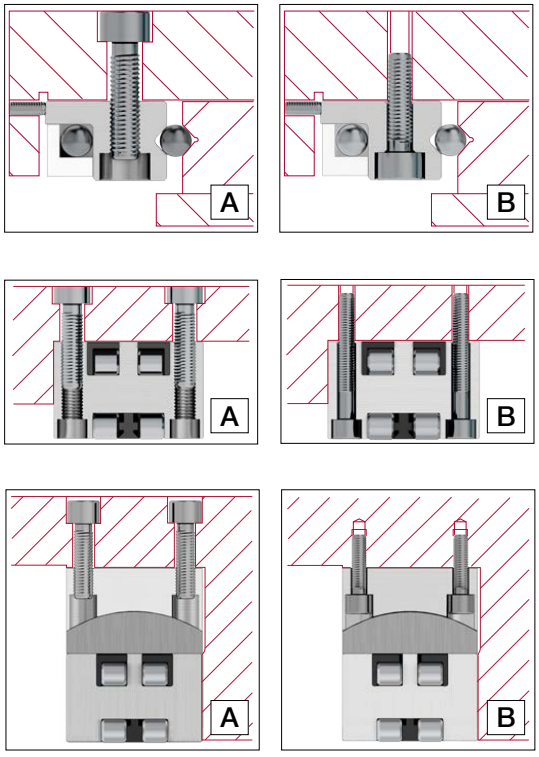
The SCHNEEBERGER linear guideways and recirculating units can be fastened to the connecting structure in two different ways:

**A** **The use of the tapped boreholes**
**B** **The use of through holes**

**Method A** is preferred because a powerful fastening is possible based on the screw size

**Method B** provides added flexibility combined with the fastening screws with a thin shaft (see chapter 5).

### Recirculating units



# 13 Construction and installation guidelines

## 13.5 Torque settings for fastening screws

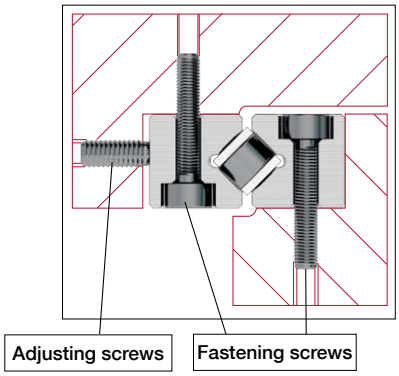
The recommended torque settings can be found in the table. These values apply in respect of oiled screws.

By using greases containing $MoS^2$, the required torque can drop to half of the values set out below.

**Strength grade 8.8**

| Sizes | Torque in Ncm | |
|---|---|---|
| | Fastening screws DIN 912 | Fastening screws with thin shaft, type GD or GDN |
| **M 2** | 35 | 28 |
| **M 2.5** | 73 | 58 |
| **M 3** | 128 | 102 |
| **M 4** | 290 | 232 |
| **M 5** | 575 | 460 |
| **M 6** | 990 | 792 |
| **M 8** | 2400 | 1920 |
| **M 10** | 4800 | 3840 |
| **M 12** | 8300 | 6640 |
| **M 14** | 13200 | 10560 |
| **M 16** | 20000 | --- |

## 13.6 Preload




The size of the preload is guided by the intended use of the guideways. A high preload …
… increases rigidity of the guideway and guarantees zero-backlash
… reduces moment loads, maximum loads on the rolling element
… increases displacement resistance
… reduces the service life

A positive effect of preload is achieved with 5 % - 20 % of the permissible load C.

### General approach

The preload can be consistently set using a torque wrench. In so doing the friction between screw and tapped fixing hole must be taken into account (to be determined by means of tests).

When using **wedge adjusters or adjusting plates**, the ideal preload must be determined based on the elastic total deformation $\delta_A$ (see chapter 12.5) and the deformation of the connecting structure.

When setting an R-guideway with **cage type EE**, the cage must first be slightly compressed before the rollers are applied.

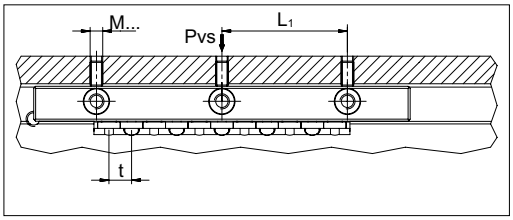
As mentioned above, the preload increases the rigidity of the guideway. A high preload, however, requires a stable connecting structure. Otherwise unwanted edge loads occur to rollers and needles as a result of angular errors, which in turn has a negative impact on load carrying capacity.

### Procedure for linear guideways

A guideway is normally set with zero-backlash using **adjusting screws**. A zero-backlash, uniform sequence is only achieved when advancing exclusively takes place where the cage with the rolling elements is located (see also chapter 13.9).

At least one **adjusting screw** must be provided per **fastening screw**, the thread size of which should match the **fastening screw**. In the case of **overrunning cages**, the shorter rail should preferably be advanced.

Example calculation for the infeed force per adjusting screw (Pvs) of their tightening torque (Mds)




**Required information per calculation:**

- Linear guide type R 3 — $L_1$ = 25 mm
- Roller cage type AC 3 — t = 5 mm
  C = 130 N
- Diameter of the adjusting screw = M4
- Factor f (for rollers = 1; for balls / needles = 2) — f = 1
- Preload p (2 % to 20 % of C) — p = 10 %
- Factor a in cm (as per the following table)

| Thread | Factor a |
|---|---|
| M2 | 0.0238 |
| M2.5 | 0.0294 |
| M3 | 0.035 |
| M4 | 0.0469 |
| M5 | 0.058 |
| M6 | 0.0699 |
| M8 | 0.0926 |
| M10 | 0.1152 |
| M12 | 0.1378 |
| M14 | 0.1591 |
| M16 | 0.1811 |

**Calculation of the infeed force per adjusting screw Pvs**

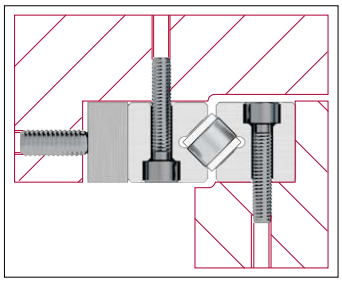
$Pvs = L_1 / t \cdot C \cdot p / 100 \cdot f$
$= 25 / 5 \cdot 130 \cdot 10 / 100 \cdot 1 = 65$ N

**Calculation of tightening torque Mds**

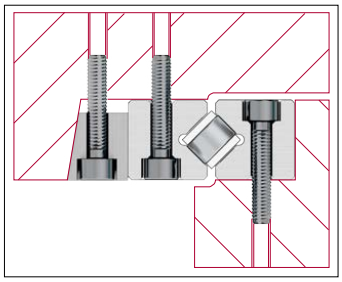
$Mds = Pvs \cdot a$
$= 65 \cdot 0.0469 = 3.05$ Ncm

## 13 Construction and installation guidelines

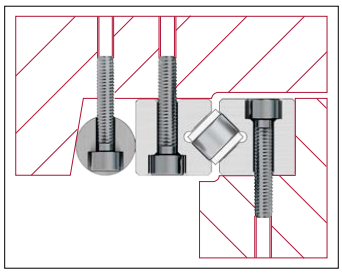
**Other technical possibilities for preloading linear guideways include:**



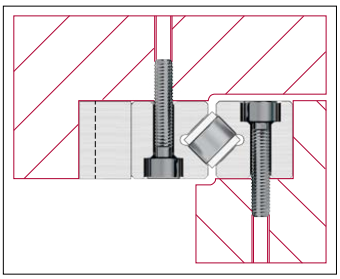
Setting using an **adjusting strip**



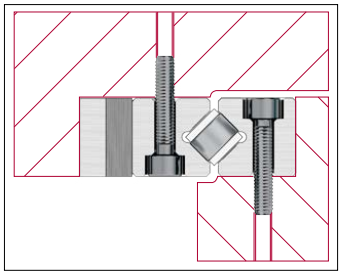
Setting using a **wedge adjuster**



Setting using a **cylinder adjuster**

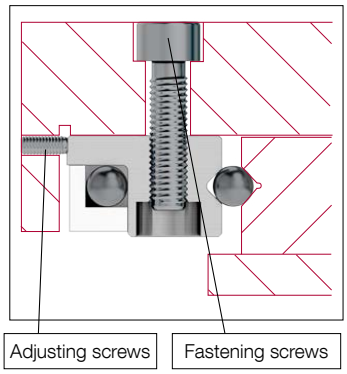


Setting using a **longitudinal wedge**



Setting using a **double longitudinal wedge**

# 13 Construction and installation guidelines




**Procedure when preloading recirculating units (SK, SKD, SKC and SR)**

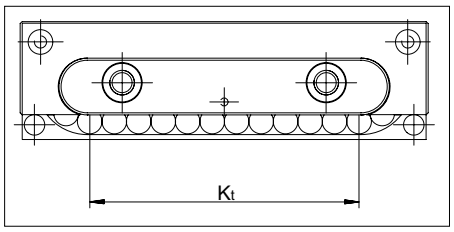
A recirculating unit is normally set with zero-backlash using **adjusting screws**. At least one adjusting screw must be provided per **fastening screw**, the thread size of which should match the fastening screw.

**Example calculation for the infeed force per adjusting screw (Pvs) of their tightening torque (Mds)**

Required information per calculation:

| | |
|---|---|
| - Recirculating unit SK 6-100 | C = 715 N |
| - Diameter of the adjusting screw | = M4 |
| - Number of adjusting screws N | = 2 |
| - Factor f ("1" for roller, "2" for balls) | = 2 |
| - Preload p (5 % to 20 % of C) | = 10% |
| - Factor a in cm | as per the following table |

| Thread | Factor a |
|---|---|
| M2 | 0.0238 |
| M2.5 | 0.0294 |
| M3 | 0.035 |
| M4 | 0.0469 |
| M5 | 0.058 |
| M6 | 0.0699 |
| M8 | 0.0926 |
| M10 | 0.1152 |
| M12 | 0.1378 |
| M14 | 0.1591 |
| M16 | 0.1811 |




**Calculation of the infeed force per adjusting screw Pvs**

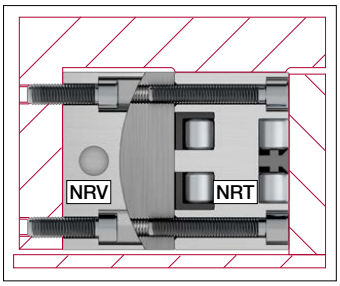
$$Pvs = C\ /N \cdot p\ /\ 100 \cdot f$$
$$= 715/2 \cdot 10/\ 100 \cdot 2 = 71.5\ N$$

**Calculation of tightening torque Mds**

$$Mds = Pvs \cdot a$$
$$= 71.5 \cdot 0.0469 = 3.35\ Ncm$$

Its advance must always remain within the load-bearing length $K_t$!

## 13 Construction and installation guidelines

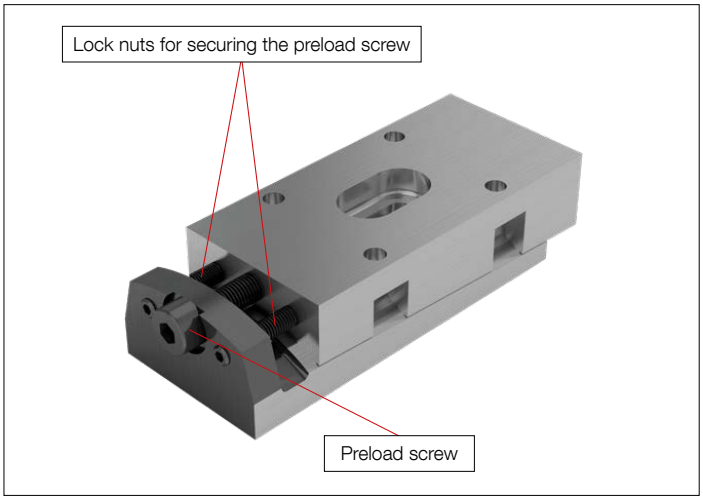



**Procedure for recirculating unit NRT with preload wedge type NRV**

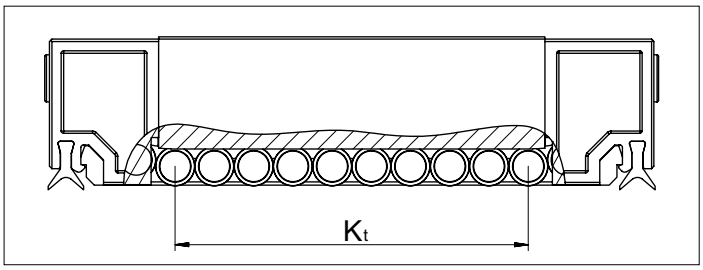
For preload using preload wedge NRV the following infeed values apply:

| Type | Size | Max adjustment range in terms of height (mm) | Height difference per revolution of the preload screw A |
|---|---|---|---|
| NRV | 19077 | 0.35 | 0.0350 |
| | 26111 | 0.40 | 0.0625 |
| | 26132 | 0.40 | 0.0625 |
| | 38144 | 0.40 | 0.0750 |

After successfully setting the preload, always tighten the two lock nuts alternately and use the wrench applying the same amount of torque!

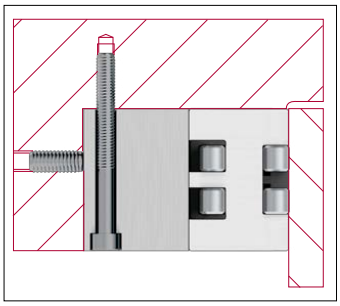



If preloading takes place without preload wedge NRV it is important to ensure that the advance must always remain within the load-bearing length $K_t$.

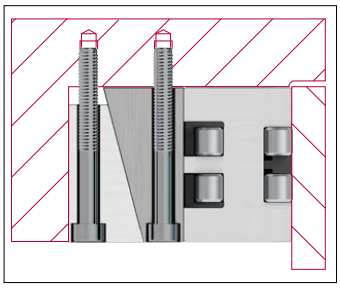


# 13 Construction and installation guidelines

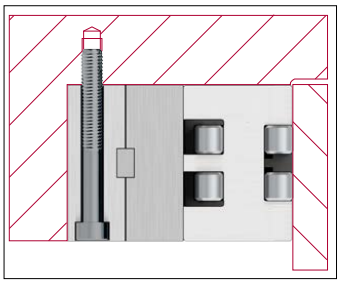
**Other technical possibilities for preloading the NRT include:**



Setting using an **intermediate plate**



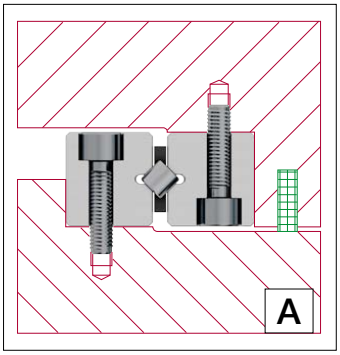
Setting using a **wedge adjuster**



Setting using a **double longitudinal wedge**

# 13 Construction and installation guidelines

## 13.7 Sealing and covers



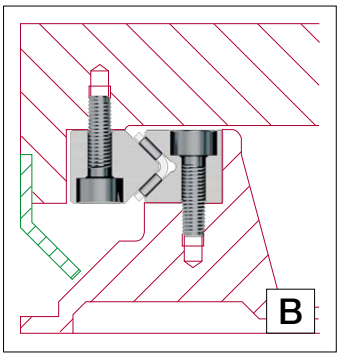

**The method of sealing or covering is significant for the smooth operation and service life of the guideways.**

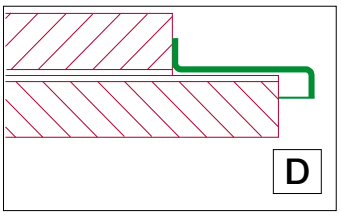
Where there is only a small amount of dirt, wipers are sufficient to keep the tracks clean. Their braking effect can generally remain unattended. We offer a variety of standard wipers, which are described in detail in the respective product specifications.

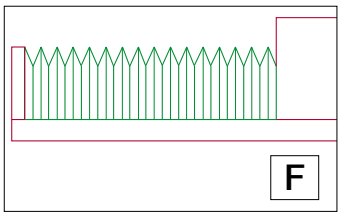
Covers are used when there is some danger of harmful contamination of the guideway. While wipers only push the dirt off the running surfaces in the area of their movement, covers provide the opportunity of also keeping penetrating dirt away at the sides.

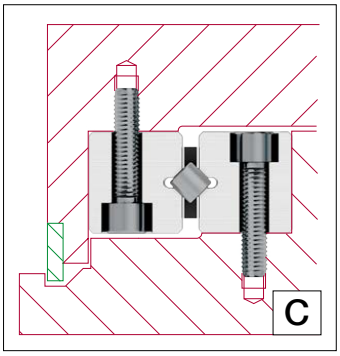
Some design options are listed below:

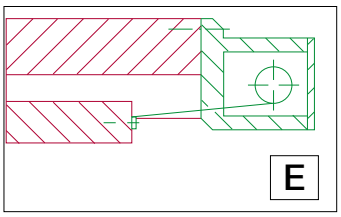
**A** = Wiper sideways
**B** = Diverting swarf and coolant away using a cover
**C** = Labyrinth seals offer an effective and economically viable protection
**D** = Simple metal cover
**E** = Roll-up cover
**F** = Bellows above or below
**G** = Telescopic cover

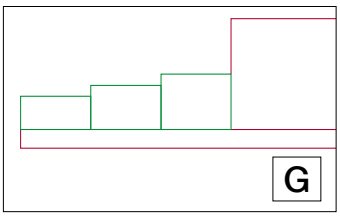


# 13 Construction and installation guidelines

## 13.8 Lubrication

Lubrication is a design element and must therefore be defined during the development phase of a machine or application. If the lubrication is only selected after design and construction is complete, based on experience this is likely to lead to considerable difficulties. A carefully thought out lubrication concept is therefore a sign of a state-of-the-art and well devised design.

**Parameters to be taken into account in selecting the lubricant, amongst others, include:**

- Operating conditions (speed, accelerations, stroke, load, installation orientation)
- External influences (temperature, aggressive media or radiation, dirt accumulating, moisture)
- Subsequent lubrication (period of time, quantity, compatibility with other lubricants)
- Compatibility (with corrosion protection, with integrated materials such as plastic cages)
- Tracks (geometry, surface roughness, hardness, material, coating, wettability)

Technical and economic considerations determine the lubricant and process to be used. Generally lithium-soap-based roller bearing grease are used to lubricate (alloyed greases KP2K in accordance with DIN 51502 or DIN 51825). Oil dispensers or occasional oiling via oil nipples fully meet the demands of the guideways. For minimal roller frictional resistance lubrication with mineral-oil-based oils is recommended (CLP or HLP in viscosities of ISO VG 15 to 100 in accordance with DIN 51519).

The lubricants are normally applied through the spacing between the linear guideways and the recirculating units or through the lubrication holes in some instances available as standard or lube nipples in the recirculating units. If this is not supported by the design (e.g. in the case of vertical installation), on request linear guideways with lube holes can also be supplied. Particularly advantageous are oil mist lubrication methods, which help to prevent dirt accumulating on the guideways with their slight excess pressure. Their acceptability is greatly limited, however, due to their environmental impact. Cutting-oils or water soluble coolants are to be kept away from the guideways, however, because they dilute or wash away the available lubricant. In addition, coolants tend to stick when drying out. Lubricants with solid additives are inappropriate.

**Subsequent lubrication intervals** depend on the aforementioned operating conditions and external influences and cannot be therefore be calculated. That is why the lubrication point must be observed over a lengthy period of time.

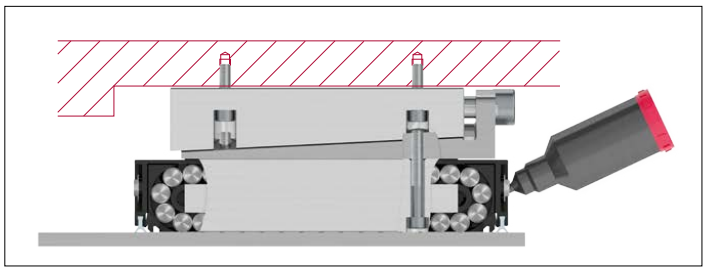
Values based on historical experience show that with normal use subsequent lubrication of up to 2 to 5 times is sufficient, spread over the calculated service life.

**Lubrication of the recirculating unit NRT**

There are three ways of lubricating the NRT

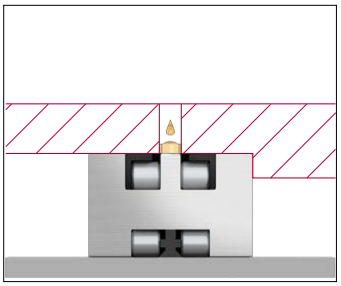
**Variant A:** **Lube nipple on each end face**
**Variant B:** **Lube opening on the top**
**Variant C:** **Optional connection for a centralised lubricating system**

**Variant A:** Lubrication by means of the lube nipple

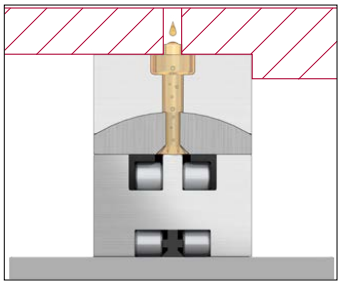


**Variants B:**

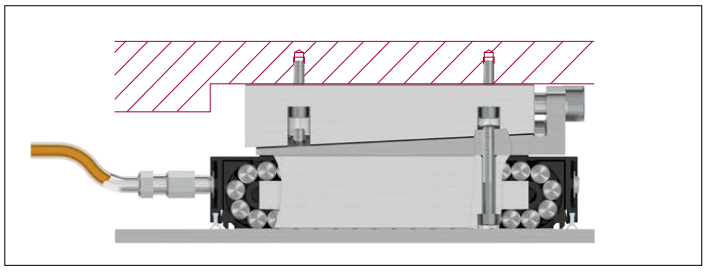
Oil delivery through the lube opening on the top



Oil delivery through the lube opening on the top through the preload wedge NRV



**Variant C:** Centralized lubricating system (option ZS)



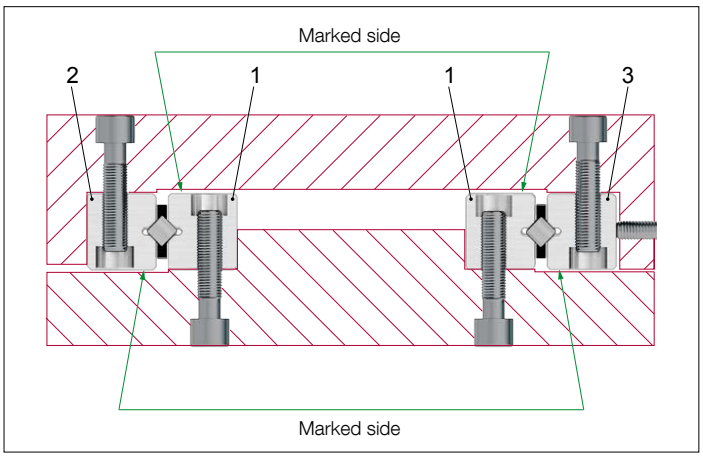
# 13 Construction and installation guidelines

## 13.9 Transport, handling and storage

Linear guideways and recirculating units are high-precision components and should therefore be handled with care. They should always be transported in their original packaging to protect them from damage and be stored at room temperature and in a dry environment.

Improper handling of the guideways can lead to preliminary damage and thus to premature failure. That is why their assembly may only be undertaken by expert professional staff.

## 13.10 Installation guidelines




**Linear guideways**

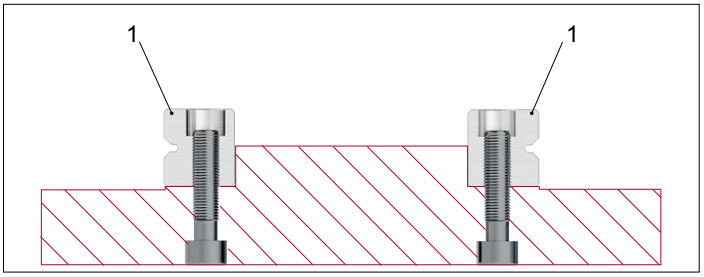
With careful, clean preparation and a step by step approach, by adopting a rational procedure you will achieve a perfect guide system.

The following installation instructions applies by analogy for all types of SCHNEEBERGER linear guideways.

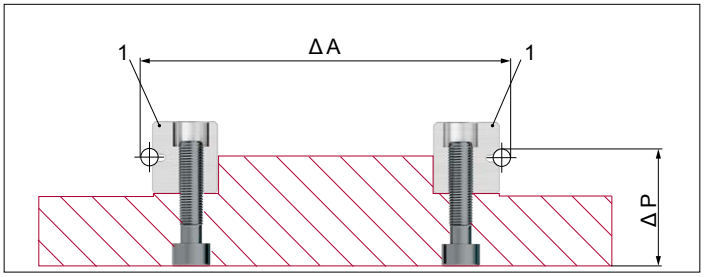
- To guarantee a perfect support for the guide rails, any remaining burrs or ridges are to be removed with a fine whetstone.
- Before installation, the linear guideways and supporting surfaced should be cleaned. By means of a subsequent light lubrication they will be protected from any consequential damage.
  **Tip for long or multi-part guide rails:**
  Due to the bore hole tolerances of the rails, the fastening holes in the supporting surfaces should be drilled according to the holes in the linear guideways. By using fastening screws with a thin shaft differences in hole spacings can also be evened out (see chapter 5).
- The marked side of the guide rail may not be used as a supporting surface!

## 13 Construction and installation guidelines

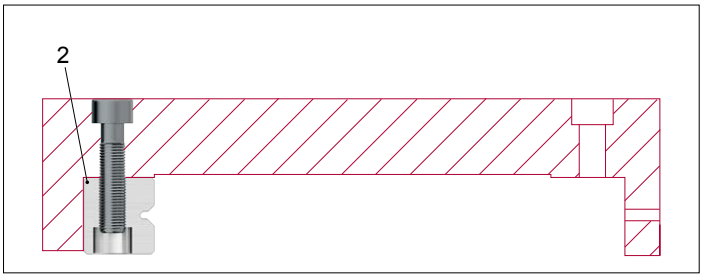
- The fixed pair of linear guideways (1) is pressed against the supports using an appropriate clamping element and the fastening screws are tightened (use a torque wrench! For tightening torque see chapter 13.5.)




- Check parallelism ΔA and ΔP. The parallelisms measured must fall within the tolerances of the linear guideway (see chapter 7.1)

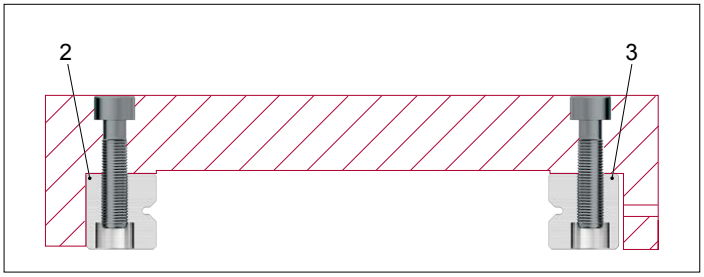



- Install the fixed rail (2) of the opposing pair.

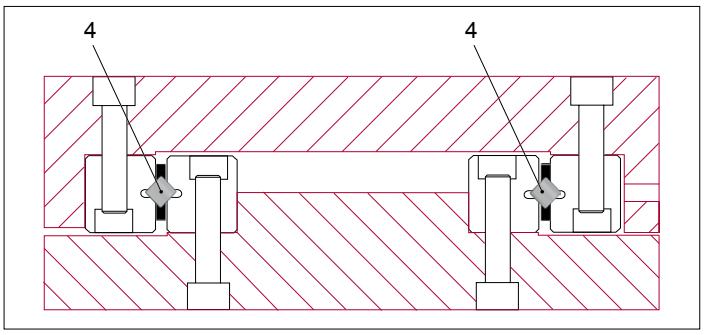


## 13 Construction and installation guidelines

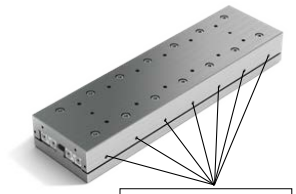
- Install the rail (3) and in so doing only lightly tighten the fastening screws.
- Lubricating (see chapter 13.8)




- Insert and center the cages (4). After that the linear bearings must be preloaded (please refer to the following page).

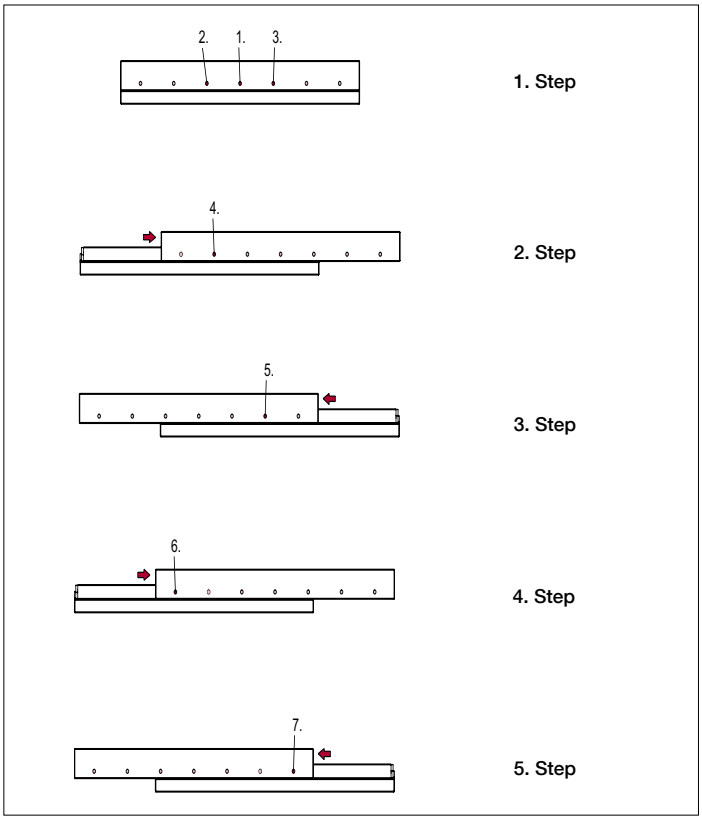


## 13 Construction and installation guidelines




- Set and/or preload the linear guideway with zero-backlash (see chapter 13.5).

Application of the preload using the adjusting screws should be carried out from the centre of the rail outwards using the following steps (the sequence can be worked out from the figures):




- Tighten the fastening screws for the rail (3).
- Install the end pieces