# Original assembly and maintenance instructions

## Ball screw

HSB-kgt®

HSB Automation GmbH
In Laisen 74
72766 Reutlingen
Germany
Tel. +49 7121 14498-0
Fax +49 7121 14498-10
Info@HSB-Automation.de
www.HSB-Automation.de

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# 1 General

## 1.1 Introduction

These assembly and maintenance instructions (A&M) are intended for persons with the necessary expertise, such as installers, users and system operators.

They contain important information regarding how to assemble, operate, carry out maintenance on and dismantle the product safely and correctly and how to rectify simple faults yourself. They must therefore always be kept close at hand so that they can be consulted.

It is important that you contact the manufacturer should there be any part of these A&M instructions that you do not clearly understand.

## 1.2 Intended use

The product is an assembly.

The product may be used in accordance with the technical documentation (product catalogue) as follows:

- To convert a rotary motion into a linear motion or vice versa.

Utilisation of the product for any other purpose would constitute inappropriate use. The manufacturer accepts no liability for any damage resulting from such use. The risk is borne solely by the user.

The product is intended for professional use, not for private use. Intended use also implies that you have read this documentation in full and understood it.

## 1.3 General safety information

- The safety regulations and requirements that apply in your country must be observed.
- The applicable regulations relating to accident prevention and environmental protection must be observed.
- Only use the product if it is in perfect technical condition.
- Only use accessories and substitute parts that have been approved by the manufacturer.
- Adhere to the technical data and ambient conditions specified in the documentation.
- Only use the product in safety-related applications if use of this nature is explicitly specified and approved in the product documentation.
- Only commission the product once it has been established that the end product (for example a machine or system) in which the product is installed meets the country-specific requirements, safety regulations and standards for use.
- The product must not be modified.
- The product components are designed based on the service life of the product; however, in exceptional cases, a serious defect may occur and, for example, the ball screw may fall down if it has been installed in a vertical or suspended position. Take appropriate protective measures to prevent this.
- Observe the operating conditions (see catalogue).
- Do not reach into moving or rotating parts.
- Do not move the ball screw up to its end stop.
- Once all work on the machine has been completed, reinstall the safety equipment according to the instructions and check that it is operating correctly.
- Dispose of the product in accordance with the applicable national requirements. Observe the safety data sheets.

## 1.4 Responsibilities of the operator

- The product operator is responsible for adhering to appropriate safety measures implemented for the specific purpose of the product.
- The product must only be operated in accordance with its intended use.
- Potential hazardous areas must be indicated.
- Carry out maintenance work.
- You must always ensure that all safety equipment is in perfect condition and is regularly inspected in accordance with the manufacturer's specifications and operating procedures.
- Prior to commissioning, you must ensure that all safety equipment required for the product is present, has been installed correctly and is fully operational.

## 1.5 Explanation

- All figures specified are standard values.
- All illustrations are basic illustrations and are therefore non-binding.
- Subject to technical modifications.

# 2 Lubrication

## 2.1 General

Ensuring the correct lubrication is important for a ball screw in order to achieve the calculated service life, prevent excessive heating and to guarantee smooth, quiet running.

The ball screw uses the same lubricants as ball bearings or linear guide systems (grease according to NLGI 1 to NLGI 2, DIN 51818).

Types of grease: Ball bearing grease without solid lubricant percentage (type of lubricant: K2K-20 according to DIN 51825).

Initial lubrication is carried out at the factory using Klüber ball bearing grease Klüberplex BE 31-102 according to NLGI 2.

Ball screws can be lubricated with oil or grease. The advantage of lubricating with grease is that the ball screws will only require relubrication after extended stroke sequences. Lubricant loss is lower for lubrication with grease than it is with oil. Ideally, the amount of grease applied should be measured so that the cavities are approximately half full.

The functions of the lubricant are as follows:

- To form a sufficiently viable lubricating film on the contact surfaces
- To dissipate any heat that arises
- To provide an additional exterior seal for the ball screw to prevent solid and liquid contaminants from entering
- To dampen the running noise
- To prevent corrosion

## 2.2 Amounts of lubricant

The amounts of lubricant required for ball screws differ primarily based on the different unit sizes.

Opinion differs on how much grease should be applied in the free space in the ball screw nut. This is due to the different views that people have on the issue of poor heat dissipation if the nut is filled with too much grease and the risk of increased wear if too little grease is applied.

The increased frictional torque that results when large amounts of grease are applied to the nut must also be taken into account. Only standard values can be provided due to the issues described above.

The values specified in the table below can be used as standard values for the amount of grease required.

| Size | Initial lubrication amount | Relubrication amount |
|---|---|---|
| 1205 | 0.8 ml / 0.7 g | 0.55 ml / 0.5 g |
| 1210 | 0.8 ml / 0.7 g | 0.55 ml / 0.5 g |
| 1605 | 2.1 ml / 1.9 g | 1.7 ml / 1.5 g |
| 1610 | 2.6 ml / 2.4 g | 1.8 ml / 1.7 g |
| 1620 | 2.1 ml / 1.9 g | 1.7 ml / 1.5 g |
| 1640 | 2.6 ml / 2.4 g | 1.8 ml / 1.7 g |
| 2005 | 2.9 ml / 2.7 g | 2.0 ml / 1.9 g |
| 2010 | 3.0 ml / 2.8 g | 2.1 ml / 2.0 g |
| 2020 | 3.3 ml / 3.0 g | 2.3 ml / 2.1 g |
| 2020 (long) | 6.4 ml / 5.9 g | 4.5 ml / 4.1 g |
| 2050 | 6.4 ml / 5.9 g | 4.5 ml / 4.1 g |
| 2505 | 3.2 ml / 2.9 g | 2.6 ml / 2.3 g |
| 2505 (long) | 4.8 ml / 4.4 g | 3.9 ml / 3.5 g |
| 2510 | 4.9 ml / 4.5 g | 3.4 ml / 3.2 g |
| 2510 (long) | 7.4 ml / 6.8 g | 5.1 ml / 4.8 g |
| 2525 | 4.4 ml / 4.1 g | 3.1 ml / 2.9 g |
| 2525 (long) | 7.7 ml / 7.1 g | 5.4 ml / 5.0 g |
| 2550 | 6.8 ml / 6.3 g | 4.8 ml / 4.4 g |
| 3205 | 5.3 ml / 4.9 g | 4.2 ml / 3.9 g |
| 3210 | 7.0 ml / 6.5 g | 5.6 ml / 4.8 g |
| 3220 | 5.8 ml / 5.4 g | 4.6 ml / 4.3 g |
| 3240 | 4.2 ml / 3.9 g | 3 ml / 2.7 g |
| 3260 | 7.4 ml / 6.8 g | 5.1 ml / 4.8 g |

## 2.3 Relubrication intervals

Relubrication should be carried out very carefully and on a regular basis, as ball screws are susceptible to higher grease loss than ball bearings.

There are no general rules for the relubrication intervals of ball screws, as the intervals depend on a range of factors. Factors can include the following:

- The unit size and the spindle diameter
- The operating speeds and rates of acceleration
- The tightness of the wipers
- Environmental influences, such as temperature, contaminants, liquids
- etc.

This large number of parameters makes it clear that it is not practical to specify general rules for relubrication intervals for all operating conditions. It is also not easy to provide a constant variable for defining relubrication intervals.

For ball bearings, the number of revolutions has become established as the preferred variable. The number of revolutions can then be used to easily derive other standard variables, such as operating hours or running performance. Numerous tests have shown that relubrication should be carried out after approximately

**1.5 to 2.5 x $10^7$ revolutions**.

With larger diameters, you should apply the lower figure and for small diameters, you should base your calculation on the higher value. The theoretical relubrication interval is then calculated based on the average speed, the stroke and the pitch.

The tables below show examples of the lubrication intervals in hours and kilometres based on 2 x $10^7$ revolutions:

| Average speed [rpm] | Lubrication interval [h] |
|---|---|
| 500 | 667 |
| 1000 | 333 |
| 1500 | 222 |
| 2000 | 167 |
| 2500 | 133 |
| 3000 | 111 |

| Pitch [mm] | Lubrication interval [km] |
|---|---|
| 5 | 100 |
| 10 | 200 |
| 20 | 400 |
| 40 | 800 |
| 50 | 1000 |
| 60 | 1200 |

## 2.4 Information on lubrication and assembly

When delivered, the ball screw is provided solely with initial lubrication; the nut must therefore be lubricated via the lubricating hole prior to commissioning.

When carrying out both initial lubrication and relubrication of the ball screw nuts via the lubricating hole, please note that the grease is distributed quite slowly and unevenly to the nut. This makes it difficult to fully fill the nut to the levels specified in the tables.

For this reason, we recommend filling the nut in several stages and moving the nut briefly along the spindle in between each stage so that the applied grease can be better distributed in the threads.

It is usually sufficient to continue to turn the nut a few times (at least the length of one nut). During the filling process, please be aware of "collars of grease" that will form at both ends of the nut.

When assembling a prelubricated ball screw nut on the corresponding ball screw spindle, you must also be aware that a certain amount of grease will also be lost from the stroke (at the end of the spindle).

If a large amount of grease is lost, we advise additionally applying a certain amount of grease via the lubricating hole of the assembled ball screw nut in order to ensure that it is sufficiently lubricated.

## 2.5 Explanation

All figures specified are standard values only and are based in part on empirical values.

It is therefore essential that you inspect the ball screw regularly and look out for signs of insufficient lubrication, such as a dry spindle or a high loss of grease.

# 3 Oil lubrication

## 3.1 General

One advantage of lubricating with oil instead of grease is the fact that it does not cause the ball screw to heat up as much, particularly at higher speeds.

Nevertheless, we strongly advise lubricating with grease due to the higher contact ratio. We therefore also recommend adapting the viscosity of the grease to the application in question.

All commercially available oils for ball bearings are suitable for oil lubrication. The required viscosity is highly dependent on the operating temperature, the speed and the load.

As with grease, additions of solid lubricants (e.g. graphite, MoS2 or similar) are not permitted.

A basic distinction is made between the following:

- Splash lubrication
- Circulating oil lubrication
- Minimum quantity lubrication

Splash lubrication should only be used for low traversing speeds.

Circulating oil lubrication involves additional heat dissipation, which benefits the accuracy of the ball screw. Ball screws without wipers are used for both splash lubrication and circulating lubrication.

For minimum quantity lubrication, you can find the initial lubrication and relubrication amounts in the table below.

The screw should be relubricated four times an hour in order to ensure optimum distribution of the oil. Excess and used oil must be able to flow out of the linear axis.

## 3.2 Lubrication amounts (minimum quantity lubrication)

| Ball screw size | Initial lubrication [cm³] | Relubrication [cm³/h] |
|---|---|---|
| 1205 | 0.8 | 0.002 |
| 1605 | 2.1 | 0.005 |
| 1610 | 2.6 | 0.007 |
| 2005 | 2.9 | 0.008 |
| 2020 | 3.3 | 0.009 |
| 2050 | 6.4 | 0.016 |
| 2505 | 3.2 | 0.008 |
| 2510 | 4.9 | 0.013 |
| 2525 | 4.4 | 0.011 |
| 2550 | 6.8 | 0.017 |
| 3205 | 5.3 | 0.014 |
| 3210 | 16.4 | 0.041 |
| 3220 | 12.0 | 0.030 |
| 3240 | 4.2 | 0.011 |
| 4005 | 6.6 | 0.017 |
| 4010 | 19.3 | 0.049 |
| 4020 | 14.6 | 0.037 |
| 4040 | 13.5 | 0.034 |
| 5010 | 32.4 | 0.081 |
| 5020 | 37.9 | 0.095 |

# 4 Assembly

## 4.1 Installation

The installation of ball screws requires expertise and sufficient measurement options and should therefore only be carried out by trained personnel.

Ball screws can only absorb axial forces. Radial or excentric forces must be absorbed by external guides.

Due to the low friction of a ball screw, alignment errors when turning the screw by hand generally go unnoticed. Suitable measurement options are therefore required.

In order to prevent damage to the ball screw, the machine must be provided with appropriate limit switches and end stops.

## 4.2 Versions

HSB Automation GmbH supplies the following versions of ball screws:

4.2.1 Ball screws with nuts in standard dimensions with standard ends

4.2.2 Ball screws based on customer drawings

4.2.3 Shortened spindles based on customer requirements, annealed shaft ends if required; nuts on sleeves (the nuts are assembled ready for installation, the sleeve holds the balls in the nut raceway)

4.2.4 Production-length spindles, nuts on sleeves

**Note!**

In order to prevent damage and contamination, the ball screws and nuts must remain the protective film until they are installed.

## 4.3 Assembly

For 4.2.3 and 4.2.4

4.3.1 Shorten the spindle with a cutting disc or similar, spindle hardness: 60 ±2 HRC

4.3.2 Anneal and machine the spindle ends. Carry out annealing at 650 to 700 °C (dark red) until the spindle has been warmed through to its core. Then allow the spindle to cool down naturally in the air (do not try to speed up the cooling process)

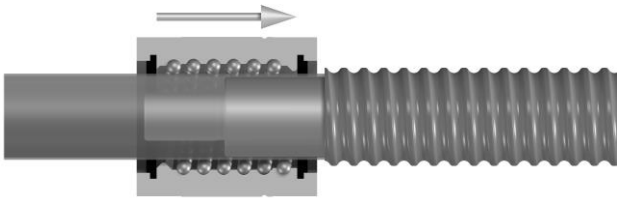
***Note:*** Neighbouring threads must be cooled during annealing! (Fig. 01)

**Fig. 01**

4.3.3 Deburr the start of the ball screw. Clean the entire spindle

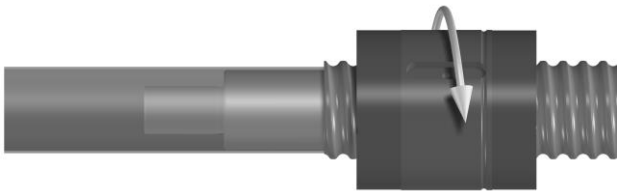
4.3.4 Remove one of the two axial supports of the nut sleeve or cut through the cable tie. Slide the sleeve containing the nut over the end of the shaft. Centre the sleeve and press it against the start of the thread (Fig. 02)

**Fig. 02**



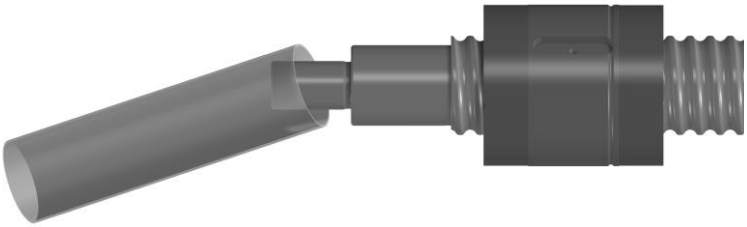
4.3.5 Screw the nut fully onto the spindle (Fig. 03)

**Fig. 03**



4.3.6 Remove the sleeve. Secure the nut from falling down the spindle (with O-ring or similar axial support) (Fig. 04)

**Fig. 04**



4.3.7 Install the ball screw. Maximum permitted alignment error: 0.03 mm/m. Turn the nut unit so that it is as close as possible to the spindle bearing, align it there, screw it in place and, if necessary, secure it. Alternatively, the bearings can be aligned with the nut in the same manner. The ball screw must not accept any radial load!

4.3.8 If necessary, connect to the central lubrication system – lubricate the flange nut directly via the lubricating nipple thread, the cylinder nut via the hole in the feather key nut or the all-round lubrication groove and a corresponding housing

## 4.4 Cover

Any contaminants that occur during installation should be removed using kerosene, oil or benzine.

Cold cleaning solvents and paint solvents are not permitted. Ball screws must be protected from dust, swarf and the like during operation, even if they have been fitted with wipers.

Possible protective measures are as follows:

- Bellows (only permitted for vertical installation if they do not have an additional guide)
- Spiral spring cover
- Telescopic tubes or sleeves (high axial space requirement)

Our range also includes fully protected and ready-to-install systems:

- HSB-Beta®, HSB-Delta® and HSB-Alpha® linear units with an integrated guide in an encapsulated aluminium profile with cover band or bellows cover. Please request our documents.

## 4.5 Operating temperature

The permitted operating temperature range for ball screws is between 0 °C and +80 °C. A minimum temperature of -20 °C and a maximum temperature of +110 °C are permitted for brief periods. This is only ever permitted if lubrication has been carried out correctly.

At temperatures of -20 °C, the torque can increase by up to ten times its normal value.