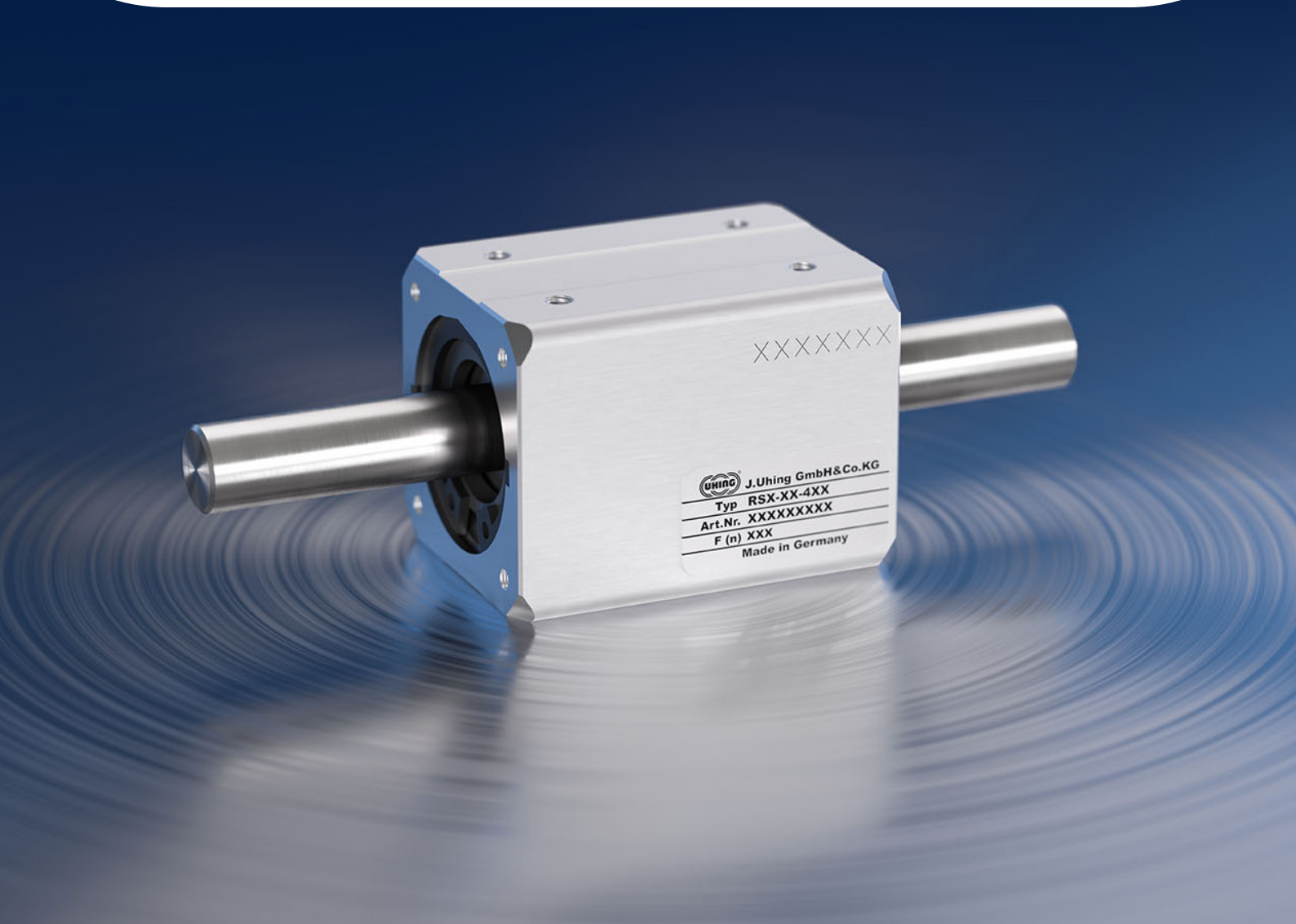
Linear Drive Nut

Uhing Linear Drives®



Joachim Uhing GmbH & Co. KG - the originator of the Rolling Ring Principle - successful since 1950. Our worldwide network of agencies guarantees a reliable service on the spot.

More about us at: www.uhing.com

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Uhing - Linear Drive Nut

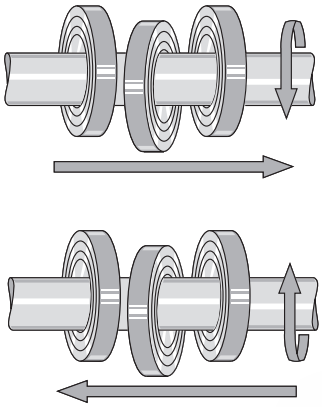
The Actuator for:

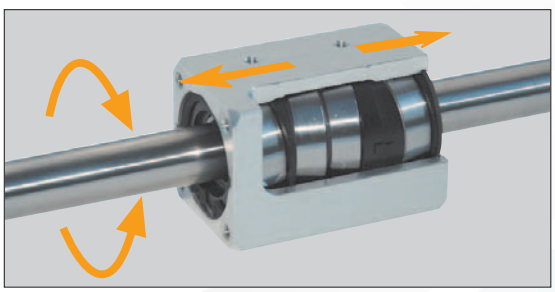
- Linear motion drives
- Measurement and inspection technology
- Materials handling systems
- Control systems
- Medical engineering

Uhing-Linear Drive Nuts (RS) are non-positive drives which convert the rotation of a plain round shaft into linear motion.

Principle of operation

The effect is achieved by pressing specially crowned Rolling Rings against the shaft and allowing them to roll on the surface of the shaft at an angle which determins their pitch.



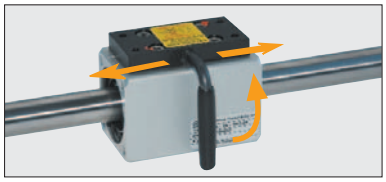


Applicational areas

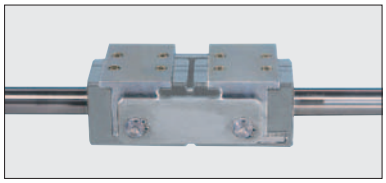
With permission of Zeiss

With permission of DMG Micro-set GmbH

With permission of Zoller



free-movement lever

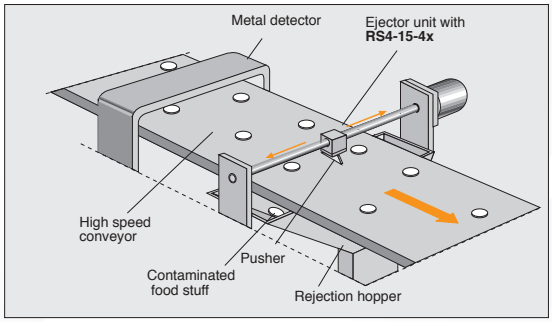


linked nuts

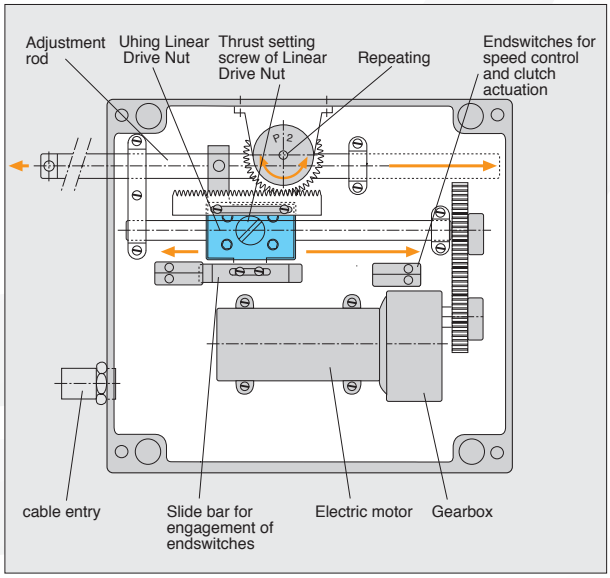
left- and right hand pitch

Characteristics

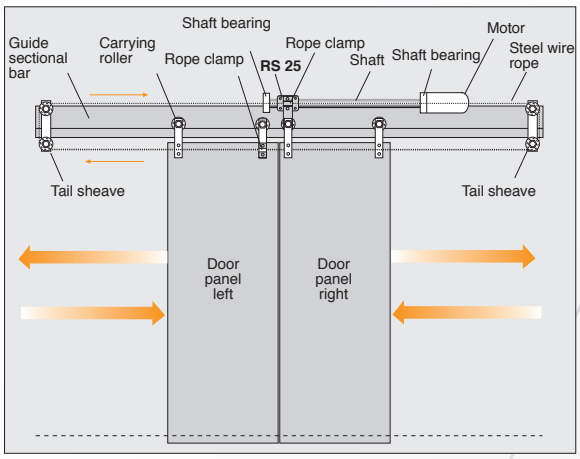
- Backlash-free
- Resistant to vibrations
- Compact design
- Overload protection
- High-efficiency
- Quiet in operation
- Low maintenance
- Free-movement lever
- Good sealing possibilities
- Linked nuts for higher side thrust
- Left- and right-hand pitch on the same shaft



Ejector unit for contaminated foodstuffs



Setting unit for speed control of ship motors



Drive for double sliding doors

Dimensions and technical details

Uhing-Linear Drive Nut Types RS

Types RS

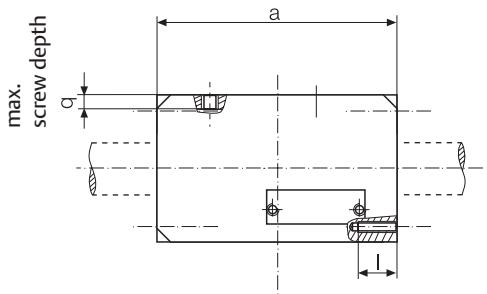
Dimensions for RS-Types (mm)

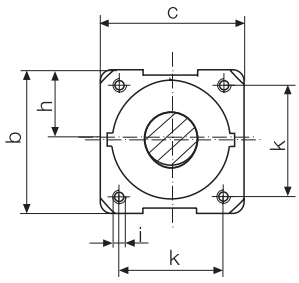
Types	weight m (kg)	a*	a_1*	b	c	d_{h6}	e	f	g	$h^{\pm0,3}$**	i	k	l	q	Technical details F_{RS}(N)	M_0(Ncm)	h_{max}(mm)
RS3-08-4	0.09	40	54	30	30	8	26	16	M 4	15	M 3	24	6	5	50	0.7	4.0
RS4-08-4	0.11	48	62	30	30	8	26	16	M 4	15	M 3	24	6	5	100	1.4	4.0
RS3-10-4	0.14	47	65	35	35	10	30	18	M 4	16.8	M 3	26	6	5	100	1.8	5.0
RS4-10-4	0.18	55	73	35	35	10	30	18	M 4	16.8	M 3	26	6	5	200	5.0	5.0
RS4-15-4	0.23	62	82	40	40	15	26	18	M 4	19.6	M 4	30	8	5	260	5.0	7.5
RS4-20-4	0.55	83	108	52	52	20	40	30	M 5	26	M 5	40	11	8	420	10.0	10.0
RS4-25-4	0.70	85	110	60	60	25	40	30	M 5	29.4	M 5	45	10	9	600	20.0	12.5
RS4-35-4	1.55	105	126	80	80	35	50	40	M 6	40	M 6	60	12	13	900	45.0	17.5
RS4-50-3	2.70	120	140	100	100	50	50	50	M 8	48.8	-	-	-	16	1300	140.0	25.0
RS4-60-3	4.20	130	156	120	120	60	69	62	M10	58.4	-	-	-	15	2000	200.0	30.0

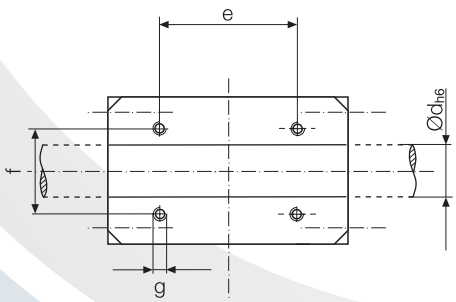
Heavy Print:
standard versions

Attention:
*If wipers are used, dimension a becomes a_1.
**Valid only for standard pitch 0,5 x d.
If pitches less than standard the value decreases.

F_{RS} (N) = Maximum available side thrust
M_0 (Ncm) = Idling torque
h_{max} (mm) = Maximum pitch

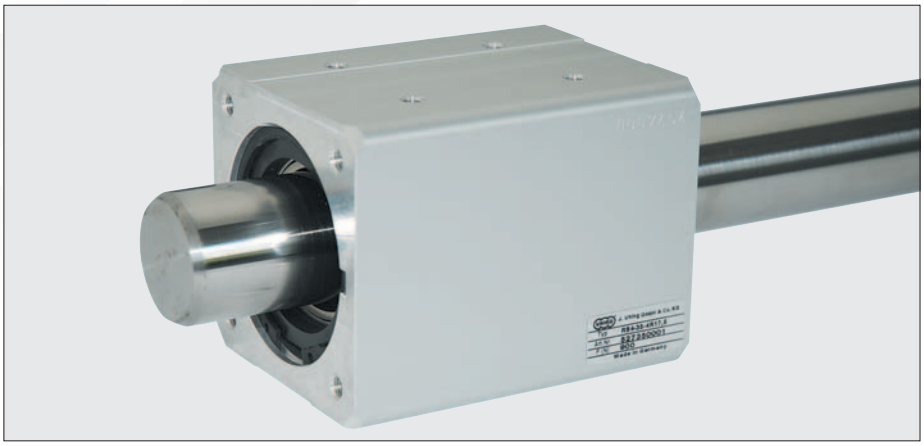






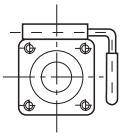
The CAD - drawing files are available at www.uhing.com

Features

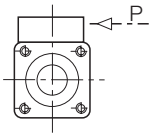


Free-Movement Lever

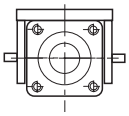
F Mechanical
when operated, the nut can be slide freely along the shaft



P Pneumatic
as above, operated with a pressure of p = 6 bar
Attention: Units supplied with P have a reduced thrust.
Refer to supplier for details

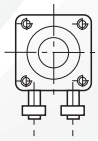


Adapter
for twist free coupling system



Wipers
for sealing between nut and shaft
Attention: For units with wipers please note dimension a_1 on page 4.

R Steady Rollers
Rolls on Linear Drive Nut (in conjunction with a guide bar) prevent the rotation of the nut on the shaft.
Not available for RS-08



Material
Al housing, silver anodized

Details of other types upon request.

Product Survey and Ordering Information

Product Survey

Product Group	Uhing Linear Drive Nut							
Type Reference	RS							
Style Number of rolling rings	**3** o. 4		3 or **4**					
Size Shaft diameter	**8**	**10**	**15**	**20**	**25**	**35**	50	60
Design Category	4	4	4	4	4	4	3	3
Pitch direction	**L** (= left), **R** (= right)							
Pitch	0,1 · 0,2 · 0,3 · 0,4 · **0,5** x shaft Ø							
Available Features[1]	F, P, R							
Customer Specific Features[2]	X							

Heavy print: standard versions

[1]) **Available features**
F Free movement lever (mechanical)
P Free movement lever (pneumatical)
R Steady Rollers

[2]) **Customer specific features**
- Adapter
- Wipers
- Felt rings
- Increased protection against corrosion
- Specific pitch
- Grease nipples
- Reduced side thrust

Example of Ordering specifications

Type reference	RS	4	-	25	-	4	R	12,5	P	X
Style		●								
Size (shaft dia.) Separator symbols				●						
Design category						●				
Pitch direction							●			
Pitch								●		
Available features									●	
Customer specific features										●

Selection

If you wish Joachim Uhing GmbH & Co. KG to make a selection for you in respect of your application, please contact us.

Formulae and related units

d(mm)	=	shaft diameter
F(N)	=	side thrust required
F_{RS}(N)	=	side thrust produced by Linear Drive Nut type RS
F_R(N)	=	friction (FN ·μ) only relevant when the the associated mass is mounted on its own independent carriage
F_N(N)	=	normal force of total weight of associated mass and carriage
μ	=	coefficent of friction
F_Z(N)	=	additional force e.g. component of the cutting force of a separator
f(mm)	=	shaft sag from Fig.1
g(m/sec²)	=	acceleration due to gravity (9,81m/sec²). Note: for horizontal applications m·g = 0
h(mm)	=	pitch of unit (travel per shaft revolution)
l(mm)	=	length of shaft between centres of bearing brackets
m(kg)	=	total mass to be moved, including Drive Nut, connections etc.
Md (Ncm)	=	drive torque
Mo (Ncm)	=	idling torque
n(r.p.m.)	=	shaft speed
n_{crit}(r.p.m.)	=	critical shaft speed
P(kW)	=	drive power required
t(s)	=	acceleration or braking time
v(m/sec)	=	maximum speed of travel
C(N)	=	dynamic loading of Rolling Rings
P_R(N)	=	radial loading of Rolling Rings

1. Side Thrust

$$F=2\left(\frac{m \cdot v}{t}+m \cdot g\right)+F_R+F_Z$$

A Drive Nut should be selected which has a greater side thrust than the value calculated.

$$F < F_{RS}$$

Several smaller Drive Nuts can be coupled together if available space so dictates. The total thrust available is the sum of the individual values.

2. Shaft Speed

$$n=\frac{v \cdot 6 \cdot 10^4}{h_{max}}$$

2.1. Max. Shaft Speed

RS	3-08-4 =	10000 min^{-1}
RS	4-08-4 =	10000 min^{-1}
RS	3-10-4 =	10000 min^{-1}
RS	4-10-4 =	10000 min^{-1}
RS	4-15-4 =	8000 min^{-1}
RS	4-20-4 =	7000 min^{-1}
RS	4-25-4 =	6000 min^{-1}
RS	4-35-4 =	4000 min^{-1}
RS	4-50-3 =	3400 min^{-1}
RS	4-60-3 =	2500 min^{-1}

2.2. Critical Shaft Speed

$$n_{crit}=1{,}225 \cdot 10^8 \frac{d}{l^2}$$

Note:
Depending upon its quality, the shaft can go out of balance at a speed of up to 25 % lower than that specified above.
If it is necessary to go through a critical range in order to reach the operational speed, this can lead to short term shaft vibration. This has no effect on the operation of the Drive Nut.
If the operational speed is in the critical speed range, this can be rectified as follows:
1. With a double bearing support at one end:
Increase factor approx. 1,5.
2. With double bearing supports at both ends: Increase factor approx. 2,2.
The distance between the bearing support brackets should be at least 2.5 x the diameter of the shaft.

3. Drive Torque

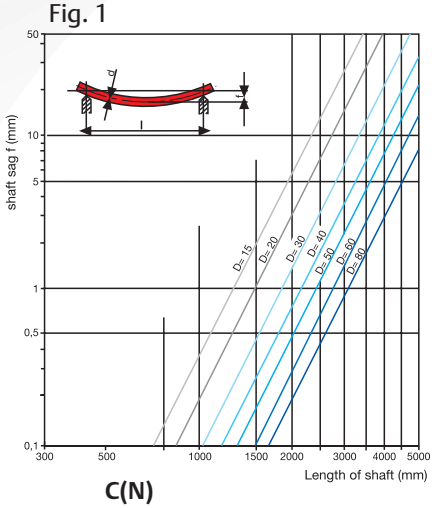
$$Md=\frac{F_{RS} \cdot h}{20 \cdot \pi}+Mo$$

Values for Mo to be taken from the technical detail tables.

4. Shaft Sag

see Diagram Fig.1

Fig. 1



5. Calculation of the operational life of Uhing Rolling Rings

1. Select C

Typ	C(N)
RS 08	3200
RS 10	4620
RS 15	5590
RS 20	9560
RS 25	11200
RS 35	15900
RS 50	21600
RS 60	29600

2. Calculate P_R
All RS3-types: $P_R = 5 \cdot F_{RS}$*
All RS4-types: $P_R = 2{,}5 \cdot F_{RS}$*
*F = calculated value of the side thrust according to 2.1 and 2.2 only if increasing of operational life time of the Rolling Rings is really necessary. In case of order it is an absolute must to mention.

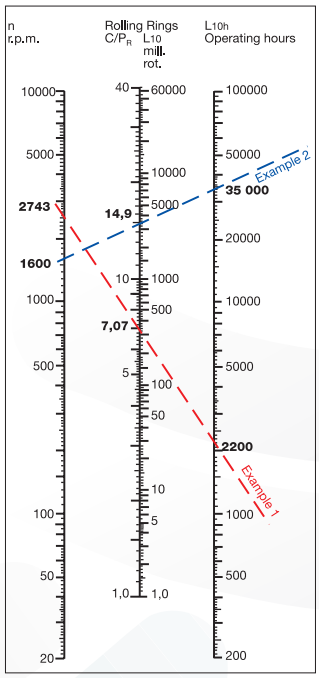
3. Divide C by P_R

4. Calculate the required shaft speed

$$n=\frac{v \cdot 6 \cdot 10^4}{h_{max}}$$

5. Determine the operational life in hours from the nomogram.

Nomogram



	Example 1	Example 2
	RS4-35-4R17,5 Speed 0,8 m/sec.	RS4-15-4R7,5 Speed 0,2 m/sec. **reduced side thrust 150 N**
1.	C = 15.900	C = 5590
2.	P_R = 2,5 · 900 N = 2.250 N	P_R = 2,5 · 150 N = 375 N
3.	$\frac{C}{P_R} = \frac{15.900}{2.250} = 7,07$	$\frac{C}{P_R} = \frac{5.590}{375} = 14,9$
4.	$n = \frac{0,8 \cdot 6 \cdot 10^4}{17,5} = 2.743$ rpm	$n = \frac{0,2 \cdot 6 \cdot 10^4}{7,5} = 1.600$ rpm
5.	L_{10h} = 2.200 Hours of operation	L_{10h} = 35.000 Hours of operation

Operational Guide

1. Shaft material

1.1. Basic requirements

Uhing Linear Drives should only be used in conjunction with steel shafts manufactured from induction surface hardened, ground and finished bar of the following quality, minimum:

- surface hardness: 50 HRC
- tolerance on diameter: h6
- out of roundness: maximum one half of the diameter variation permitted by ISO tolerance h6
- true running tolerance (DIN ISO 1101): ≤0,1 mm/m

1.2. Uhing Precision Shaft

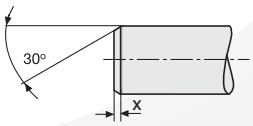
Standard:Material Cf 53, Mat.-Nr. 1.1213, induction surface hardened, 60-64 HRC
Rust resistant:
Material X 40 Cr 13, Mat.-Nr. 1.4034, induction surface hardened, 51-55 HRC
Rust and acid resistant:
Material X 90 CrMoV 18, Mat.-Nr. 1.4112, induction surface hardened, 52-56 HRC

- all ground and superfinished
- surface roughness: mean value (DIN 4768 T.1) R_a:≤ 0.35 µm
- tolerance on diameter: h6
- out of roundness: maximum one half of the dia meter variation permitted by ISO tolerance h6
- true running tolerance(DIN ISO 1101): ≤ 0.1 mm/m

1.3. Uhing Precision Shafts with Enhanced True Running Tolerance

Available in the above styles, but true running tolerance (DIN ISO 1101): ≤0.03 mm/m

1.4. Leading end chamfer



The leading end of the shaft should be chamfered to avoid damage to the Rolling Rings when screwing the unit on to the shaft.

X = depends upon type

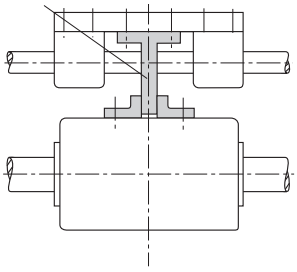
2. Pitch

The standard pitch is 0,5 x d. This can be ordered for RS as either a right- or a left-handed pitch.
Unless otherwise specified, units having a right-handed pitch will be supplied. For RS subsequent alterations to the pitch are possible with units having a design category -4 reference by changing the associated pitch control wedges.
Non-standard pitches 0,1 - 0,2 - 0,3 and 0,4 x d are avail-able. In this version reduction of the side thrust is recommended to improve the smooth running.

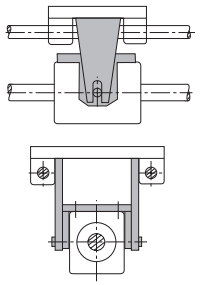
3. Separately carried loads

If Uhing Linear Drive Nuts are used to move separately carried loads, allowance should be made in the coupling to compensate for any misalignment between the drive shaft and the carriage. The available side thrust will otherwise be affected. If the application so permits, we recommend the use of our twist-free coupling system.

self-alingning coupling



Torque-free coupling system



4. Vertical applications

For vertical applications we advise the use of a directly braked motor so as to avoid the possibility of the shaft rotating backwards and the Drive Nut falling due to the high efficiency of the drive.
Depending upon the application (safety considerations and value of the installation) a reserve of side thrust should be built in (using a second Drive Nut).

With units having a free-movement lever, care must be taken before its operation to ensure that they are unable to drop in an uncontrolled manner - danger of injury!

5. Temperature range

Uhing Linear Drive Nuts are suitable for operation at temperatures from -10°C to +50°C.
Please enquire for other temperatures.

6. Maintenance

For the lubrication of the shaft, commercially available **MoS2-free ballbearing greases** can be used, e. g. SKF Alfalub LGMT2, Shell Alvania R2 or G2, Esso Beacon 2, BP Energrease LS2.
Procedure: Clean the shaft and spread the grease as thinly as possible with a rag.
Frequency: Once every ten weeks.

7. Symmetry

The maximum difference in pitch for the two directions of travel is 2 %. We therefore recommend the use of positional sensors for positioning applications.

We reserve the right to make technical alterations.

For further information please refer to our Operating Instructions, available on request or in the internet as download:

www.uhing.com

Uhing worldwide
Go straight to your local sales partner.

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