



# Sprag Type Freewheel Clutches



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GMN Sprag type freewheel clutches





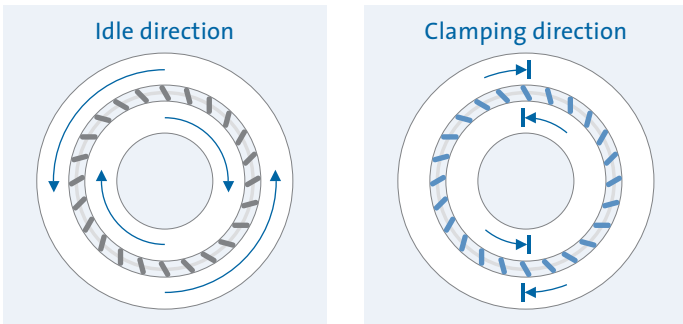
Based on its many years of experience in the development and production of high-quality machine components, GMN has chosen to specialize, within the field of freewheel-clutches, in the production of efficient, long-life sprag type freewheel clutches.

Emphasis is placed on the highest precision in the development and production of GMN sprag type freewheel clutches. This ensures their certification to international standards and produces consistent, outstanding quality characteristics with respect to torque handling, indexing reliability and long service life.

The standardized model series offer a large selection of feature options to furnish effective freewheel-clutch solutions for almost any field of application.

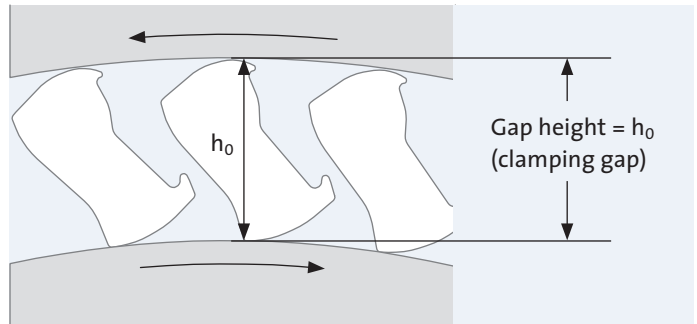
# Sprag Type Freewheel Clutches

## Function



Freewheel clutches are machine elements which permit rotation in one direction (idle) and stop rotation or transmit torque in the opposite direction.

## Idle direction



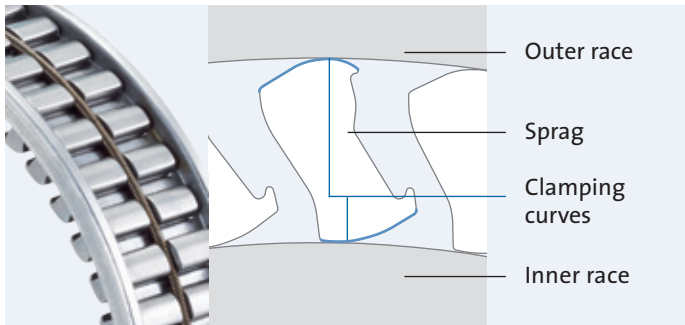
The sprags slide on the rotating raceway surfaces of the rings (sliding friction) in the idle direction. Torque is not transmitted from the driving side to the driven side under these conditions.

### Gap height

The inner and outer rings define a constant gap height  $h_0$  (start gap) in which the sprags slide over the raceways in the idle direction.

### Spring system

The sprags are spring-loaded to ensure constant friction contact between the sprags and the rings.

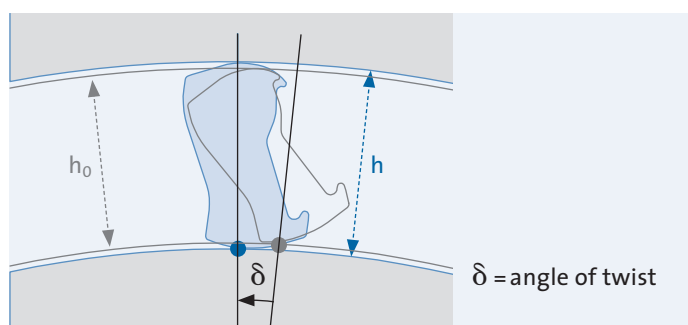


## Driving/driven side

Force transfer takes place from the driving side to the driven side. Torque can be applied as desired, via the outer ring or the inner ring.



## Clamping direction



When rotating the clutch in the driving direction, the sprags will instantaneously engage to drive the races/rings in the desired direction. This instantaneous engagement is a result of static friction contact with the raceways because of the specifically designed clamping curve. Torque could be transmitted through the sprags now.

### Angle of twist and torque transfer

As the force transfer increases, the sprags become more upright and expand the distance between the steel rings. This increased gap height is represented by  $h$ , and lies within the elastic deformation of the materials. The rings rotate with respect to each other in the amount of angle  $\delta$ .

The rotation of the sprags ends when a balance of forces is established between the applied torque and the reaction forces exerted in the freewheel clutch. Subsequently the force is transmitted to the driven side.

The angle of twist  $\delta$  is necessary to build up the balance of forces.

If the direction of rotation changes from the clamping direction to the idle direction, the system turns back in the opposite direction and the angle of twist reverses to the idle or start position. The rotation back and forth of the sprags from the driving to idle positions occur with a high degree of repeatability and precision.

## Applications



### Backstop

A Backstop application is where rotation is allowed in one direction and stopped in the opposite.



### Indexing clutch

A repeated drive then idle motion will be transferred to the driven side, step by step, as rotary motion in one direction (the clamping direction).



### Overrunning clutch

If the speed of the driven side exceeds the speed of the driving side, the freewheel-clutch disengages the driving and driven sides by switching from torque transmit to idle.

All GMN Freewheel clutches can be used for backstop, indexing or for overrunning clutch applications.



GMN Sprag Type  
Freewheel Clutches

GMN  
Sprag Type Freewheel Clutches  
Products





## Complete freewheel clutch units



- + Freewheel clutch insert element
- + Inner and outer ring
- + Ball bearing
- + Roller bearing
- + Seals (optional)

## Ball bearing freewheel clutch units



- + Freewheel clutch insert element
- + Inner and outer ring
- + Ball bearing
- + Seals (optional)

## Freewheel clutch insert elements with rings



- + Freewheel clutch insert element
- + Inner and outer ring

## Freewheel clutch insert elements



- + Freewheel clutch insert element

## Freewheel selection

GMN offers highly effective, long-life freewheel solutions for many applications.

All GMN Freewheel clutches can be used as backstop, indexing or for overrunning clutch applications.

The proper selection of the optimal Freewheel clutch for any application must include many design aspects:

1. Type (features of surrounding construction)
2. Size and torque requirements
3. Mode of operation (suitable spring system)

### 1. Type

Selection of a suitable GMN Clutch can be influenced by existing shaft and housing design characteristics:

The shaft and housing are already hardened to specification:

**Freewheel-clutch insert elements: GMN series FE**

If hardened mating rings are required:

**Freewheel-clutch insert elements with inner and outer ring: GMN series FR, FRN**

If bearing support is required:

**Ball bearing- / complete freewheel clutch units:**

**GMN series FK, FKN, FKNN, FP, FN**

If integrated lubrication and sealing is required :

**Pre-lubricated ball bearing- / complete freewheel clutch units**

**GMN series FPD, FND, RA, FK 2RS, FKN 2RS, FKNN 2RS**

### 2. Size and torque

All GMN clutches are available in many different sizes and performance classes (*Size tables: Pg. 24–55*).

### 3. Mode of operation (design / spring system)

Selection of a suitable spring system requires particular consideration with respect to the intended mode of operation:

**Indexing clutch:**

Spring system: meander spring (M)

**Backstop:**

Spring system: tension spring (Z)

**Overrunning clutch:**

Spring system: tension spring (Z) or meander spring (M)

### Custom solutions

The production of a custom GMN Clutch solution is possible on request.



# GMN Sprag Type Freewheel Clutches

## GMN Complete freewheel clutch units

Powerful and compact complete clutch solutions with integrated fixed and floating bearings for high torque requirements.

### Series: FPD



**Components:**

Insert element  
FE 400 Z / FE 400 M

- + Raceway rings  
Inner ring press fit  
Outer ring press fit
- + Ball bearing
- + Roller bearing
- + Oil lubrication
- + GMN rubber seals

**Width:**  
34 mm

**Operating temperature:**  
max. 100°C

*(Pg. 26–27)*

### Series: FND



**Components:**

Insert element  
FE 400 Z / FE 400 M

- + Raceway rings  
Inner ring keyway  
Outer ring press fit
- + Ball bearing
- + Roller bearing
- + Oil lubrication
- + GMN rubber seals

**Width:**  
34 mm

**Operating temperature:**  
max. 100°C

*(Pg. 28–29)*

### Series: RA



**Components:**

Insert element  
FE 400 Z

- + Raceway rings  
Inner ring keyway  
Outer ring mounting tab
- + Ball bearing
- + Roller bearing
- + Oil lubrication
- + GMN rubber seals

**Width:**  
34 mm

**Operating temperature:**  
max. 100°C

*(Pg. 30–31)*

### Series: FP



**Components:**

Insert element  
FE 400 Z / FE 400 M

- + Raceway rings  
Inner ring press fit  
Outer ring press fit
- + Ball bearing
- + Roller bearing

**Lubrication:**  
Oil or grease

**Width:**  
27 mm

**Operating temperature:**  
max. 140°C

Higher temp. on request

*(Pg. 32–33)*



## GMN Ball bearing freewheel clutch units

Economical freewheel-clutch solutions with integrated ball bearings for small to medium torque requirements in standardized dimensions of ball bearing series 62 (DIN 625).

### Series: FN



#### Components:

Insert element  
FE 400 Z / FE 400 M

- + Raceway rings
  - Inner ring keyway
  - Outer ring press fit
- + Ball bearing
- + Roller bearing

#### Lubrication:

Oil or grease

#### Width:

27 mm

#### Operating temperature:

max. 140°C  
Higher temp. on request

(Pg. 34–35)

### Series: FK (2RS)



#### Components:

Insert element  
FE 400 Z2

- + Raceway rings
  - Inner ring press fit
  - Outer ring press fit
- + Ball bearing
- + Grease lubrication\*
- + RS seals\*

#### Width:

12 / 14 / 15 / 16 / 17 / 18 mm

#### Operating temperature:

max. 140°C  
max. 170 °C on request  
max. 110°C (series 2RS)

(Pg. 36–37)

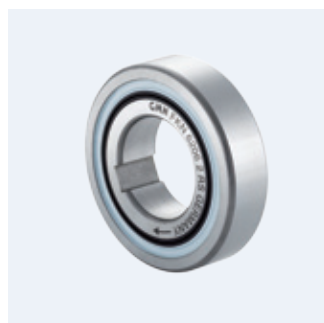
\*Ball bearing freewheel clutches are offered with no seals or two seals (2RS).

The seals do not effect the width requirement of the clutches.

The double-sealed type is greased for lifetime.

GMN ball bearing freewheels without seals are suitable for either oil or also grease lubrication.

### Series: FKN (2RS)



#### Components:

Insert element  
FE 400 Z2

- + Raceway rings
  - Inner ring keyway
  - Outer ring press fit
- + Ball bearing
- + Grease lubrication\*
- + RS seals\*

#### Width:

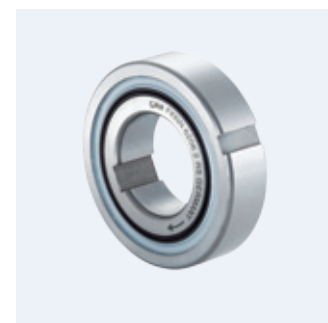
12 / 14 / 15 / 16 / 17 / 18 mm

#### Operating temperature:

max. 140°C  
max. 170 °C on request  
max. 110°C (series 2RS)

(Pg. 38–39)

### Series: FKNN (2RS)



#### Components:

Insert element  
FE 400 Z2

- + Raceway rings
  - Inner ring keyway
  - Outer ring keyway
- + Ball bearing
- + Grease lubrication\*
- + RS seals\*

#### Width:

12 / 14 / 15 / 16 / 18 mm

#### Operating temperature:

max. 140°C  
max. 170 °C on request  
max. 110°C (series 2RS)

(Pg. 40–41)

# GMN Sprag Type Freewheel Clutches

## GMN Freewheel clutch insert elements with rings

Series FR and FRN consist of a freewheel clutch insert element and hardened and ground thrust rings.

### Series: FR



#### Components:

Insert element  
FE 400 Z / FE 400 M

+ Raceway rings  
Inner ring press fit  
Outer ring press fit

#### Lubrication:

Oil or grease

#### Width:

12 mm

#### Operating temperature:

max. 140°C  
Higher temp. on request

(Pg. 42–43)

### Series: FRN



#### Components:

Insert element  
FE 400 Z / FE 400 M

+ Raceway rings  
Inner ring keyway  
Outer ring press fit

#### Lubrication:

Oil or grease

#### Width:

12 mm

#### Operating temperature:

max. 140°C  
Higher temp. on request

(Pg. 44–45)

## GMN Freewheel clutch insert elements

A freewheel clutch insert element consists of a cage, a spring and a size dependent number of sprags.



All GMN Freewheel clutch units and ball bearing freewheel clutch units are equipped with an insert element of series FE 400 M, FE 400 Z or FE 400 Z2.

#### Complete freewheel clutch units:

Series FPD, FND, RA, FP, FN

#### Freewheel clutch insert element:

FE 400 Z, FE 400 M

#### Ball bearing freewheel clutch units:

Series FK, FKN, FKNN

#### Freewheel-clutch insert element:

FE 400 Z2

#### Freewheel clutch insert elements with rings:

Series FR, FRN

#### Freewheel clutch insert elements:

FE 400 Z, FE 400 M

#### Note

Freewheel clutch insert elements are not self-centering. They require external bearing support to ensure concentricity of the shaft to the housing.



**Series: FE 400 Z**



**Components:**

- Sprags
- Spring: tension spring
- Cage: steel / plastic

**Lubrication:**

Oil or grease

**Width/installed width:**

11 mm / 12 mm

**Operating temperature:**

max. 170°C (steel cage)  
max. 140°C (plastic cage)

(Pg. 46–47)

**Series: FE 400 M**



**Components:**

- Sprags
- Spring: meander spring
- Cage: steel

**Lubrication:**

Oil or grease

**Width/installed width:**

11 mm / 12 mm

**Operating temperature:**

max. 170°C

(Pg. 48–49)

**Series: FE 400 Z2**



**Components:**

- Sprags
- Spring: tension spring
- Cage: steel / plastic

**Lubrication:**

Oil or grease

**Width/installed width:**

6.3 mm / 7 mm

**Operating temperature:**

max. 170°C (steel cage)  
max. 140°C (plastic cage)

(Pg. 50–51)

**Series: FE 8000 Z**



**Components:**

- Sprags
- Spring: tension spring
- Cage: steel

**Lubrication:**

Oil or grease

**Width/installed width:**

16 mm / 16.5–18 mm  
19 mm / 19.5–21 mm  
25 mm / 25.5–27 mm

**Operating temperature:**

max. 170°C

(Pg. 52–53)



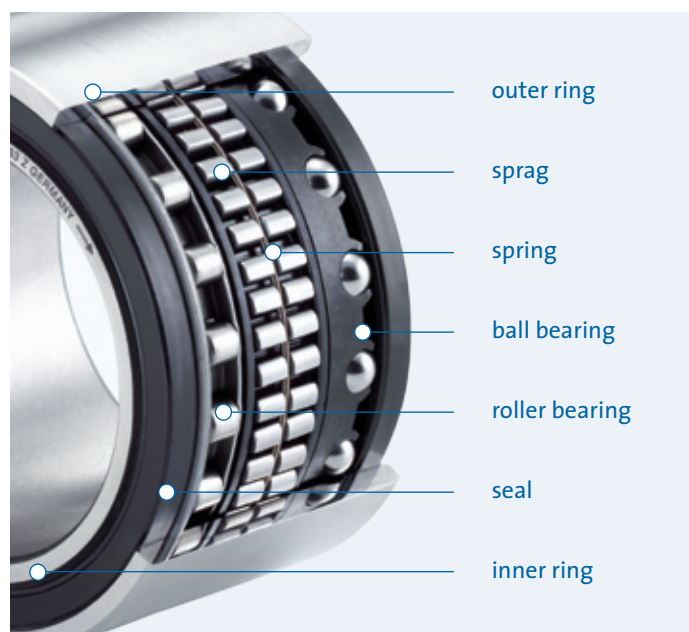
GMN  
Sprag Type Freewheel Clutches  
Freewheel Clutch Components



# GMN Freewheel Clutch Components

## Components

Use of the highest quality components is the basis for the outstanding performance and the long service life exhibited by GMN sprag type freewheel clutches.



### Freewheel clutch insert elements

GMN series FE 400 Z, FE 400 M, FE 400 Z2 and FE 8000 have, as their basic components, sprags, sprag cage and spring. GMN series FR and FRN additionally include inner and outer rings which are intended for press-fit or key way connect to the mating parts.

### Ball bearing freewheel clutch units

GMN series FK, FKN and FKNN are additionally equipped with ball bearings.

RS series with RS seals

### Complete freewheel clutch units

GMN series FP and FN are distinguished by an integrated ball bearing and an additional roller bearing.

Series FPD, FND and RA with GMN rubber seals

## Performance features

GMN Sprag type freewheel clutches are distinguished by compact construction and exhibit outstanding performance characteristics with respect to torque, indexing accuracy, indexing frequency and service life.

### Minimal sprag size

- Space very small

### Low sprag mass

- Minimal inertia
- High indexing frequencies

### High density of installed sprags

- Maximum torque capacity in minimal space

### Highly precise clamping curve geometry (logarithmic spirals) with a constant clamping angle

- Minimum indexing delay due to small angle of twist
- Homogeneous load distribution independent of individual sprag angle
- No localized material stress peaks

### Exact spring force

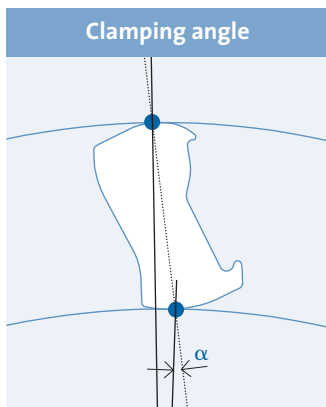
- Highly reliable indexing with repetition accuracy

# GMN Freewheel Clutch Components

## Sprags

The compact size of these sprags in combination with their highly precise production geometry result in outstanding performance characteristics.

**Clamping angle and clamping curve:** The specific shape of the clamping curve along the sprags' inner and outer race defines in contact with the round mating parts (shaft and housing) the clamping angle  $\alpha$ .



The correct function of the sprag relies on a specific clamping angle.

$$\mu > \tan \alpha$$

$\mu$  = static friction coefficient  
 $\alpha$  = clamping angle

As long as the tangent of the clamping angle is smaller than the coefficient of static friction  $\mu$ , the sprags will be in static friction contact with the connecting parts when load is applied.

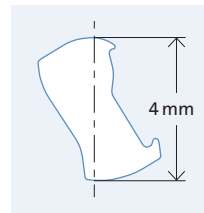
**Material:**

Bearing steel 100Cr6 (material number: 1.3505)  
 Hardness: HRC = 60<sup>+4</sup> (HV = 700<sup>+100</sup>)

**Mating parts:**

The geometry of the clamping curve is designed for steel mating parts – raceways in other materials are not permissible.

## Sprag series 400



The small sprag size permits high sprag density and thus maximum performance in a minimum of space. The low inertia of sprags also makes it possible to achieve extremely high indexing frequencies of up to 60 Hz.

**Height (radial) in idle position:**

4 mm

**Widths**

5 / 8 mm (for tension spring)

8 mm (for meander spring)

**Clamping curve geometry:**

Logarithmic spiral

**Clamping angle:**

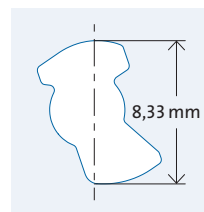
Constant

**Sprag characteristic:**

Lift off inner ring at high speed



## Sprag series 8000



To achieve maximum torque capacity with the larger 8000 series sprag the profile was adjusted with a slightly higher clamping angle. Due to the center of gravity's position the design is not lifting off and provides indexing reliability even in high speed applications.

**Height (radial) in idle position:**

8.33 mm

**Widths**

13 / 16 / 22 mm (for tension spring)

**Clamping curve geometry:**

Compound circles

**Clamping angle:**

Increasing

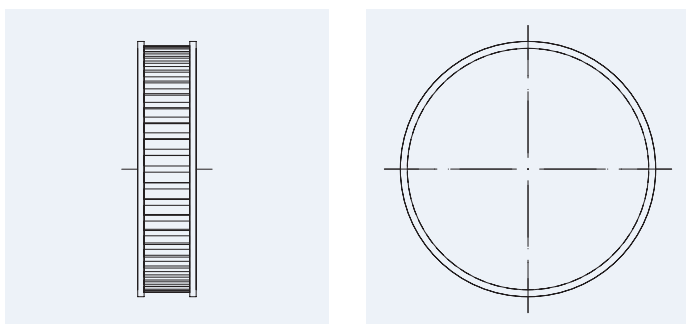
**Sprag characteristic:**

Press towards inner ring at high speed





## Sprag cage



The sprags are evenly spaced around the circumference of the insert element cage. The insert element cage does not come in contact with the inner or outer races; it remains absolutely load free under any application.

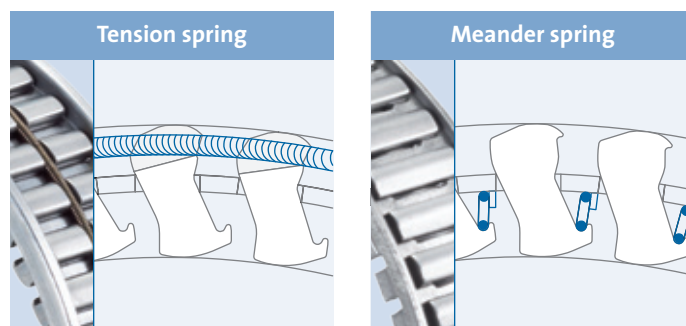
GMN Sprag type freewheel clutches with a plastic cage in their standard design are also available as a special design with a steel cage on request.

### Operating temperature:

Steel cage: max. 170°C

Plastic cage: max. 140°C

## Spring



GMN offers two different spring systems which maintain a constant friction contact between sprags and the mating parts.

### Tension spring

The GMN tension spring is a circular spring that envelops all of the sprags and provides them with a collective spring force.

The spring force per sprag is slightly less than that of a meander spring.

This results in a longer service life in idle.

The max. indexing frequency is  $f_{\max} = 10$  Hz.

### Series with tension springs:

Freewheel clutch insert element: FE 400 Z, FE 400 Z2, FE 8000 Z

Freewheel clutch insert elements with rings: all series

Ball bearing freewheel clutches: all series

Complete freewheel clutch units: all series

### Meander spring

A 3-dimensionally bent spring that loads each sprag separately (individual spring force for each sprag).

The structural characteristics of this spring increases transferable torque by about 10% (in comparison to tension springs) because maximum sprag line contact to race is achieved.

The max. indexing frequency is  $f_{\max} = 60$  Hz.

### Series with meander springs:

Freewheel clutch insert element: FE 400 M

Freewheel clutch insert elements with rings: all series

Complete freewheel clutch units: all series

| Mode of operation  | Spring system       |
|--------------------|---------------------|
| Indexing clutch    | Meander spring      |
| Backstop           | Z spring            |
| Overrunning clutch | Meander or Z spring |

# GMN Freewheel Clutch Components

## Rings

Rings for press fit



Inner ring with keyway



GMN Freewheel clutch rings are made of hardened and ground ball bearing steel.

### Press fit installation

The thin wall thickness (2–2.5 mm) of the rings for press fit permits installation within a limited space requirement. The rings are designed to achieve the optimal start gap height ( $h_0$ ) only after the rings are pressed into the housing and onto the shaft (see tolerance tables). Press fit installation guarantees transmission of maximum torque capacity.

### Keyway installation

All GMN rings with a keyway are designed for light press fit to support torque transfer. A key connection alone without a press fit will be insufficient to achieve maximum torque transfer.

### Series with rings:

- Freewheel clutches with rings: all series
- Ball bearing freewheel clutches: all series
- Complete freewheel clutch units: all series

### Properties:

- 100Cr6 (material number 1.3505)
- Hardness: HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>)
- Surface: Rz ≤ 2.5 μm (Ra ≤ 0.4)

## Seals

GMN rubber seals



RS seals



### GMN rubber seals

GMN Complete freewheel clutch units in series FPD, FND and RA are equipped with effective round seals that protect the freewheel clutch from external contamination and keep the oil filling reliably inside.

### Series with GMN round seals

Complete freewheel clutch units: Series FPD, FND and RA

### Operating temperature:

max. 100°C

### RS seals

GMN ball bearing freewheel clutches that integrate RS seals protect the clutch from external contamination and keep the lubrication inside the clutch.

### Series with RS seals

Ball bearing freewheel clutch units: 2RS designs

### Operating temperature:

max. 110°C





## Ball bearings



GMN Ball bearing freewheel clutch units and complete freewheel clutch units have standard ball bearings integrated.

The rings each have a ground-in ball bearing raceway and form a unit with the balls, which cannot be disassembled.

The ball bearing raceways for all inner and outer rings are individually measured and paired.

Bearing clearance between C3 and C5 is established according to the tolerance fields of the mating parts after press-fitting the freewheel clutch.

Minimum bearing clearance C3 is achieved with the largest dimension of the shaft's diameter and the smallest dimension of the bore diameter (housing).

### Ball bearing freewheel clutch units:

Ball bearing freewheel clutch units: all series

Complete freewheel clutch units: all series

### Balls:

Diameter: 5 mm

Material: 100Cr6 (material number: 1.3505)

### Ball cage:

Plastic (PA)

(ball bearing freewheel clutch units sizes 6204 and 6205: brass)

## Roller bearings



GMN series RL 400 roller bearings are available as an option for GMN freewheel clutch insert elements: FE 400, FE 400 Z and FE 400 Z2.

GMN Roller bearings with the tolerance "-4" (4 µm smaller than nominal dimension) are produced both as components for GMN Complete freewheel clutch units and as separate accessories.

For applications with reduced bearing clearance tolerance "0" is also available on request.

(order designation: RL 432-0)

### Series with roller bearings:

Complete freewheel clutch units: all series

### Materials:

Rollers: 100Cr6 (material number: 1.3505)

Roller cage: steel

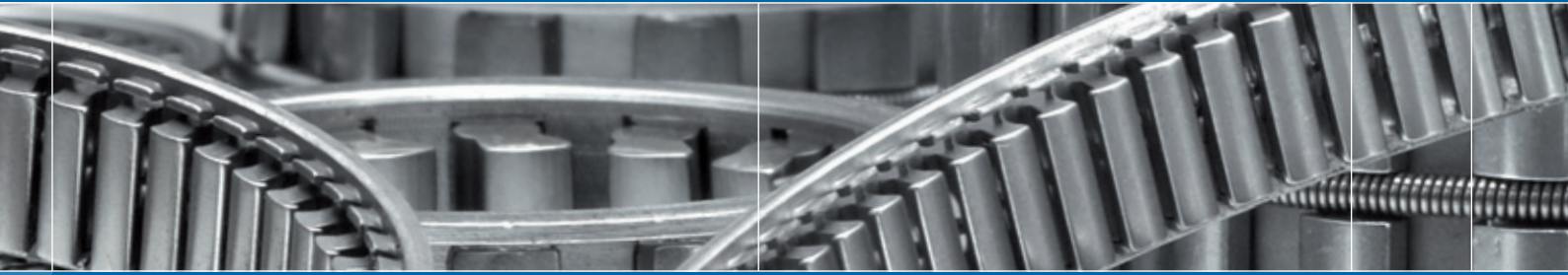
(RL 448 and RL 443: brass)

### Operating temperature (max.):

170°C

(RL 448 and RL 443: 150°C)





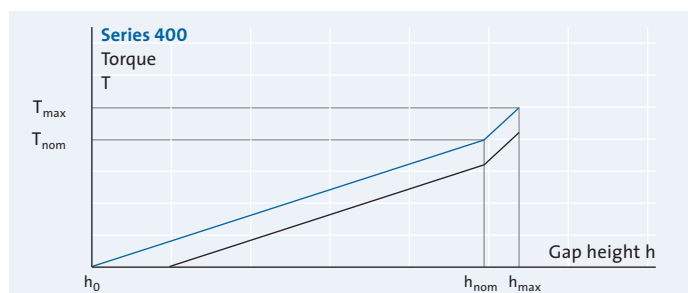
GMN  
Sprag Type Freewheel Clutches  
Torque

# Torque

## Torque development

As the force transfer increases in driving direction, the sprags become more upright and expand the clamping gap between the rings elastically.

When nominal gap height  $h_{nom}$  is reached, the freewheel clutch will transmit its nominal torque  $T_{nom}$ ; at the maximum gap height  $h_{max}$  its maximum torque  $T_{max}$ .



— Torque development for optimal start gap  $h_0$ .

— Torque development for start gap  $h > h_0$ .

The gradient of the graph remains unchanged, nominal and maximum torque are reduced.

| Insert element | Start gap height $h_0$ | Nom. gap height $h_{nom}$ | Max. gap height $h_{max}$ |
|----------------|------------------------|---------------------------|---------------------------|
| Series 400     | 4.00 mm                | 4.06 mm                   | 4.07 mm                   |
| Series 8000    | 8.33 mm                | 8.46 mm                   | 8.6 mm                    |

The maximum gap height ( $h_{max}$ ) is a consequence of the sprag geometry.

## Torque limit

- A load-dependent stress reaction is built up in the sprags and the mating parts.
- The linear contact of the sprags along the clamping curves with the mating parts is evaluated according to the Hertzian model.
- The sprags expand the gap. Maximum gap height is determined by the geometry of sprags.

The freewheel clutch's nominal and maximum torque are defined by reaching one of the relevant limits.

| Torque    | Gap height      | Hertzian pressure | perm. tension                                      |
|-----------|-----------------|-------------------|--|
| $M_{nom}$ | Nom. gap height | 4,200 MPa         | $\sigma_{perm.ab}$<br>all participating components |
| $M_{max}$ | Max. gap height | 4,600 MPa         |  |

## Stresses

Sprags as well as the rings are loaded in the contact area by tangential and radial stress.

Bending stresses  $\sigma_{BS perm.}$  is valid as an equivalent stress for this load.

| Material   | $\sigma_{BS perm.}$ | Hardness   |
|------------|---------------------|--|
| 34 CrMo 4V | 400 MPa             | case hardened<br>HRC = 60 <sup>+4</sup> ; Eht = 1.3 mm |
| 16 MnCr 5  | 400 MPa             | case hardened<br>HRC = 60 <sup>+4</sup> ; Eht = 1.3 mm |
| 20 MnCr 5  | 600 MPa             | case hardened<br>HRC = 60 <sup>+4</sup> ; Eht = 1.3 mm |
| 100 Cr 6   | 750 MPa             | hardened and tempered<br>HRC = 60 <sup>+4</sup>        |

Yield strength  $R_e$  is the applicable load limit for all other components in press fits.

## Freewheel clutches in a row

Rough calculation of the torque capacity for a maximum of 3 freewheel clutches in a row:

- 2 freewheel clutches in a row:  
90% of the sum of individual torque capacity
- 3 freewheel clutches in a row:  
80% of the sum of individual torque capacity

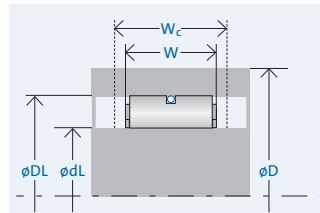
# Torque

## Nominal torque

The nominal torque ( $T_{nom}$ ) (size tables Pg. 24–55) describes the torque that the freewheel clutch can transfer as a continuous load.

The calculation of nominal torque is based on a standardized surrounding construction.

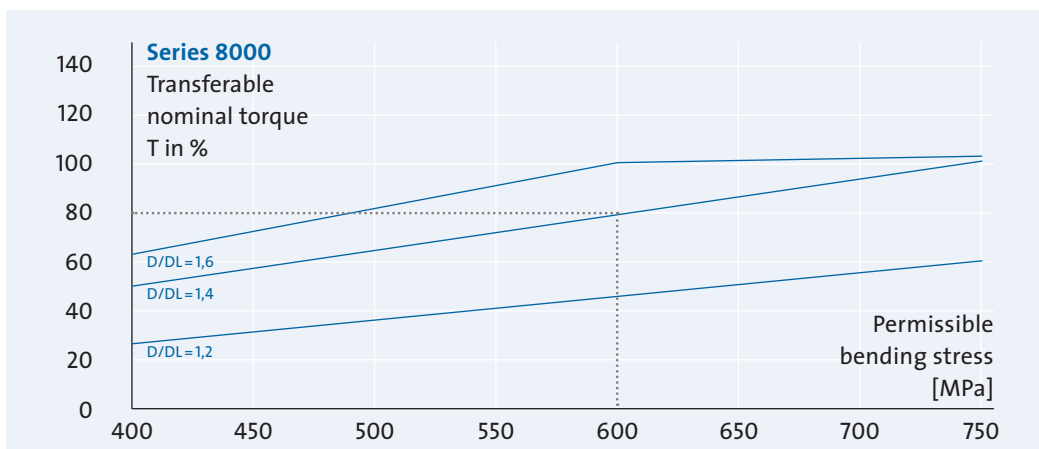
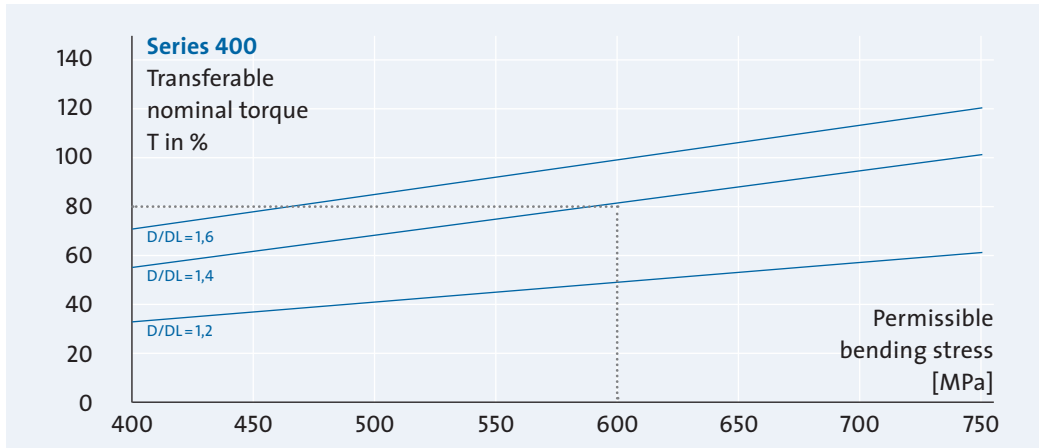
- Solid shaft
- Mating parts material: 100Cr6 hardened and tempered; HRC = 60<sup>+</sup><sub>4</sub>
- Wall thickness ratio  $D/DL = 1.4$
- Calculative width  $W_c$



- $W$  = width
- $W_c$  = calculative width
- FE 400:  $W_c = 15$  mm
- FR/FRN:  $W_c = 15$  mm
- FP/FN/FPD/FND/FK/FKN:  $W_c = W$
- FE 8000:  $W_c = W + 3$  mm

Deviating characteristics in the surrounding construction have an influence on nominal torque.

Influence of the mating parts stiffness on the nominal torque.  
(wall thickness ratios:  $D/DL = 1.2 / 1.4 / 1.6$ )



Example for 20 MnCr5 -  $D/DL = 1.4$



## Maximum torque

If the load exceeds the specified nominal torque ( $T_{nom}$ ) the clamping angle changes and rises steeply to increase gap height to its maximum permissible dimension ( $h_{max}$ ).

Depending on type and surrounding construction, the maximum torque ( $T_{max}$ ) is 1.5 to 2 times the specified nominal torque. Please note that maximum torque capacity cannot be transferred in continuous operation.

## Overload protection

If the applied torque exceeds the maximum permissible value ( $T_{max}$ ), static friction contact is loosened between the sprags and the rings and the clutch slips.

## Drag torque

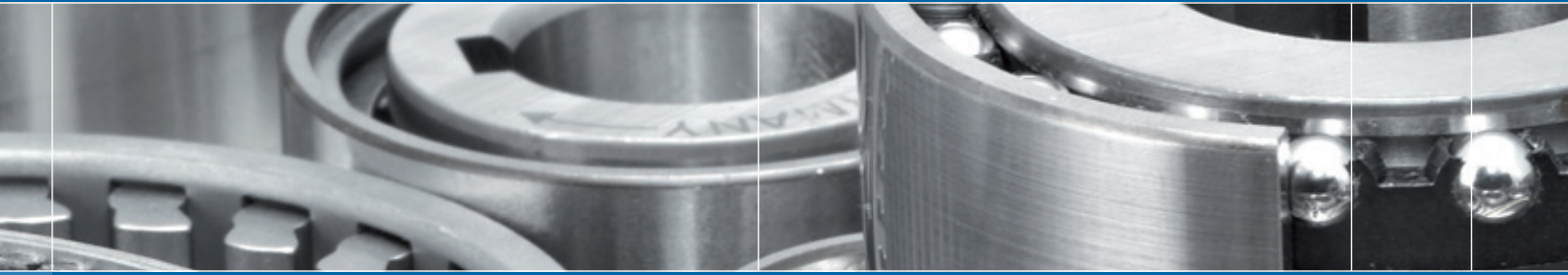
In idle direction the freewheel clutch shows only a very low drag torque to overcome the sliding friction between sprags and the rings. Drag torque is increased in sealed freewheel clutches: ball bearing freewheel clutch units,  $T_s = 0.01$  to  $0.05$  Nm. complete freewheel clutch units,  $T_s = 0.1$  to  $0.3$  Nm

## Torque calculation

The GMN calculation program determines specific nominal torque with consideration for all influencing factors.

The analysis of a given surrounding construction can reveal optimization potential for mating parts, provide performance enhancing design advisories and offer support in the selection of a suitable freewheel-clutch.





GMN  
Sprag Type Freewheel Clutches  
Technical Data





## Complete freewheel clutch units

**FPD** (Pg. 26-27)



**FND** (Pg. 28-29)



**RA** (Pg. 30-31)



**FP** (Pg. 32-33)



**FN** (Pg. 34-35)



## Ball bearing freewheel clutch units

**FK** (Pg. 36-37)



**FKN** (Pg. 38-39)



**FKNN** (Pg. 40-41)



## Freewheel clutch insert elements with rings

**FR** (Pg. 42-43)



**FRN** (Pg. 44-45)

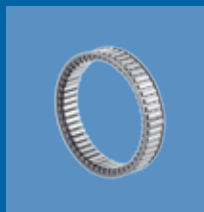


## Freewheel clutch insert elements

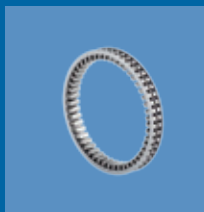
**FE 400 Z** (Pg. 46-47)



**FE 400 M** (Pg. 48-49)



**FE 400 Z2** (Pg. 50-51)

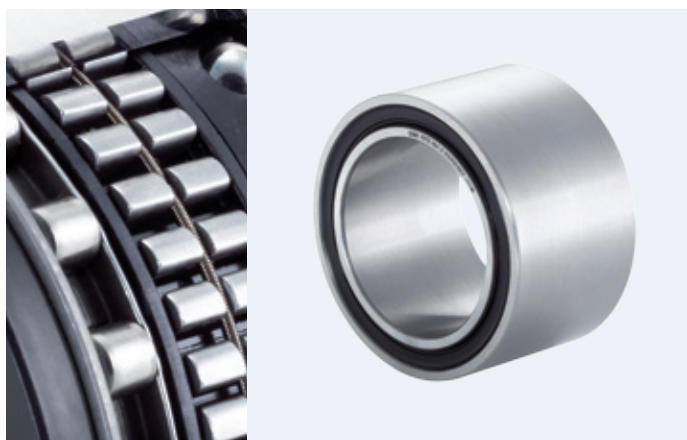


**FE 8000 Z** (Pg. 52-53)



# Complete Freewheel Clutch Unit FPD

with seals



## Components

### Freewheel clutch

**insert element\*** FE 400 M (meander spring)  
FE 400 Z (tension spring)

**+ Raceways** Bearing steel, hardened and ground  
**inner ring** Press fit  
**outer ring** Press fit

**+ Ball bearing** Integrated

**+ Roller bearing** RL 400

**+ Lubrication** Lifetime oil lubrication

**+ Seal** GMN rubber seal

\* available with either freewheel clutch insert element FE 400 M (meander spring) or FE 400 Z (tension spring).

## Characteristics

### Width

34 mm

### Operating temperature

max. 100° C

## Lubrication

Operative lifetime oil lubrication

## Installation

### Installation tolerances

Shaft h5; hub H6

### Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

### Bearing

The freewheel clutch includes ball and roller bearings. Additional external bearing support is not necessary.

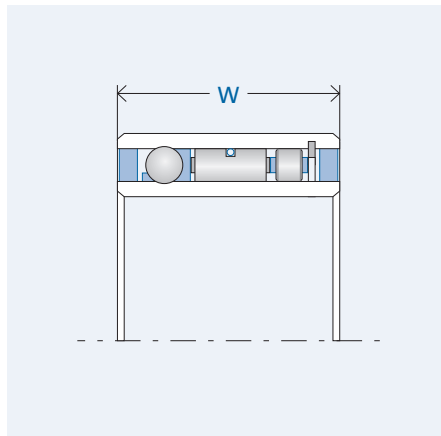
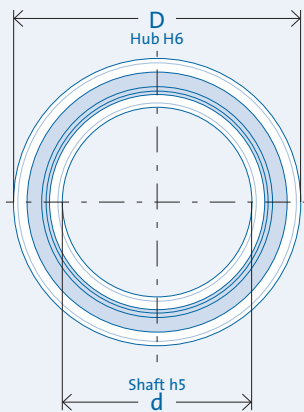
### Press fit pressure

Press fit pressure must not be applied to the balls.

### Clamping direction

The arrow on the inner ring designates the inner ring's clamping direction.

## Data



### Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- T = torque
- n = rotation speed
- C = load capacity

| Designation | d [mm] | D [mm] | W [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | C <sub>dyn.</sub> [N] | C <sub>stat.</sub> [N] | Weight [kg] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|-----------------------|------------------------|-------------|----------|
| FPD 427 M   | 15     | 31     | 34     | 94                    | 2,000                  | 7,679                 | 6,397                  | 0.09        | 306516   |
| FPD 427 Z   | 15     | 31     | 34     | 84                    | 2,000                  | 7,679                 | 6,397                  | 0.09        | 306517   |
| FPD 432 M   | 20     | 36     | 34     | 133                   | 1,800                  | 8,104                 | 7,241                  | 0.12        | 306518   |
| FPD 432 Z   | 20     | 36     | 34     | 121                   | 1,800                  | 8,104                 | 7,241                  | 0.12        | 306519   |
| FPD 437 M   | 25     | 41     | 34     | 176                   | 1,700                  | 9,201                 | 8,142                  | 0.15        | 306520   |
| FPD 437 Z   | 25     | 41     | 34     | 160                   | 1,700                  | 9,201                 | 8,142                  | 0.15        | 306521   |
| FPD 442 M   | 30     | 46     | 34     | 223                   | 1,500                  | 10,247                | 10,708                 | 0.18        | 300696   |
| FPD 442 Z   | 30     | 46     | 34     | 208                   | 1,500                  | 10,247                | 10,708                 | 0.18        | 300697   |
| FPD 448 M   | 35     | 53     | 34     | 286                   | 1,300                  | 11,642                | 13,440                 | 0.23        | 306524   |
| FPD 448 Z   | 35     | 53     | 34     | 262                   | 1,300                  | 11,642                | 13,440                 | 0.23        | 306525   |
| FPD 453 M   | 40     | 58     | 34     | 343                   | 1,200                  | 11,417                | 13,577                 | 0.26        | 300702   |
| FPD 453 Z   | 40     | 58     | 34     | 314                   | 1,200                  | 11,417                | 13,577                 | 0.26        | 300700   |
| FPD 463 M   | 50     | 68     | 34     | 461                   | 1,100                  | 13,070                | 17,063                 | 0.34        | 306534   |
| FPD 463 Z   | 50     | 68     | 34     | 428                   | 1,100                  | 13,070                | 17,063                 | 0.34        | 306535   |
| FPD 473 M   | 60     | 78     | 34     | 588                   | 1,000                  | 14,128                | 19,896                 | 0.41        | 306536   |
| FPD 473 Z   | 60     | 78     | 34     | 543                   | 1,000                  | 14,128                | 19,896                 | 0.41        | 306537   |

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22)  
 Rotation speed n = speed difference of mating parts

# Complete Freewheel Clutch Unit FND

with seals and keyway (IR)



## Characteristics

**Width**  
34 mm

**Operating temperature**  
max. 100°C

## Lubrication

Operative lifetime oil lubrication

## Installation

**Installation tolerances**  
Shaft js6 (k5); hub H6

## Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

## Bearing

The freewheel clutch includes ball and roller bearings. Additional external bearing support is not necessary.

## Press fit pressure

Press fit pressure must not be applied to the balls.

## Clamping direction

The arrow on the inner ring designates the inner ring's clamping direction.

## Components

### Freewheel clutch

**insert element\*** FE 400 M (meander spring)  
FE 400 Z (tension spring)

**+ Raceways** Bearing steel, hardened and ground  
**inner ring** Keyway per DIN 6885, Sheet 1  
Tolerance: P9 with back clearance  
**outer ring** Press fit

**+ Ball bearing** Integrated

**+ Roller bearing** RL 400

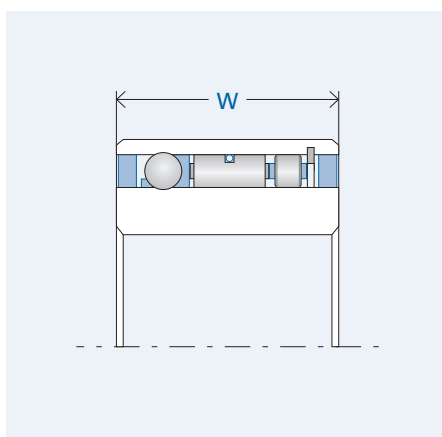
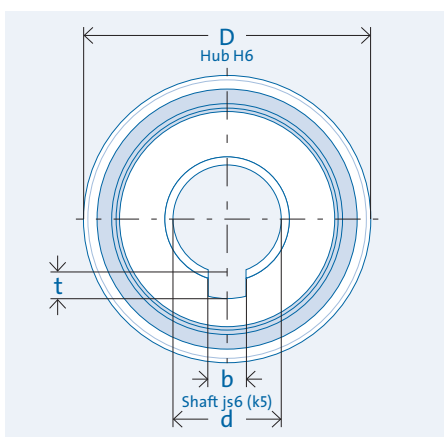
**+ Lubrication** Lifetime oil lubrication

**+ Seal** GMN rubber seal

\* available with either freewheel clutch insert element FE 400 M (meander spring) or FE 400 Z (tension spring).



## Data



## Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- T = torque
- n = rotation speed
- C = load capacity
- b = keyway width
- t = keyway depth

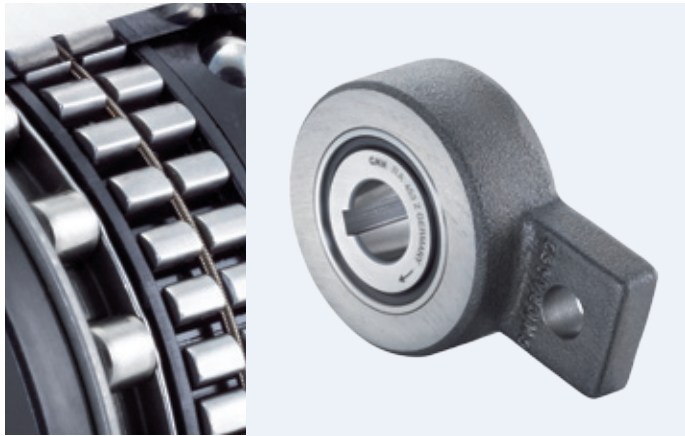
| Designation | d [mm] | D [mm] | W [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | C <sub>dyn.</sub> [N] | C <sub>stat.</sub> [N] | Weight [kg] | b [mm] | t [mm] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|-----------------------|------------------------|-------------|--------|--------|----------|
| FND 437 M   | 15     | 41     | 34     | 176                   | 1,700                  | 8,962                 | 8,661                  | 0.24        | 5      | 2.3    | 300737   |
| FND 437 Z   | 15     | 41     | 34     | 161                   | 1,700                  | 8,962                 | 8,661                  | 0.24        | 5      | 2.3    | 300738   |
| FND 442 M   | 20     | 46     | 34     | 223                   | 1,500                  | 10,247                | 10,708                 | 0.28        | 6      | 2.8    | 300743   |
| FND 442 Z   | 20     | 46     | 34     | 208                   | 1,500                  | 10,247                | 10,708                 | 0.28        | 6      | 2.8    | 300744   |
| FND 453 M   | 25     | 58     | 34     | 343                   | 1,200                  | 11,417                | 13,577                 | 0.46        | 8      | 3.3    | 300751   |
| FND 453 Z   | 25     | 58     | 34     | 314                   | 1,200                  | 11,417                | 13,577                 | 0.46        | 8      | 3.3    | 300752   |
| FND 459 M   | 30     | 64     | 34     | 411                   | 1,100                  | 12,691                | 16,320                 | 0.55        | 8      | 3.3    | 300758   |
| FND 459 Z   | 30     | 64     | 34     | 381                   | 1,100                  | 12,691                | 16,320                 | 0.55        | 8      | 3.3    | 300760   |
| FND 463 M   | 35     | 68     | 34     | 462                   | 1,100                  | 13,070                | 17,063                 | 0.60        | 10     | 3.3    | 306528   |
| FND 463 Z   | 35     | 68     | 34     | 428                   | 1,100                  | 13,070                | 17,063                 | 0.60        | 10     | 3.3    | 306529   |
| FND 470 M   | 40     | 75     | 34     | 550                   | 1,000                  | 14,050                | 19,840                 | 0.69        | 12     | 3.3    | 300765   |
| FND 470 Z   | 40     | 75     | 34     | 509                   | 1,000                  | 14,050                | 19,840                 | 0.69        | 12     | 3.3    | 300766   |
| FND 473 M   | 45     | 78     | 34     | 588                   | 1,000                  | 14,128                | 19,896                 | 0.73        | 14     | 3.8    | 306532   |
| FND 473 Z   | 45     | 78     | 34     | 543                   | 1,000                  | 14,128                | 19,896                 | 0.73        | 14     | 3.8    | 306533   |

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22) and refers to the integrated insert element, not the key way.

Rotation speed n = speed difference of mating parts

# Complete Freewheel Clutch Unit RA

with seals, keyway (IR) and mounting tab (OR)



## Characteristics

**Width**  
34 mm

**Operating temperature**  
max. 100°C

## Lubrication

Operative lifetime oil lubrication

## Installation

**Installation tolerances**  
Shaft js6 (k5)

## Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

## Bearing

The freewheel clutch includes ball and roller bearings. Additional external bearing support is not necessary.

## Press fit pressure

Press fit pressure must not be applied to the balls. Installation/removal through inner ring only.

## Clamping direction

The arrow on the inner ring designates the inner ring's clamping direction.

## Mounting tab

Mounting tab must not be fixed to the housing tight.

## Components

**Freewheel clutch insert element** Complete freewheel clutch unit, series FND FE 400 Z (tension spring)

**+ Raceways** Bearing steel, hardened and ground  
**inner ring** Keyway per DIN 6885, Sheet 1 P9 with back clearance  
**outer ring** With mounting tab (cast steel or steel)\*

**+ Ball bearing** Integrated

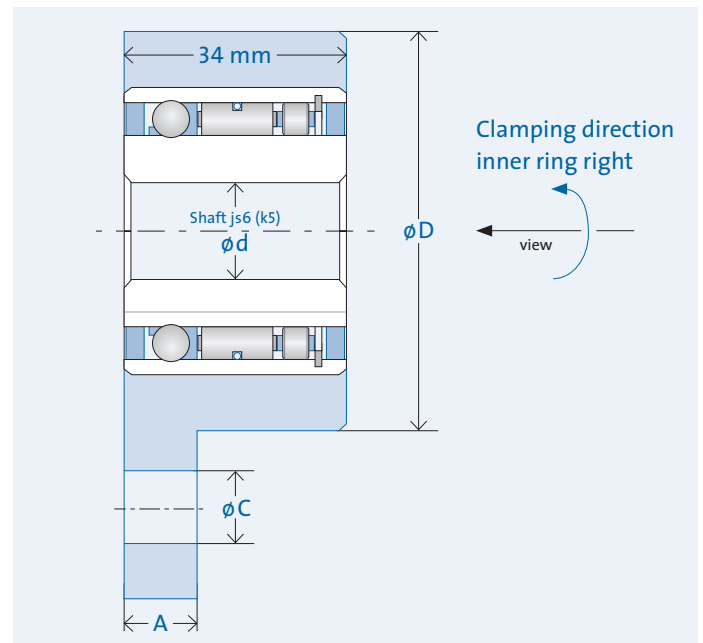
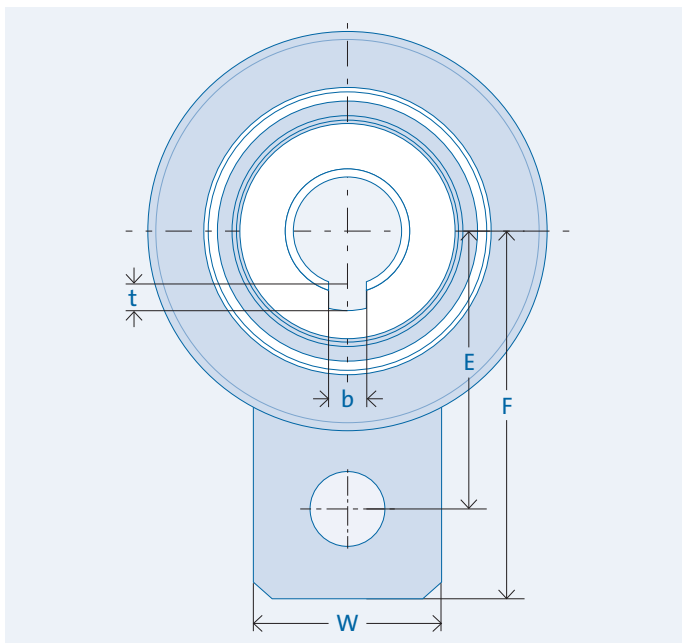
**+ Roller bearing** RL 400

**+ Lubrication** Lifetime oil lubrication

**+ Seal** GMN rubber seal

\* Not suitable for indexing freewheel clutch applications.

## Data



| Designation | d [mm] | D [mm] | A [mm] | W [mm] | C [mm] | E [mm] | F [mm] | $T_{\text{nom}}$ [Nm] | $n_{\text{max}}$ [rpm] | $C_{\text{dyn.}}$ [N] | $C_{\text{stat.}}$ [N] | Weight [kg] | b [mm] | t [mm] | Item no. |
|-------------|--------|--------|--------|--------|--------|--------|--------|-----------------------|------------------------|-----------------------|------------------------|-------------|--------|--------|----------|
| RA 437 Z    | 15     | 65     | 12     | 32     | 10     | 47     | 62     | 161                   | 1,700                  | 8,962                 | 8,661                  | 0.81        | 5      | 2.3    | 301026   |
| RA 442 Z    | 20     | 75     | 16     | 36     | 12     | 54     | 72     | 208                   | 1,500                  | 10,247                | 10,708                 | 1.08        | 6      | 2.8    | 301030   |
| RA 453 Z    | 25     | 90     | 16     | 45     | 16     | 62     | 84     | 314                   | 1,200                  | 11,417                | 13,577                 | 1.50        | 8      | 3.3    | 301043   |
| RA 459 Z    | 30     | 100    | 16     | 50     | 16     | 68     | 92     | 381                   | 1,100                  | 12,691                | 16,320                 | 1.81        | 8      | 3.3    | 301048   |
| RA 463 Z    | 35     | 100    | 16     | 50     | 16     | 68     | 92     | 428                   | 1,100                  | 13,070                | 17,063                 | 1.75        | 10     | 3.3    | 306681   |
| RA 470 Z    | 40     | 110    | 20     | 50     | 20     | 85     | 115    | 509                   | 1,000                  | 14,050                | 19,840                 | 2.28        | 12     | 3.3    | 301056   |
| RA 473 Z    | 45     | 110    | 20     | 50     | 20     | 85     | 115    | 543                   | 1,000                  | 14,128                | 19,896                 | 2.2         | 14     | 3.8    | 306682   |

Inner ring clamping direction left available on request. Rotation speed  $n$  = shaft speed

The specified nominal torque refers to the integrated freewheel clutch insert element, not the key way.

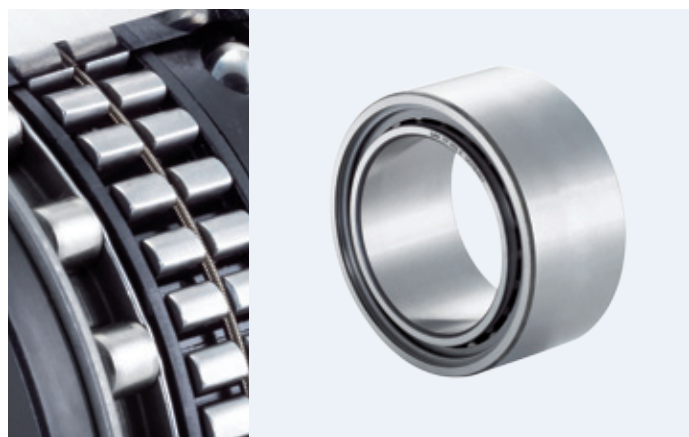
## Drawing legend

$E$  = bore spacing  
 $F$  = support lever length  
 $T$  = torque  
 $n$  = rotation speed  
 $C$  = mounting tab bore

$d$  = inner diameter  
 $b$  = keyway width  
 $t$  = keyway depth  
 $D$  = outer diameter  
 $B$  = mounting tab width  
 $A$  = mounting tab thickness

# Complete Freewheel Clutch Unit FP

for press fit (IR and OR)



## Characteristics

**Width**  
27 mm

**Operating temperature**  
max. 140°C  
Higher temperatures on request

## Lubrication

oil or grease lubrication (Pg. 60–61)  
Delivered with corrosion protection.  
Operative grease filling on request.

## Installation

**Installation tolerances**  
Shaft h5; hub H6

## Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

## Bearing

The freewheel clutch includes ball and roller bearings. Additional external bearing support is not necessary.

## Press fit pressure

Press fit pressure must not be applied to the balls.

## Clamping direction

The arrow on the inner ring designates the inner ring's clamping direction.

## Components

**Freewheel clutch insert element\*** FE 400 M (meander spring)  
FE 400 Z (tension spring)

**+ Raceways** Bearing steel, hardened and ground  
inner ring Press fit  
outer ring Press fit

**+ Ball bearing** Integrated

**+ Roller bearing** Integrated

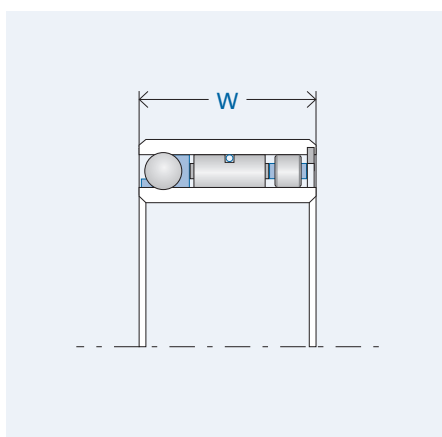
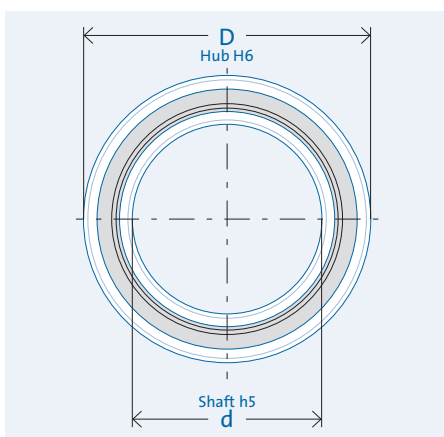
- Lubrication -

- Seal -

\* available with either freewheel clutch insert element FE 400 M (meander spring) or FE 400 Z (tension spring).



## Data



## Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- T = torque
- n = rotation speed
- C = load capacity

| Designation | d [mm] | D [mm] | W [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | C <sub>dyn.</sub> [N] | C <sub>stat.</sub> [N] | Weight [kg] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|-----------------------|------------------------|-------------|----------|
| FP 422 M    | 10     | 26     | 27     | 60                    | 10,100                 | 6,013                 | 4,380                  | 0.07        | 300655   |
| FP 422 Z    | 10     | 26     | 27     | 53                    | 10,100                 | 6,013                 | 4,380                  | 0.07        | 300656   |
| FP 427 M    | 15     | 31     | 27     | 94                    | 7,400                  | 7,679                 | 6,397                  | 0.08        | 300663   |
| FP 427 Z    | 15     | 31     | 27     | 84                    | 7,400                  | 7,679                 | 6,397                  | 0.08        | 300664   |
| FP 432 M    | 20     | 36     | 27     | 133                   | 5,900                  | 8,104                 | 7,241                  | 0.10        | 300669   |
| FP 432 Z    | 20     | 36     | 27     | 121                   | 5,900                  | 8,104                 | 7,241                  | 0.10        | 300670   |
| FP 437 M    | 25     | 41     | 27     | 176                   | 4,800                  | 9,201                 | 8,142                  | 0.12        | 300673   |
| FP 437 Z    | 25     | 41     | 27     | 160                   | 4,800                  | 9,201                 | 8,142                  | 0.12        | 300674   |
| FP 442 M    | 30     | 46     | 27     | 223                   | 4,200                  | 10,247                | 10,708                 | 0.14        | 300679   |
| FP 442 Z    | 30     | 46     | 27     | 208                   | 4,200                  | 10,247                | 10,708                 | 0.14        | 300680   |
| FP 448 M    | 35     | 53     | 27     | 286                   | 4,300                  | 11,642                | 13,440                 | 0.19        | 306522   |
| FP 448 Z    | 35     | 53     | 27     | 262                   | 4,300                  | 11,642                | 13,440                 | 0.19        | 306523   |
| FP 453 M    | 40     | 58     | 27     | 343                   | 3,400                  | 11,417                | 13,577                 | 0.21        | 300683   |
| FP 453 Z    | 40     | 58     | 27     | 314                   | 3,400                  | 11,417                | 13,577                 | 0.21        | 300684   |
| FP 463 M    | 50     | 68     | 27     | 461                   | 2,900                  | 13,070                | 17,063                 | 0.25        | 300685   |
| FP 463 Z    | 50     | 68     | 27     | 428                   | 2,900                  | 13,070                | 17,063                 | 0.25        | 300687   |
| FP 473 M    | 60     | 78     | 27     | 588                   | 2,500                  | 14,128                | 19,896                 | 0.30        | 300691   |
| FP 473 Z    | 60     | 78     | 27     | 543                   | 2,500                  | 14,128                | 19,896                 | 0.30        | 300693   |

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22).

Rotation speed n = insert element's inherent speed (Pg. 57)

# Complete Freewheel Clutch Unit FN

with keyway (IR)



## Characteristics

**Width**  
27 mm

**Operating temperature**  
max. 140°C  
Higher temperatures on request

## Lubrication

oil or grease lubrication (Pg. 60–61)  
Delivered with corrosion protection.  
Operative grease filling on request.

## Installation

**Installation tolerances**  
Shaft js6 (k5); hub H6

## Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

## Bearing

The freewheel clutch includes ball and roller bearings. Additional external bearing support is not necessary.

## Press fit pressure

Press fit pressure must not be applied to the balls.

## Clamping direction

The arrow on the inner ring designates the inner ring's clamping direction.

## Components

### Freewheel clutch

**insert element\*** FE 400 M (meander spring)  
FE 400 Z (tension spring)

**+ Raceways** Bearing steel, hardened and ground  
**inner ring** Keyway per DIN 6885, Sheet 1  
Tolerance: P9 with back clearance  
**outer ring** Press fit

**+ Ball bearing** Integrated

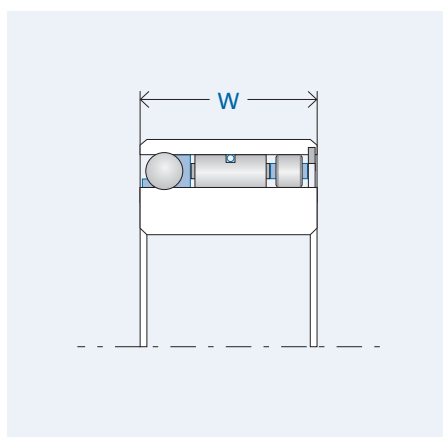
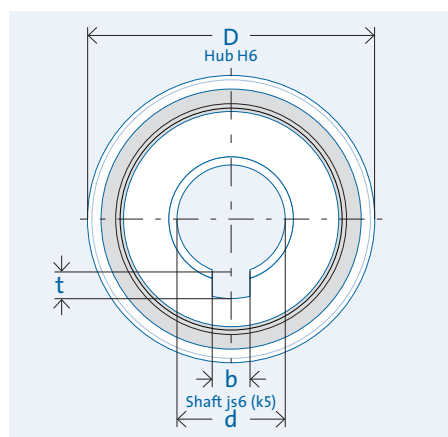
**+ Roller bearing** RL 400

- Lubrication -

- Seal -

\* available with either freewheel clutch insert element FE 400 M (meander spring) or FE 400 Z (tension spring).

## Data



## Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- T = torque
- n = rotation speed
- C = load capacity
- b = keyway width
- t = keyway depth

| Designation | d [mm] | D [mm] | W [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | C <sub>dyn.</sub> [N] | C <sub>stat.</sub> [N] | Weight [kg] | b [mm] | t [mm] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|-----------------------|------------------------|-------------|--------|--------|----------|
| FN 437 M    | 15     | 41     | 27     | 176                   | 4,800                  | 8,962                 | 8,661                  | 0.19        | 15     | 2.3    | 300706   |
| FN 437 Z    | 15     | 41     | 27     | 160                   | 4,800                  | 8,962                 | 8,661                  | 0.19        | 15     | 2.3    | 300707   |
| FN 442 M    | 20     | 46     | 27     | 223                   | 4,200                  | 10,247                | 10,708                 | 0.22        | 20     | 2.8    | 300712   |
| FN 442 Z    | 20     | 46     | 27     | 208                   | 4,200                  | 10,247                | 10,708                 | 0.22        | 20     | 2.8    | 300714   |
| FN 453 M    | 25     | 58     | 27     | 343                   | 3,400                  | 11,417                | 13,577                 | 0.36        | 25     | 3.3    | 300718   |
| FN 453 Z    | 25     | 58     | 27     | 314                   | 3,400                  | 11,417                | 13,577                 | 0.36        | 25     | 3.3    | 300719   |
| FN 459 M    | 30     | 64     | 27     | 411                   | 3,000                  | 12,691                | 16,320                 | 0.43        | 30     | 3.3    | 300726   |
| FN 459 Z    | 30     | 64     | 27     | 381                   | 3,000                  | 12,691                | 16,320                 | 0.43        | 30     | 3.3    | 300728   |
| FN 463 M    | 35     | 68     | 27     | 461                   | 2,900                  | 13,070                | 17,063                 | 0.47        | 35     | 3.3    | 306526   |
| FN 463 Z    | 35     | 68     | 27     | 427                   | 2,900                  | 13,070                | 17,063                 | 0.47        | 35     | 3.3    | 306527   |
| FN 470 M    | 40     | 75     | 27     | 550                   | 2,600                  | 14,050                | 19,840                 | 0.54        | 40     | 3.3    | 300731   |
| FN 470 Z    | 40     | 75     | 27     | 509                   | 2,600                  | 14,050                | 19,840                 | 0.54        | 40     | 3.3    | 300733   |
| FN 473 M    | 45     | 78     | 27     | 588                   | 2,500                  | 14,128                | 19,896                 | 0.58        | 45     | 3.8    | 306530   |
| FN 473 Z    | 45     | 78     | 27     | 544                   | 2,500                  | 14,128                | 19,896                 | 0.58        | 45     | 3.8    | 306531   |

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22) and refers to the integrated insert element, not the key way.

Rotation speed n = insert element's inherent speed (Pg. 57)

# Ball Bearing Freewheel Clutch Unit FK (2RS)



for press fit (IR and OR)



## Characteristics

### Dimensions

Dimensions in accordance with bearing series 62 (DIN 625)

### Width

12 / 14 / 15 / 16 / 17 / 18 mm

### Operating temperature

max. 140°C

Higher temperatures on request  
max. 110°C (design 2RS with RS seals)

## Lubrication

### Series FK 2RS with seals

Operative lifetime grease lubrication

### Series FK without seal discs

Oil or grease lubrication (Pg. 60–61)  
Delivered with corrosion protection.

## Installation

### Installation tolerances

Shaft n6; hub N7

### Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

### Bearing

The freewheel clutch includes a ball bearing. Additional external bearing support is not necessary.

### Press fit pressure

Press fit pressure must not be applied to the balls.

### Clamping direction

The arrow on the inner ring designates the inner ring's clamping direction.

### Seals\*

The RS Seals reliably seal out grease and dust but are not suitable to protect against permanent higher liquid levels.

Series FK 6203-RS has an RS seal on one side only (RS Seal on the freewheel side).

## Components

### Freewheel clutch

insert element FE 400 Z2

### + Raceways

inner ring Bearing steel, hardened and ground  
outer ring Press fit

### + Ball bearing

Integrated

- Roller bearing -

### + Lubrication

Lifetime grease lubrication\*

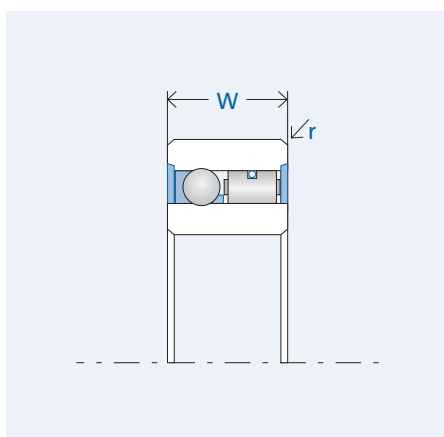
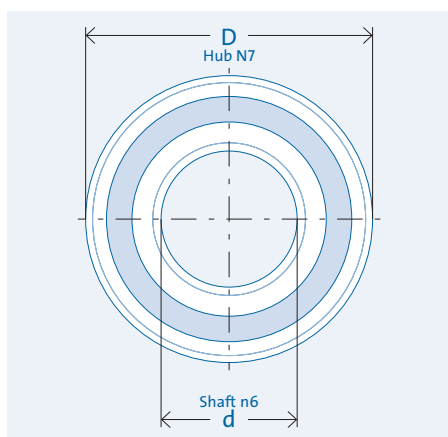
### + Seal

RS seals\*

\* Series FK 2RS (with RS seals)



## Data



## Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- r = edge radius
- T = torque
- n = rotation speed
- C = load capacity

| Designation | d [mm] | D [mm] | W [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | C <sub>dyn.</sub> [N] | C <sub>stat.</sub> [N] | r [mm] | Weight [kg] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|-----------------------|------------------------|--------|-------------|----------|
| FK 6203     | 17     | 40     | 12     | 53                    | 10,800                 | 6,245                 | 3,441                  | 1.0    | 0.07        | 301065   |
| FK 6203-RS  | 17     | 40     | 12     | 53                    | 3,700                  | 6,245                 | 3,441                  | 1.0    | 0.07        | 301079   |
| FK 6204     | 20     | 47     | 14     | 60                    | 7,500                  | 6,869                 | 4,268                  | 1.5    | 0.12        | 301068   |
| FK 6204-2RS | 20     | 47     | 14     | 60                    | 3,200                  | 6,869                 | 4,268                  | 1.5    | 0.12        | 301087   |
| FK 6205     | 25     | 52     | 15     | 104                   | 5,400                  | 7,448                 | 5,146                  | 1.5    | 0.15        | 301070   |
| FK 6205-2RS | 25     | 52     | 15     | 104                   | 2,800                  | 7,448                 | 5,146                  | 1.5    | 0.15        | 301092   |
| FK 6206     | 30     | 62     | 16     | 148                   | 5,100                  | 7,859                 | 6,066                  | 1.5    | 0.23        | 301074   |
| FK 6206-2RS | 30     | 62     | 16     | 148                   | 2,400                  | 7,859                 | 6,066                  | 1.5    | 0.23        | 301103   |
| FK 6207     | 35     | 72     | 17     | 265                   | 3,700                  | 8,902                 | 7,819                  | 2.7    | 0.34        | 301077   |
| FK 6207-2RS | 35     | 72     | 17     | 265                   | 1,900                  | 8,902                 | 7,819                  | 2.7    | 0.34        | 301108   |
| FK 6208     | 40     | 80     | 18     | 267                   | 3,700                  | 8,902                 | 7,752                  | 2.7    | 0.45        | 301078   |
| FK 6208-2RS | 40     | 80     | 18     | 267                   | 1,900                  | 8,902                 | 7,752                  | 2.7    | 0.45        | 301110   |
| FK 6304-2RS | 20     | 52     | 15     | 104                   | 2,800                  | 7,448                 | 5,146                  | 1.5    | 0.17        | 301098   |

All specifications for series FK 2RS (with seals) and series FK (without seals)

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22).

Rotation speed n for series FK (without seals) = assembly unit's inherent speed (Pg. 57)

Rotation speed n for series FK 2RS (with seals) = speed difference of mating parts.

# Ball Bearing Freewheel Clutch Unit FKN (2RS)



with keyway (IR)



## Characteristics

### Dimensions

Dimensions per bearing series 62 (DIN 625)

### Width

12 / 14 / 15 / 16 / 17 / 18 mm

### Operating temperature

max. 140°C

Higher temperatures on request  
max. 110°C (design 2RS with RS seals)

## Lubrication

### Series FKN 2RS with seals

Operative lifetime grease lubrication

### Series FKN without seals

Oil or grease lubrication (Pg. 60–61)  
Delivered with corrosion protection.

## Installation

### Installation tolerances

Shaft n6; hub N7

### Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

### Bearing

The freewheel clutch includes a ball bearing. Additional external bearing support is not necessary.

### Press fit pressure

Press fit pressure must not be applied to the balls.

### Clamping direction

The arrow on the inner ring designates the inner ring's clamping direction.

### Seals\*

The employed RS seal reliably seal out grease and dust but are not suitable protection against the presence of liquids.

Series FKN 6203-RS has a RS seal on one side only (RS seal on the freewheel side).

## Components

### Freewheel clutch

**insert element** FE 400 Z2

### + Raceways inner ring

Bearing steel, hardened and polished  
Keyway per DIN 6885, Sheet 3  
(Sizes 6203-6206)  
Keyway per DIN 6885, Sheet 1  
(Sizes 6207-6208)

### outer ring

Tolerance: P9 with back clearance  
Press fit

### + Ball bearing

Integrated

### - Roller bearing -

### + Lubrication

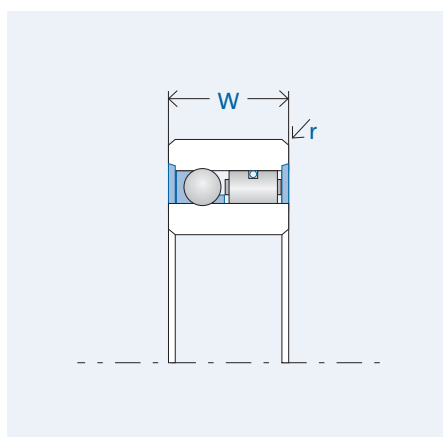
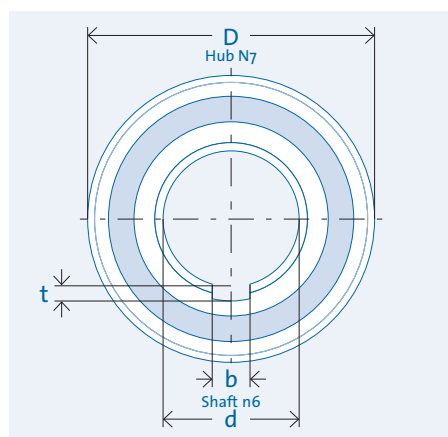
Lifetime grease lubrication\*

### + Seal

RS seals\*

\* Series FKN 2RS (with RS seals)

## Data



## Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- r = edge radius
- b = keyway width IR
- t = keyway depth IR
- T = torque
- n = rotation speed
- C = load capacity

| Designation  | d [mm] | D [mm] | W [mm] | r [mm] | b [mm] | t [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | C <sub>dyn.</sub> [N] | C <sub>stat.</sub> [N] | Weight [kg] | Item no. |
|--------------|--------|--------|--------|--------|--------|--------|-----------------------|------------------------|-----------------------|------------------------|-------------|----------|
| FKN 6203     | 17     | 40     | 12     | 1      | 5      | 12     | 53                    | 10,800                 | 6,245                 | 3,441                  | 0.07        | 301112   |
| FKN 6203-RS  | 17     | 40     | 12     | 1      | 5      | 1.2    | 53                    | 3,700                  | 6,245                 | 3,441                  | 0.07        | 301114   |
| FKN 6204     | 20     | 47     | 14     | 1.5    | 6      | 1.6    | 60                    | 7,500                  | 6,869                 | 4,268                  | 0.12        | 301120   |
| FKN 6204-2RS | 20     | 47     | 14     | 1.5    | 6      | 1.6    | 60                    | 3,200                  | 6,869                 | 4,268                  | 0.12        | 301125   |
| FKN 6205     | 25     | 52     | 15     | 1.5    | 8      | 2      | 104                   | 5,400                  | 7,448                 | 5,146                  | 0.15        | 301131   |
| FKN 6205-2RS | 25     | 52     | 15     | 1.5    | 8      | 2      | 104                   | 2,800                  | 7,448                 | 5,146                  | 0.15        | 301130   |
| FKN 6206     | 30     | 62     | 16     | 1.5    | 8      | 2      | 148                   | 5,100                  | 7,859                 | 6,066                  | 0.23        | 301145   |
| FKN 6206-2RS | 30     | 62     | 16     | 1.5    | 8      | 2      | 148                   | 2,400                  | 7,859                 | 6,066                  | 0.23        | 301143   |
| FKN 6207     | 35     | 72     | 17     | 1.5    | 10     | 3.3    | 265                   | 3,700                  | 8,902                 | 7,819                  | 0.33        | 301156   |
| FKN 6207-2RS | 35     | 72     | 17     | 1.5    | 10     | 3.3    | 265                   | 1,900                  | 8,902                 | 7,819                  | 0.33        | 301158   |
| FKN 6208     | 40     | 80     | 18     | 1.5    | 12     | 3.3    | 267                   | 3,700                  | 8,902                 | 7,752                  | 0.45        | 301161   |
| FKN 6208-2RS | 40     | 80     | 18     | 1.5    | 12     | 3.3    | 267                   | 1,900                  | 8,902                 | 7,752                  | 0.45        | 301163   |

All specifications for series FKN 2RS (with seals) and series FKN (without seals)

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22) and refers to the integrated insert element, not the key way.

Rotation speed n for series FKN (without seals) = insert element's inherent speed (Pg. 57)

Rotation speed n for series FKN 2RS (with seals) = speed difference of mating parts.

# Ball Bearing Freewheel Clutch Unit FKNN (2RS)



with keyway (IR) and rectangular groove (OR)



## Characteristics

### Dimensions

Dimensions in accordance with bearing series 62 (DIN 625)

### Width

12 / 14 / 15 / 16 / 18 mm

### Operating temperature

max. 140°C

Higher temperatures on request  
max. 110°C (design 2RS with RS seals)

## Lubrication

### Series FKNN 2RS with seals

Operative lifetime grease lubrication

### Series FKNN without seals

Oil or grease lubrication (Pg. 60–61)  
Delivered with corrosion protection.

## Installation

### Installation tolerances

Shaft n6; hub N7

### Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

### Bearing

The freewheel clutch is bearing mounted. Additional external bearing support is not necessary.

### Press fit pressure

Press fit pressure must not be applied to the balls.

### Clamping direction

The arrow on the inner ring designates the inner ring's clamping direction.

### Seals\*

The employed RS seals reliably seal out grease and dust but are not suitable protection against the presence of liquids.

Series FKNN 6203-RS has a RS seal disc on one side only (RS seal on the freewheel side).

## Components

### Freewheel clutch

insert element FE 400 Z2

### + Raceways inner ring

Bearing steel, hardened and ground  
Keyway per DIN 6885, Sheet 3  
(Sizes 6203-6206)  
Keyway per DIN 6885, Sheet 1  
(Sizes 6207-6208)

### outer ring

Tolerance: P9 with back clearance  
Rectangular groove

### + Ball bearing

Integrated

### - Roller bearing -

### + Lubrication

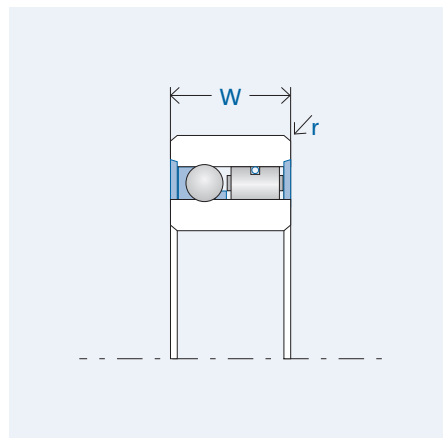
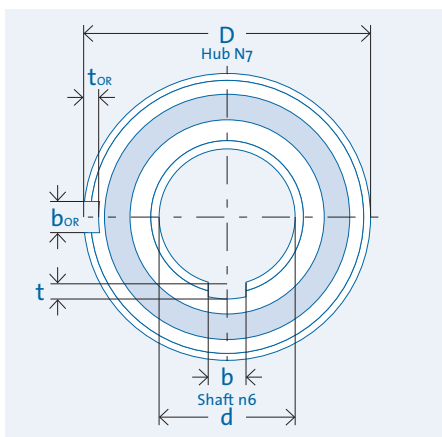
Lifetime grease lubrication\*

### + Seal

RS seals\*

\* Series FKNN 2RS (with RS seals)

## Data



## Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- r = edge radius
- b = keyway width
- t = keyway depth
- b<sub>OR</sub> = rectangular groove width
- t<sub>OR</sub> = rectangular groove depth
- T = torque
- n = rotation speed
- C = load capacity

| Designation   | d [mm] | D [mm] | W [mm] | r [mm] | b [mm] | t [mm] | b <sub>OR</sub> [mm] | t <sub>OR</sub> [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | C <sub>dyn.</sub> [N] | C <sub>stat.</sub> [N] | Weight [kg] | Item no. |
|---------------|--------|--------|--------|--------|--------|--------|----------------------|----------------------|-----------------------|------------------------|-----------------------|------------------------|-------------|----------|
| FKNN 6203     | 17     | 40     | 12     | 1      | 5      | 1.2    | 2                    | 1                    | 53                    | 10,800                 | 6,245                 | 3,441                  | 0.07        | 305989   |
| FKNN 6203-RS  | 17     | 40     | 12     | 1      | 5      | 1.2    | 2                    | 1                    | 53                    | 3,700                  | 6,245                 | 3,441                  | 0.07        | 305990   |
| FKNN 6204     | 20     | 47     | 14     | 1.5    | 6      | 1.6    | 3                    | 1,5                  | 60                    | 7,500                  | 6,869                 | 4,268                  | 0.12        | 305992   |
| FKNN 6204-2RS | 20     | 47     | 14     | 1.5    | 6      | 1.6    | 3                    | 1,5                  | 60                    | 3,200                  | 6,869                 | 4,268                  | 0.12        | 305993   |
| FKNN 6205     | 25     | 52     | 15     | 1.5    | 8      | 2      | 6                    | 2                    | 104                   | 5,400                  | 7,448                 | 5,146                  | 0.14        | 305995   |
| FKNN 6205-2RS | 25     | 52     | 15     | 1.5    | 8      | 2      | 6                    | 2                    | 104                   | 2,800                  | 7,448                 | 5,146                  | 0.14        | 305996   |
| FKNN 6206     | 30     | 62     | 16     | 1.5    | 8      | 2      | 6                    | 2                    | 148                   | 5,100                  | 7,859                 | 6,066                  | 0.22        | 305998   |
| FKNN 6206-2RS | 30     | 62     | 16     | 1.5    | 8      | 2      | 6                    | 2                    | 148                   | 2,400                  | 7,859                 | 6,066                  | 0.22        | 305999   |
| FKNN 6208     | 40     | 80     | 18     | 1.5    | 12     | 3.3    | 10                   | 3                    | 267                   | 3,700                  | 8,902                 | 7,752                  | 0.44        | 306004   |
| FKNN 6208-2RS | 40     | 80     | 18     | 1.5    | 12     | 3.3    | 10                   | 3                    | 267                   | 1,900                  | 8,902                 | 7,752                  | 0.44        | 306005   |
| FKNN 6304-2RS | 20     | 52     | 15     | 1.5    | 6      | 2      | 6                    | 2                    | 104                   | 2,800                  | 7,448                 | 5,146                  | 0.15        | 306137   |

All specifications for series FKNN 2RS (with seals) and series FKNN (without seals)

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22) and refers to the integrated insert element, not the key way.

Rotation speed n for series FKNN (without seals) = insert element's inherent speed (Pg. 57)

Rotation speed n for series FKNN 2RS (with seals) = speed difference of mating parts.



# Freewheel Clutch Insert Element FR

with rings



## Components

### Freewheel clutch insert element\*

FE 400 M (meander spring)  
FE 400 Z (tension spring)

**+ Raceways** Bearing steel, hardened and ground  
**inner ring** Press fit  
**outer ring** Press fit

- Ball bearing -

- Roller bearing -

- Lubrication -

- Seal -

\* available with either freewheel clutch insert element FE 400 M (meander spring) or FE 400 Z (tension spring).

## Characteristics

**Width**  
12 mm

**Operating temperature**  
max. 140°C  
Higher temperatures on request

## Lubrication

Oil or grease lubrication (Pg. 60–61)  
Delivered with corrosion protection.  
Operative grease filling on request.

## Installation

**Installation tolerances**  
Shaft h5; hub H6

## Constraints

The freewheel clutch insert element requires axial constraints on both sides.

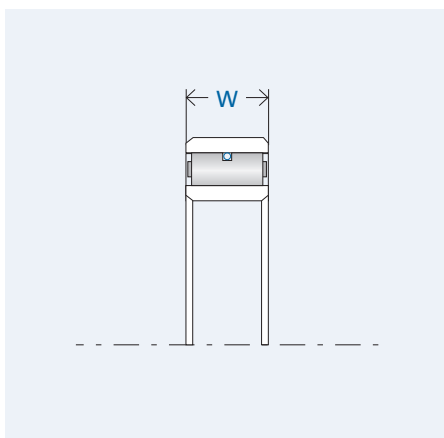
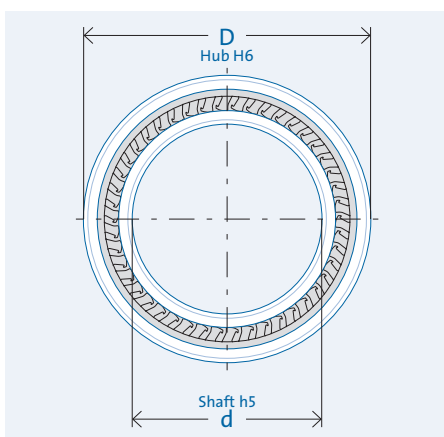
## Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

## Bearing

Freewheel clutch insert elements are not self-centering. External bearing support to define the gap between mating parts (inner and outer rings) is necessary.

## Data



## Drawing legend

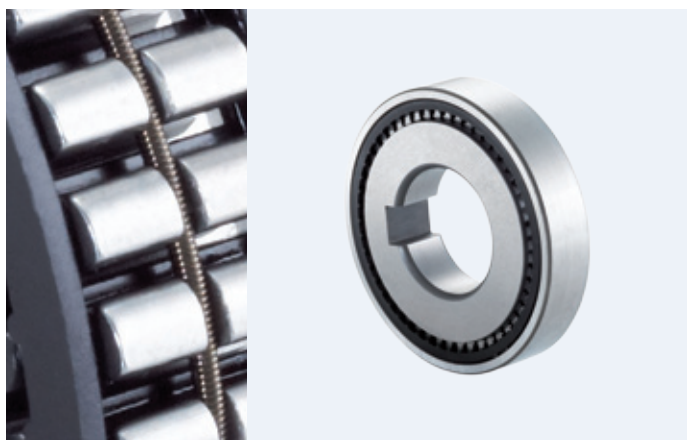
- d = inner diameter
- D = outer diameter
- W = width
- T = torque
- n = rotation speed

| Designation | d [mm] | D [mm] | W [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | Weight [kg] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|-------------|----------|
| FR 422 M    | 10     | 26     | 12     | 60                    | 10,100                 | 0.03        | 300587   |
| FR 422 Z    | 10     | 26     | 12     | 53                    | 10,100                 | 0.03        | 300588   |
| FR 427 M    | 15     | 31     | 12     | 92                    | 7,400                  | 0.04        | 300591   |
| FR 427 Z    | 15     | 31     | 12     | 83                    | 7,400                  | 0.04        | 300592   |
| FR 432 M    | 20     | 36     | 12     | 128                   | 5,900                  | 0.05        | 300593   |
| FR 432 Z    | 20     | 36     | 12     | 117                   | 5,900                  | 0.05        | 300594   |
| FR 437 M    | 25     | 41     | 12     | 169                   | 4,800                  | 0.06        | 300595   |
| FR 437 Z    | 25     | 41     | 12     | 154                   | 4,800                  | 0.06        | 300598   |
| FR 442 M    | 30     | 46     | 12     | 212                   | 4,200                  | 0.07        | 300599   |
| FR 442 Z    | 30     | 46     | 12     | 198                   | 4,200                  | 0.07        | 300600   |
| FR 448 M    | 35     | 53     | 12     | 272                   | 4,300                  | 0.09        | 300602   |
| FR 448 Z    | 35     | 53     | 12     | 248                   | 4,300                  | 0.09        | 300603   |
| FR 453 M    | 40     | 58     | 12     | 321                   | 3,400                  | 0.10        | 300605   |
| FR 453 Z    | 40     | 58     | 12     | 294                   | 3,400                  | 0.10        | 300606   |
| FR 463 M    | 50     | 68     | 12     | 427                   | 2,900                  | 0.12        | 300608   |
| FR 463 Z    | 50     | 68     | 12     | 394                   | 2,900                  | 0.12        | 300610   |
| FR 473 M    | 60     | 78     | 12     | 539                   | 2,500                  | 0.14        | 300611   |
| FR 473 Z    | 60     | 78     | 12     | 496                   | 2,500                  | 0.14        | 300613   |

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22).  
Rotation speed n = insert element's inherent speed (Pg. 57)

# Freewheel Clutch Insert Element FRN

with rings and keyway (IR)



## Components

### Freewheel clutch insert element\*

FE 400 M (meander spring)  
FE 400 Z (tension spring)

**+ Raceways**  
**inner ring** Bearing steel, hardened and ground  
Keyway per DIN 6885, Sheet 1  
Tolerance: P9 with back clearance  
**outer ring** Press fit

- Ball bearing -

- Roller bearing -

- Lubrication -

- Seal -

\* available with either freewheel clutch insert element FE 400 M (meander spring) or FE 400 Z (tension spring).

## Characteristics

### Width

12 mm

### Operating temperature

max. 140°C

Higher temperatures on request

## Lubrication

### Oil or grease lubrication (Pg. 60–61)

Delivered with corrosion protection.

Operative grease filling on request.

## Installation

### Installation tolerances

Shaft js6 (k5); hub H6

### Constraints

The freewheel clutch insert element requires axial constraints on both sides.

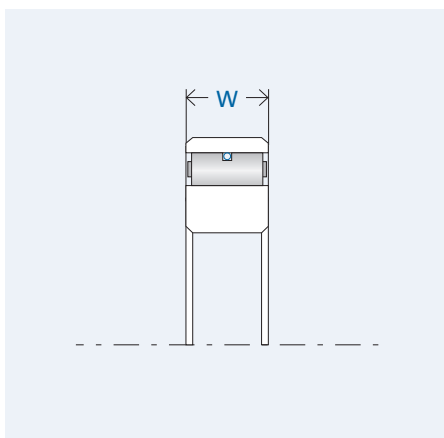
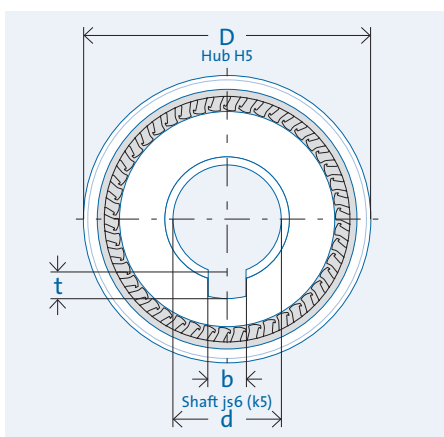
### Mating parts

Hardening and grinding of the mating parts is not necessary. Thoroughly clean (grease free) the mating parts in the vicinity of the freewheel clutch as well as the freewheel clutch's rings before making the press fit.

### Bearing

Freewheel clutch insert elements are not self-centering. External bearing support to define the gap between mating parts (inner and outer rings) is necessary.

## Data



## Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- T = torque
- n = rotation speed
- b = keyway width
- t = keyway depth

| Designation | d [mm] | D [mm] | W [mm] | T <sub>nom</sub> [N] | n <sub>max</sub> [rpm] | Weight [kg] | b [mm] | t [mm] | Item no. |
|-------------|--------|--------|--------|----------------------|------------------------|-------------|--------|--------|----------|
| FRN 427 M   | 10     | 31     | 12     | 92                   | 7,400                  | 0.05        | 3      | 1.4    | 300625   |
| FRN 427 Z   | 10     | 31     | 12     | 83                   | 7,400                  | 0.05        | 3      | 1.4    | 300626   |
| FRN 432 M   | 12     | 36     | 12     | 128                  | 5,900                  | 0.07        | 4      | 1.8    | 300628   |
| FRN 432 Z   | 12     | 36     | 12     | 117                  | 5,900                  | 0.07        | 4      | 1.8    | 300629   |
| FRN 437 M   | 15     | 41     | 12     | 169                  | 4,800                  | 0.08        | 5      | 2.3    | 300630   |
| FRN 437 Z   | 15     | 41     | 12     | 154                  | 4,800                  | 0.08        | 5      | 2.3    | 300631   |
| FRN 442 M   | 20     | 46     | 12     | 212                  | 4,200                  | 0.10        | 6      | 2.8    | 300633   |
| FRN 442 Z   | 20     | 46     | 12     | 198                  | 4,200                  | 0.10        | 6      | 2.8    | 300634   |
| FRN 453 M   | 25     | 58     | 12     | 321                  | 3,400                  | 0.17        | 8      | 3.3    | 300636   |
| FRN 453 Z   | 25     | 58     | 12     | 294                  | 3,400                  | 0.17        | 8      | 3.3    | 300637   |
| FRN 459 M   | 30     | 64     | 12     | 332                  | 3,000                  | 0.20        | 8      | 3.3    | 300639   |
| FRN 459 Z   | 30     | 64     | 12     | 353                  | 3,000                  | 0.20        | 8      | 3.3    | 300640   |
| FRN 463 M   | 35     | 68     | 12     | 427                  | 2,900                  | 0.21        | 10     | 3.3    | 300641   |
| FRN 463 Z   | 35     | 68     | 12     | 393                  | 2,900                  | 0.21        | 10     | 3.3    | 300642   |
| FRN 470 M   | 40     | 75     | 12     | 506                  | 2,600                  | 0.25        | 12     | 3.3    | 300644   |
| FRN 470 Z   | 40     | 75     | 12     | 466                  | 2,600                  | 0.25        | 12     | 3.3    | 300645   |
| FRN 473 M   | 45     | 78     | 12     | 539                  | 2,500                  | 0.26        | 14     | 3.8    | 300647   |
| FRN 473 Z   | 45     | 78     | 12     | 496                  | 2,500                  | 0.26        | 14     | 3.8    | 300649   |

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22) and refers to the integrated insert element, not the key way.  
Rotation speed n = insert element's inherent speed (Pg. 57)

# Insert Element FE 400 Z

with tension spring



## Components

### Freewheel

- Spring
- Cage
- Sprags

### Insert element FE 400 Z

Tension spring (Z)  
 Stamped steel / plastic (PA)  
 Hardened bearing steel  
 Start gap height  $h_0 = 4 \text{ mm}$

- |                  |   |
|------------------|---|
| - Thrust rings   | - |
| - Ball bearing   | - |
| - Roller bearing | - |
| - Lubrication    | - |
| - Seal           | - |

## Characteristics

### Installed width

12 mm

### Operating temperature

max. 140°C

Higher temperatures on request

### Indexing frequency

max. 10 Hz

## Lubrication

Oil or grease lubrication (Pg. 60–61)

Delivered with corrosion protection.

Pre-greased on request.

## Installation

### Installation tolerances

Shaft h5; hub H6

### Inner ring/shaft

steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

### Outer ring/housing

steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

### Constraints

The freewheel clutch insert element requires axial constraints on both sides.

### Mating parts

Hardening and grinding of the mating parts is necessary.

Chamfered shafts and hubs ease installation (Pg. 58).

### Bearing

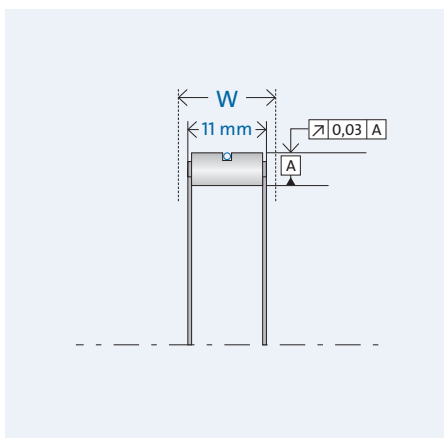
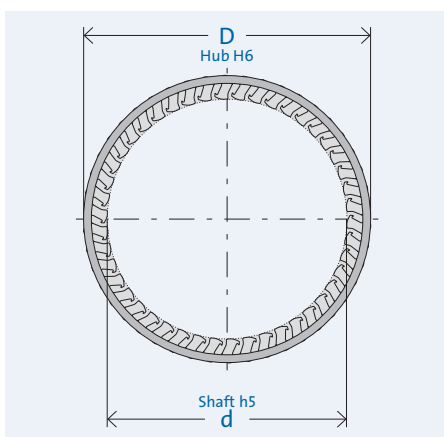
Freewheel clutch insert elements are not self-centering.

External bearing support to define the gap between mating parts (shaft and housing) is necessary.





## Data



### Drawing legend

**d** = inner diameter  
**D** = outer diameter  
**W** = width  
**T** = torque  
**n** = rotation speed

| Designation | d [mm] | D [mm] | B [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | Weight [kg] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|-------------|----------|
| FE 412 Z    | 4      | 12     | 12     | 4                     | 27,000                 | 0.003       | 300393   |
| FE 416 Z    | 8      | 16     | 12     | 16                    | 19,200                 | 0.006       | 300400   |
| FE 420 Z    | 12     | 20     | 12     | 35                    | 12,500                 | 0.007       | 306041   |
| FE 422 Z    | 14     | 22     | 12     | 53                    | 10,100                 | 0.008       | 300405   |
| FE 423 Z    | 15     | 23     | 12     | 62                    | 9,200                  | 0.009       | 300411   |
| FE 425 Z    | 17     | 25     | 12     | 72                    | 8,100                  | 0.011       | 300415   |
| FE 427 Z    | 19     | 27     | 12     | 83                    | 7,400                  | 0.013       | 300422   |
| FE 428 Z    | 20     | 28     | 12     | 93                    | 7,500                  | 0.013       | 300430   |
| FE 430 Z    | 22     | 30     | 12     | 107                   | 6,300                  | 0.014       | 300435   |
| FE 432 Z    | 24     | 32     | 12     | 117                   | 5,900                  | 0.016       | 300439   |
| FE 433 Z    | 25     | 33     | 12     | 128                   | 6,000                  | 0.016       | 300445   |
| FE 435 Z    | 27     | 35     | 12     | 143                   | 5,100                  | 0.017       | 300448   |
| FE 437 Z    | 29     | 37     | 12     | 154                   | 4,800                  | 0.018       | 300455   |
| FE 438 Z    | 30     | 38     | 12     | 166                   | 4,900                  | 0.019       | 300460   |
| FE 442 Z    | 34     | 42     | 12     | 198                   | 4,400                  | 0.018       | 300463   |
| FE 443 Z    | 35     | 43     | 12     | 207                   | 4,300                  | 0.022       | 300469   |
| FE 448 Z    | 40     | 48     | 12     | 248                   | 4,200                  | 0.024       | 300478   |
| FE 453 Z    | 45     | 53     | 12     | 293                   | 3,400                  | 0.022       | 300482   |
| FE 455 Z    | 47     | 55     | 12     | 313                   | 3,300                  | 0.026       | 300487   |
| FE 458 Z    | 50     | 58     | 12     | 344                   | 3,100                  | 0.029       | 300489   |
| FE 459 Z    | 51     | 59     | 12     | 353                   | 3,000                  | 0.030       | 300494   |
| FE 463 Z    | 55     | 63     | 12     | 393                   | 2,900                  | 0.032       | 300497   |
| FE 468 Z    | 60     | 68     | 12     | 444                   | 2,700                  | 0.034       | 300501   |
| FE 470 Z    | 62     | 70     | 12     | 465                   | 2,600                  | 0.035       | 300505   |
| FE 473 Z    | 65     | 73     | 12     | 495                   | 2,500                  | 0.037       | 300508   |
| FE 478 Z    | 70     | 78     | 12     | 548                   | 2,600                  | 0.039       | 300511   |
| FE 488 Z    | 80     | 88     | 12     | 657                   | 2,100                  | 0.045       | 300514   |
| FE 508 Z    | 100    | 108    | 12     | 889                   | 1,700                  | 0.055       | 300519   |
| FE 528 Z    | 120    | 128    | 12     | 1,127                 | 1,300                  | 0.066       | 300522   |
| FE 648 Z    | 240    | 248    | 12     | 2,673                 | 800                    | 0.131       | 300524   |

The specified nominal torque is based on sufficient stiffness of mating parts (Pg. 22).  
 Rotation speed n = insert element's inherent speed (Pg. 57)

# Insert Element FE 400 M

with meander spring



## Components

### Freewheel

- Spring
- Cage
- Sprags

### Insert element FE 400 M

Meander spring (M)  
Stamped steel  
Hardened bearing steel  
Start gap height  $h_0 = 4$  mm

- |                  |   |
|------------------|---|
| - Thrust rings   | - |
| - Ball bearing   | - |
| - Roller bearing | - |
| - Lubrication    | - |
| - Seal           | - |

## Characteristics

### Installed width

12 mm

### Operating temperature

max. 170°C

### Indexing frequency

max. 60 Hz

## Lubrication

Oil or grease lubrication (Pg. 60–61)

Delivered with corrosion protection.

Pre-greased on request.

## Installation

### Installation tolerances

Shaft h5; hub H6

### Inner ring/shaft

steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

### Outer ring/housing

steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

### Constraints

The freewheel clutch insert element requires axial constraints on both sides.

### Mating parts

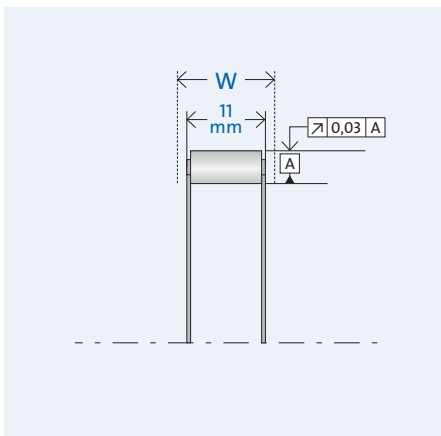
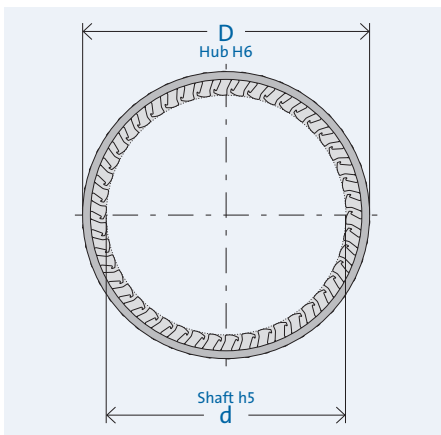
Hardening and grinding of the mating parts is necessary. Chamfered shafts and hubs ease installation (Pg. 58).

### Bearing

Freewheel clutch insert elements are not self-centering. External bearing support to define the gap between mating parts (Shaft and housing) is necessary.



## Data



### Drawing legend

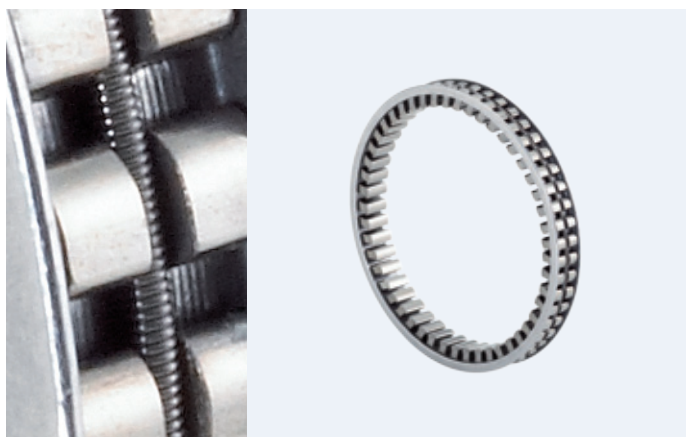
$d$  = inner diameter  
 $D$  = outer diameter  
 $W$  = width  
 $T$  = torque  
 $n$  = rotation speed

| Designation | $d$<br>[mm] | $D$<br>[mm] | $W$<br>[mm] | $T_{nom}$<br>[Nm] | $n_{max}$<br>[rpm] | Weight<br>[kg] | Item no. |
|-------------|-------------|-------------|-------------|-------------------|--------------------|----------------|----------|
| FE 422 M    | 14          | 22          | 12          | 59                | 10,100             | 0.011          | 300404   |
| FE 423 M    | 15          | 23          | 12          | 66                | 9,200              | 0.012          | 300409   |
| FE 425 M    | 17          | 25          | 12          | 79                | 8,100              | 0.013          | 300414   |
| FE 427 M    | 19          | 27          | 12          | 92                | 7,400              | 0.014          | 300421   |
| FE 428 M    | 20          | 28          | 12          | 99                | 7,500              | 0.014          | 300428   |
| FE 430 M    | 22          | 30          | 12          | 114               | 6,300              | 0.016          | 300434   |
| FE 432 M    | 24          | 32          | 12          | 128               | 5,900              | 0.016          | 300438   |
| FE 433 M    | 25          | 33          | 12          | 140               | 6,000              | 0.017          | 300444   |
| FE 435 M    | 27          | 35          | 12          | 153               | 5,100              | 0.018          | 300447   |
| FE 437 M    | 29          | 37          | 12          | 169               | 4,800              | 0.019          | 300451   |
| FE 438 M    | 30          | 38          | 12          | 178               | 4,900              | 0.020          | 300459   |
| FE 442 M    | 34          | 42          | 12          | 213               | 4,200              | 0.022          | 300462   |
| FE 443 M    | 35          | 43          | 12          | 224               | 4,300              | 0.023          | 300468   |
| FE 448 M    | 40          | 48          | 12          | 271               | 4,300              | 0.025          | 300473   |
| FE 453 M    | 45          | 53          | 12          | 321               | 3,400              | 0.028          | 300481   |
| FE 458 M    | 50          | 58          | 12          | 372               | 3,400              | 0.031          | 300488   |
| FE 459 M    | 51          | 59          | 12          | 381               | 3,000              | 0.032          | 300492   |
| FE 463 M    | 55          | 63          | 12          | 426               | 2,900              | 0.035          | 300495   |
| FE 468 M    | 60          | 68          | 12          | 481               | 2,700              | 0.036          | 300500   |
| FE 470 M    | 62          | 70          | 12          | 505               | 2,600              | 0.037          | 300503   |
| FE 473 M    | 65          | 73          | 12          | 538               | 2,500              | 0.040          | 300506   |
| FE 478 M    | 70          | 78          | 12          | 596               | 2,600              | 0.043          | 300510   |
| FE 488 M    | 80          | 88          | 12          | 715               | 2,100              | 0.048          | 300515   |

The specified nominal torque is based on sufficient stiffness of mating parts. (Pg. 22)  
 Rotation speed  $n$  = insert element's inherent speed (Pg. 57)

# Insert Element FE 400 Z2

in narrow design with tension spring



## Characteristics

**Installed width**  
7 mm

**Operating temperature**  
max. 140°C  
higher temperatures on request

**Indexing frequency**  
max. 10 Hz

## Lubrication

**Oil or grease lubrication (Pg. 60–61)**  
Delivered with corrosion protection.  
Pre-greased on request.

## Installation

**Installation tolerances**  
Shaft h5; hub H6

**Inner ring/shaft**  
steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

**Outer ring/housing**  
steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

## Constraints

The freewheel clutch insert element requires axial constraints on both sides.

## Mating parts

Hardening and grinding of the mating parts is necessary. Chamfered shafts and hubs ease installation (Pg. 58).

## Bearing

Freewheel clutch insert elements are not self-centering. External bearing support to define the gap between mating parts (Shaft and housing) is necessary.

## Components

### Freewheel

- Spring
- Cage
- Sprags

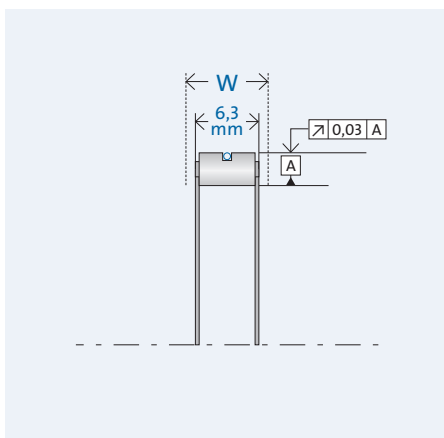
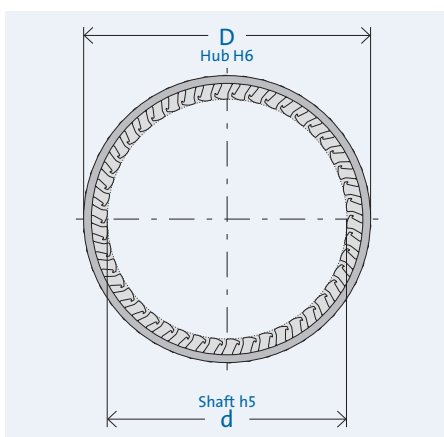
### Insert element FE 400 Z2

Tension spring (Z)  
Stamped steel / plastic (PA)  
Hardened bearing steel  
Start gap height  $h_0 = 4$  mm

- |                  |   |
|------------------|---|
| - Thrust rings   | - |
| - Ball bearing   | - |
| - Roller bearing | - |
| - Lubrication    | - |
| - Seal           | - |



## Data



| Designation | d [mm] | D [mm] | W [mm] | T <sub>nom</sub> [Nm] | n <sub>max</sub> [rpm] | Weight [kg] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|-------------|----------|
| FE 410 Z2   | 2      | 10     | 7      | 0,6                   | 52,600                 | 0.001       | 300390   |
| FE 412 Z2   | 4      | 12     | 7      | 2,5                   | 40,900                 | 0.002       | 300394   |
| FE 413 Z2   | 5      | 13     | 7      | 4                     | 34,900                 | 0.003       | 300395   |
| FE 414 Z2   | 6      | 14     | 7      | 6                     | 31,200                 | 0.003       | 300396   |
| FE 416 Z2   | 8      | 16     | 7      | 10                    | 27,200                 | 0.004       | 300399   |
| FE 418 Z2   | 10     | 18     | 7      | 16                    | 18,900                 | 0.005       | 300401   |
| FE 422 Z2   | 14     | 22     | 7      | 30                    | 13,200                 | 0.006       | 300406   |
| FE 423 Z2   | 15     | 23     | 7      | 40                    | 13,200                 | 0.006       | 300410   |
| FE 425 Z2   | 17     | 25     | 7      | 43                    | 10,600                 | 0.007       | 300416   |
| FE 428 Z2   | 20     | 28     | 7      | 55                    | 9,700                  | 0.008       | 300431   |
| FE 433 Z2   | 25     | 33     | 7      | 78                    | 7,700                  | 0.010       | 300446   |
| FE 437 Z2   | 29     | 37     | 7      | 97                    | 6,100                  | 0.011       | 300457   |
| FE 438 Z2   | 30     | 38     | 7      | 105                   | 6,400                  | 0.011       | 300461   |
| FE 442 Z2   | 34     | 42     | 7      | 125                   | 5,400                  | 0.012       | 300465   |
| FE 443 Z2   | 35     | 43     | 7      | 131                   | 5,600                  | 0.013       | 300472   |
| FE 448 Z2   | 40     | 48     | 7      | 156                   | 5,500                  | 0.014       | 300477   |
| FE 453 Z2   | 45     | 53     | 7      | 185                   | 4,400                  | 0.016       | 300484   |
| FE 458 Z2   | 50     | 58     | 7      | 216                   | 4,400                  | 0.017       | 300490   |
| FE 463 Z2   | 55     | 63     | 7      | 246                   | 3,700                  | 0.019       | 300498   |
| FE 468 Z2   | 60     | 68     | 7      | 277                   | 3,500                  | 0.020       | 300502   |

The specified nominal torque is based on sufficient stiffness of mating parts. (Pg. 22)

Rotation speed n = insert element's inherent speed (Pg. 57)

### Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- T = torque
- n = rotation speed



# Insert Element FE 8000 Z

with tension spring



## Components

| Freewheel | Insert element FE 8000 Z         |
|-----------|----------------------------------|
| · Spring  | Tension spring (Z)               |
| · Cage    | Stamped steel / drawn steel      |
| · Sprags  | Hardened bearing steel           |
|           | Start gap height $h_0 = 8.33$ mm |

|                  |   |
|------------------|---|
| - Thrust rings   | - |
| - Ball bearing   | - |
| - Roller bearing | - |
| - Lubrication    | - |
| - Seal           | - |

## Characteristics

### Width

16 / 19 / 25 mm

### Operating temperature

max. 170°C

### Indexing frequency

max. 5 Hz

## Lubrication

Oil or grease lubrication (Pg. 60–61)

Delivered with corrosion protection.

Pre-greased on request.

## Installation

### Installation tolerances

Shaft h6; hub H6

### Inner ring/shaft

steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

### Outer ring/housing

steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

### Constraints

The freewheel clutch insert element requires axial constraints on both sides.

### Connecting parts

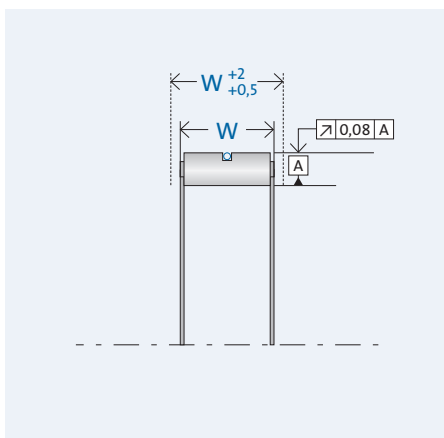
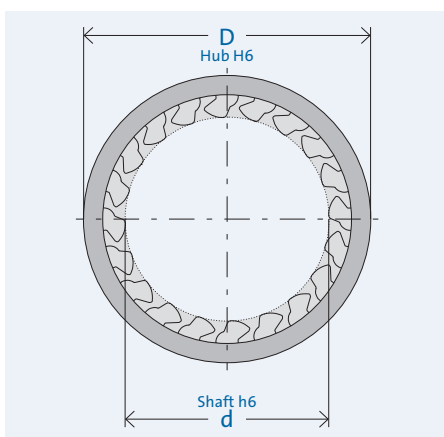
Hardening and grinding of the mating parts is necessary. Chamfered shafts and hubs ease installation (Pg. 58).

### Bearing

Freewheel clutch insert elements are not self-centering. External bearing support to define the gap between mating parts (Shaft and housing) is necessary.



## Data



## Drawing legend

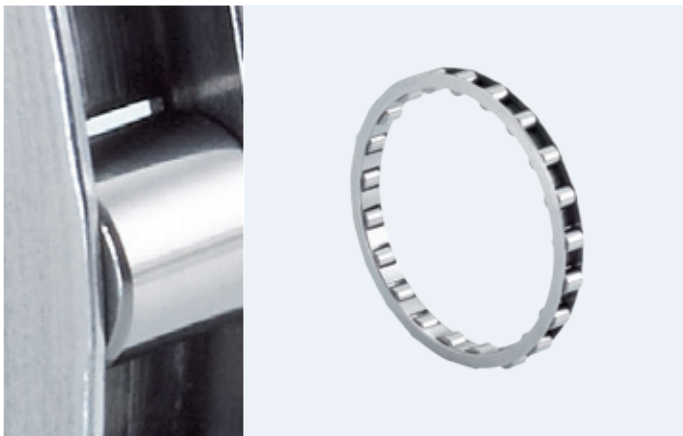
d = inner diameter  
 D = outer diameter  
 W = width  
 T = torque

| Designation   | d<br>[mm] | D<br>[mm] | W<br>[mm] | T <sub>nom</sub><br>[Nm] | Weight<br>[kg] | Item no. |
|---------------|-----------|-----------|-----------|--------------------------|----------------|----------|
| FE 8038 Z 16  | 38.09     | 54.75     | 16        | 609                      | 0.082          | 300527   |
| FE 8038 Z 19  | 38.09     | 54.75     | 19        | 801                      | 0.096          | 300528   |
| FE 8040 Z 16  | 40.00     | 56.66     | 16        | 668                      | 0.084          | 300530   |
| FE 8040 Z 19  | 40.00     | 56.66     | 19        | 880                      | 0.102          | 300531   |
| FE 8044 Z 16  | 44.45     | 61.11     | 16        | 799                      | 0.091          | 300535   |
| FE 8044 Z 19  | 44.45     | 61.11     | 19        | 1.052                    | 0.112          | 300536   |
| FE 8049 Z 16  | 49.72     | 66.38     | 16        | 923                      | 0.100          | 300538   |
| FE 8049 Z 19  | 49.72     | 66.38     | 19        | 1.201                    | 0.118          | 300539   |
| FE 8050 Z 16  | 50.00     | 66.66     | 16        | 942                      | 0.100          | 306637   |
| FE 8050 Z 25  | 50.00     | 66.66     | 19        | 1,237                    | 0.123          | 306638   |
| FE 8054 Z 16  | 54.76     | 71.42     | 16        | 1,080                    | 0.107          | 300541   |
| FE 8054 Z 19  | 54.76     | 71.42     | 19        | 1,424                    | 0.128          | 300542   |
| FE 8054 Z 25  | 54.76     | 71.42     | 25        | 2,015                    | 0.172          | 300543   |
| FE 8060 Z 16  | 60.00     | 76.66     | 16        | 1,243                    | 0.113          | 306639   |
| FE 8060 Z 19  | 60.00     | 76.66     | 19        | 1,560                    | 0.141          | 306640   |
| FE 8060 Z 25  | 60.00     | 76.66     | 25        | 2,111                    | 0.188          | 306641   |
| FE 8072 Z 16  | 72.21     | 88.87     | 16        | 1,740                    | 0.135          | 300548   |
| FE 8072 Z 19  | 72.21     | 88.87     | 19        | 2,145                    | 0.163          | 300549   |
| FE 8072 Z 25  | 72.21     | 88.87     | 25        | 2,918                    | 0.220          | 300550   |
| FE 8079 Z 25  | 79.69     | 96.36     | 25        | 3,295                    | 0.227          | 300551   |
| FE 8080 Z 16  | 80.00     | 96.66     | 16        | 1,848                    | 0.141          | 306642   |
| FE 8080 Z 19  | 80.00     | 96.66     | 19        | 2,278                    | 0.176          | 306643   |
| FE 8080 Z 25  | 80.00     | 96.66     | 25        | 3,101                    | 0.235          | 306644   |
| FE 8083 Z 25  | 83.34     | 100.00    | 25        | 3,640                    | 0.245          | 300553   |
| FE 8100 Z 16  | 100.00    | 116.66    | 16        | 2,632                    | 0.188          | 306645   |
| FE 8100 Z 19  | 100.00    | 116.66    | 19        | 3,303                    | 0.228          | 306646   |
| FE 8100 Z 25  | 100.00    | 116.66    | 25        | 4,535                    | 0.306          | 306647   |
| FE 8103 Z 16  | 103.23    | 119.89    | 16        | 2,887                    | 0.184          | 300556   |
| FE 8103 Z 19  | 103.23    | 119.89    | 19        | 3,582                    | 0.290          | 300557   |
| FE 8103 Z 25  | 103.23    | 119.89    | 25        | 4,920                    | 0.300          | 300558   |
| FES 8123 Z 25 | 123.34    | 140.00    | 25        | 6,600                    | 0.370          | 300561   |
| FE 8123 Z 25  | 123.88    | 140.54    | 25        | 6,604                    | 0.370          | 300559   |
| FE 8126 Z 25  | 126.22    | 142.88    | 25        | 6,744                    | 0.375          | 300562   |
| FE 8140 Z 25  | 140.00    | 156.66    | 25        | 7,388                    | 0.410          | 300565   |
| FE 8150 Z 25  | 150.00    | 166.66    | 25        | 8,272                    | 0.440          | 300567   |
| FE 8160 Z 25  | 160.00    | 176.66    | 25        | 9,096                    | 0.470          | 306344   |
| FE 8180 Z 25  | 180.00    | 196.66    | 25        | 10,463                   | 0.520          | 306274   |
| FE 8220 Z 25  | 220.00    | 236.66    | 25        | 14,060                   | 0.640          | 306148   |

The specified nominal torque is based on sufficient stiffness of mating parts. (Pg. 22)

# Roller Bearings RL 400

## Accessories



## Components

**Roller bearing** **RL 400**  
 · Cage Steel (RL 443 and RL 448 brass)  
 · Rollers Hardened bearing steel  
 Nominal diameter 4 mm

- Thrust rings -

- Ball bearing -

- Roller bearing -

- Lubrication -

- Seal -

## Characteristics

**Installed width:**  
6 mm

**Operating temperature:**  
max. 170 °C  
(RL 443 and RL 448 max. 150°C)

## Lubrication

oil or grease lubrication (Pg. 60–61)  
 Delivered with corrosion protection.

## Installation

**Installation tolerances**  
 Shaft h5; hub H6

**Inner ring/shaft**  
 steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

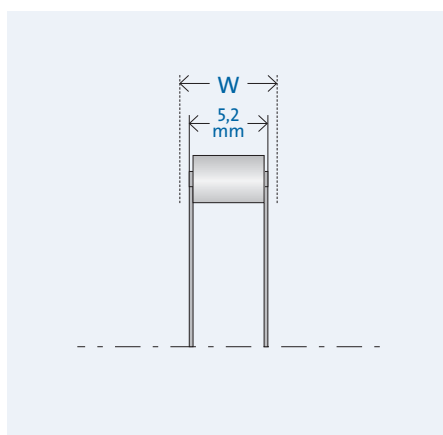
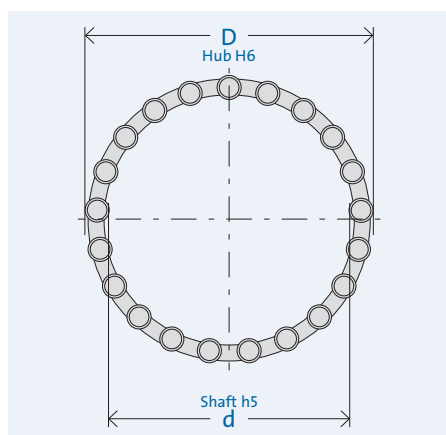
**Outer ring/hub**  
 steel, HRC 60<sup>+4</sup> (HV 700<sup>+100</sup>); Ehd ≥ 1.3 mm; Rz ≤ 2.5 μm

## Constraints

The roller bearing requires axial constraints on both sides.  
 (collar, snap ring, C-clip, etc.).



## Data



### Drawing legend

- d = inner diameter
- D = outer diameter
- W = width
- n = rotation speed
- C = load capacity

| Designation | d [mm] | D [mm] | W [mm] | C <sub>dyn.</sub> [N] | C <sub>stat.</sub> [N] | Oil n <sub>max</sub> [rpm] | Grease n <sub>max</sub> [rpm] | Item no. |
|-------------|--------|--------|--------|-----------------------|------------------------|----------------------------|-------------------------------|----------|
| RL 412 - 4  | 4      | 12     | 6      | 3,040                 | 1,760                  | 55,000                     | 45,000                        | 303071   |
| RL 414 - 4  | 6      | 14     | 6      | 3,575                 | 2,112                  | 50,000                     | 37,000                        | 303131   |
| RL 416 - 4  | 8      | 16     | 6      | 3,895                 | 2,347                  | 36,000                     | 30,000                        | 303091   |
| RL 418 - 4  | 10     | 18     | 6      | 5,212                 | 3,520                  | 30,000                     | 24,000                        | 303111   |
| RL 422 - 4  | 14     | 22     | 6      | 6,013                 | 4,380                  | 25,000                     | 19,000                        | 302652   |
| RL 423 - 4  | 15     | 23     | 6      | 6,034                 | 4,446                  | 24,000                     | 18,000                        | 302914   |
| RL 425 - 4  | 17     | 25     | 6      | 7,157                 | 5,699                  | 21,000                     | 17,000                        | 302954   |
| RL 427 - 4  | 19     | 27     | 6      | 7,679                 | 6,397                  | 20,000                     | 15,000                        | 302672   |
| RL 428 - 4  | 20     | 28     | 6      | 7,679                 | 6,453                  | 19,000                     | 15,000                        | 302853   |
| RL 430 - 4  | 22     | 30     | 6      | 8,150                 | 7,148                  | 17,000                     | 14,000                        | 302974   |
| RL 432 - 4  | 24     | 32     | 6      | 8,104                 | 7,241                  | 16,000                     | 13,000                        | 302692   |
| RL 433 - 4  | 25     | 33     | 6      | 8,104                 | 7,283                  | 15,000                     | 12,000                        | 303169   |
| RL 437 - 4  | 29     | 37     | 6      | 8,962                 | 8,661                  | 14,000                     | 11,000                        | 302712   |
| RL 438 - 4  | 30     | 38     | 6      | 8,962                 | 8,696                  | 13,000                     | 10,000                        | 302993   |
| RL 442 - 4  | 34     | 42     | 6      | 10,247                | 10,708                 | 12,000                     | 9,000                         | 302732   |
| RL 443 - 4  | 35     | 43     | 6      | 10,103                | 10,741                 | 12,000                     | 9,000                         | 302873   |
| RL 448 - 4  | 40     | 48     | 6      | 11,642                | 13,440                 | 10,000                     | 8,000                         | 302893   |
| RL 453 - 4  | 45     | 53     | 6      | 11,417                | 13,577                 | 9,000                      | 7,000                         | 302752   |
| RL 455 - 4  | 47     | 55     | 6      | 11,417                | 13,624                 | 8,800                      | 6,900                         | 303012   |
| RL 458 - 4  | 50     | 58     | 6      | 11,922                | 14,993                 | 8,500                      | 6,500                         | 303031   |
| RL 459 - 4  | 51     | 59     | 6      | 12,691                | 16,320                 | 8,000                      | 6,400                         | 302773   |
| RL 463 - 4  | 55     | 63     | 6      | 13,070                | 17,063                 | 7,500                      | 6,000                         | 302793   |
| RL 468 - 4  | 60     | 68     | 6      | 12,690                | 17,160                 | 7,100                      | 5,600                         | 303151   |
| RL 470 - 4  | 62     | 70     | 6      | 14,128                | 19,840                 | 7,000                      | 5,300                         | 302813   |
| RL 473 - 4  | 65     | 73     | 6      | 14,128                | 19,896                 | 6,500                      | 5,100                         | 302833   |
| RL 478 - 4  | 70     | 78     | 6      | 13,614                | 19,978                 | 6,000                      | 5,000                         | 303051   |
| RL 488 - 4  | 80     | 88     | 6      | 14,954                | 22,796                 | 5,300                      | 4,300                         | 303183   |



# GMN Sprag Type Freewheel Clutches

Speed limits

Installation

Tolerances

Lubrication

Service Life

Applications



# Speed Limits

Theoretically, freewheel clutches have no speed limit during torque transfer. However, in idle and overrun operation the influence of centrifugal forces must be considered.

## Series 400

### The influence of centrifugal force

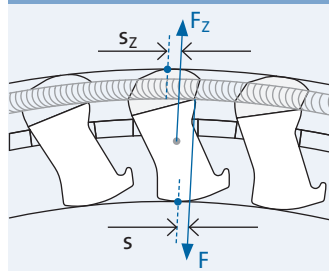
Spring force produces a torque  $F_s$ , which rotates the sprags and maintains constant friction contact with the mating parts. During rotation an opposing torque  $F_z s_z$  is imposed by centrifugal force.

When the opposing torque becomes greater than the torque created by the spring, the sprags will lift off the inner raceway. A reliable indexing process is no longer possible under these conditions. Decisive for this effect is the freewheel clutch insert element's inherent speed.

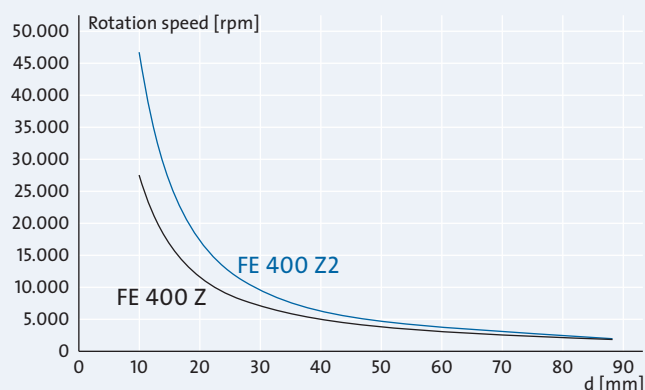
### Lift-off speed

$$n = \frac{1}{2\pi} \sqrt{\frac{F_s}{mr \times s_z}}$$

### Example tension spring



### Speed limits



### Inherent speed of the freewheel clutch insert element

Inherent speed of the freewheel clutch insert element cannot be precisely predetermined because the freewheel clutch insert element is only in friction contact (sliding friction) with the mating parts. The freewheel clutch insert element will never rotate completely with the turning part, nor will it completely adhere to the standing part; a difference in speed will always occur.

The rotation speed limits provided in the diagram and size tables describe the inherent speed of freewheel clutch insert elements, they do not describe the maximum rotation speed of the shaft or hub. These values serve as a means to estimate whether centrifugal influences might have an effect.

For example, a critical operational state can be reached when the freewheel clutch is currently transferring torque and is then accelerated beyond the rotation speed limit. If the freewheel clutch is then disengaged, the sprags will lift off and lose contact with the raceway. A subsequent indexing process is only then possible if the rotation speed of the freewheel clutch insert element is once more reduced to below the lifting-off speed.

### Freewheel clutches with seals

The maximum permissible rotation speed of all sealed freewheel clutches is limited, not by centrifugal force but rather by the friction and heat generated at the seal.

In these cases, the rotation speed limit specified in the size tables is the maximum permissible difference speed of mating parts.

## Series 8000

The sprag profile for our 8000 series is a non lift-off design, i.e. at high rotation speeds centrifugal force will produce a pressing torque on the sprags because of their altered center of gravity (in comparison to series 400 sprags). Series 8000 freewheel clutch insert elements therefore have no rotation speed limit.

# Installation

## Freewheel clutch insert elements

### FE 400 M / FE 400 Z / FE 400 Z2

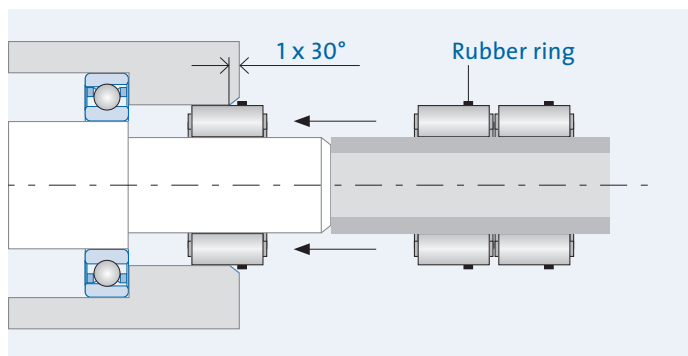
GMN Freewheel clutch insert elements assembly units are built symmetrically and can be installed for a left or right clamping direction. All freewheel clutch insert elements are delivered on a packaging tube to protect them against damage. This tube can also be used as an installation aid.

If possible, mating parts should be chamfered to improve installation: installation chamfer for shaft and housing: 1 x 30°

### FE 400 M

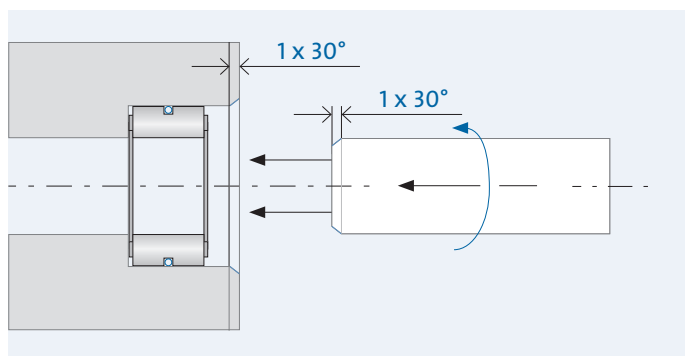
As an additional protective measure for the sprag, a rubber ring is stretched around the freewheel clutch insert element of type series FE 400 M.

Installation is performed by pushing the freewheel directly from the packaging tube onto the shaft and into the hub. The freewheel can be completely pushed in after the rubber ring has been removed.



### FE 400 Z installation with chamfer

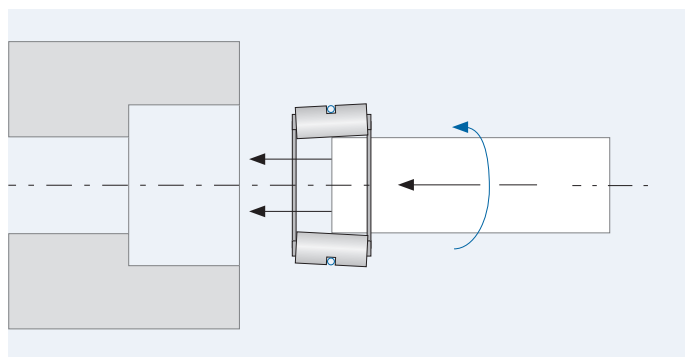
The freewheel clutch is first positioned in the hub, the chamfered shaft can then be inserted with a turning motion in the idle direction.



### FE 400 Z installation without chamfer (tilted)

If the shaft is not chamfered, the freewheel clutch insert element should be pushed halfway onto the end of the shaft so that the sprags are slightly tilted.

This reduces the outer diameter of the freewheel clutch insert element enough to allow the shaft to be inserted together with the freewheel with a turning motion in the idle direction.



# Tolerances

## Tolerances

### Shaft tolerances (excerpt from DIN EN ISO 286-2)

| Shaft diameter d nominal dimension [mm] |           |           |              |              |              |            |              |            |                |                |            |
|---|-----------|-----------|--------------|--------------|--------------|------------|--------------|------------|----------------|----------------|------------|
| over<br>to                              | 1<br>3    | 3<br>6    | 6<br>10      | 10<br>18     | 18<br>30     | 30<br>50   | 50<br>80     | 80<br>120  | 120<br>180     | 180<br>250     | 250<br>315 |
| h5 [ $\mu\text{m}$ ]                    | 0<br>-4   | 0<br>-5   | 0<br>-6      | 0<br>-8      | 0<br>-9      | 0<br>-11   | 0<br>-13     | 0<br>-15   | 0<br>-18       | 0<br>-20       | 0<br>-23   |
| h6 [ $\mu\text{m}$ ]                    | 0<br>-6   | 0<br>-8   | 0<br>-9      | 0<br>-11     | 0<br>-13     | 0<br>-16   | 0<br>-19     | 0<br>-22   | 0<br>-25       | 0<br>-29       | 0<br>-32   |
| js6 [ $\mu\text{m}$ ]                   | +3<br>-3  | +4<br>-4  | +4.5<br>-4.5 | +5.5<br>-5.5 | +6.5<br>-6.5 | +8<br>-8   | +9.5<br>-9.5 | +11<br>-11 | +12.5<br>-12.5 | +14.5<br>-14.5 | 16<br>-16  |
| k5 [ $\mu\text{m}$ ]                    | +4<br>0   | +6<br>+1  | +7<br>+1     | +9<br>+1     | +11<br>+2    | +13<br>+2  | +15<br>+2    | +18<br>+3  | +21<br>+3      | +24<br>+4      | +27<br>+4  |
| n6 [ $\mu\text{m}$ ]                    | +10<br>+4 | +16<br>+8 | +19<br>+10   | +23<br>+12   | +28<br>+15   | +33<br>+17 | +39<br>+20   | +45<br>+23 | +52<br>+27     | +60<br>+31     | +66<br>+34 |

### Housing tolerances (excerpt from DIN EN ISO 286-2)

| Bore diameter D nominal dimension [mm] |        |           |           |           |           |           |           |            |            |            |            |
|--|--------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|
| over<br>to                             | 1<br>3 | 3<br>6    | 6<br>10   | 10<br>18  | 18<br>30  | 30<br>50  | 50<br>80  | 80<br>120  | 120<br>180 | 180<br>250 | 250<br>315 |
| N7 [ $\mu\text{m}$ ]                   | -<br>- | -4<br>-16 | -4<br>-19 | -5<br>-23 | -7<br>-28 | -8<br>-33 | -9<br>-39 | -10<br>-45 | -12<br>-52 | -14<br>-60 | -14<br>-66 |
| H6 [ $\mu\text{m}$ ]                   | -<br>- | +8<br>0   | +9<br>0   | +11<br>0  | +13<br>0  | +16<br>0  | +19<br>0  | +22<br>0   | +25<br>0   | +29<br>0   | +32<br>0   |



# Lubrication

Providing freewheels with an adequate supply of GMN selected lubricants ensures correct performance and a long service life. GMN Freewheel clutches are suitable for oil or grease lubrication.

### Corrosion protection

All GMN Freewheel clutches without seals are delivered with an effective corrosion protection and have to be greased by customer.

### Lifetime pre-lubrication

GMN offers complete freewheel clutch units and ball bearing freewheel clutch units sealed on both sides with operative lifetime lubrication.

GMN Complete freewheel clutch units:

Series FPD, FND and RA

GMN Ball bearing freewheel clutch units:

Series FK 2RS, FKN 2RS, FKNN 2RS

The lubricant qualities and quantities selected by GMN ensure unrestricted capability for the freewheel clutch over its entire service lifetime.

Further lubrication (re-lubrication) for freewheel clutches with Lifetime pre-lubrication is not necessary.

### Special solutions

Custom solutions for reliable lubrication under exceptional operating conditions, extreme operating temperatures or for vertical installation position applications are possible on request.

### Notes:

An insufficient supply of lubricant, deviating lubricant qualities or the use of lubricants with friction reducing additives (such as MoS<sub>2</sub> or graphite, for example) can cause serious functional impairments or damage the freewheel clutches.

The use of lubricants from other manufacturers which have equivalent compositions is possible.

The compositions and characteristics of the specified lubricants can change due to technical advances and may necessitate re-testing with respect to lubricant qualification for GMN freewheel clutches.

All specifications reflect conditions as of the time of printing in June 2013.

## Oil lubrication

Oil bath or oil mist lubrication is particularly well suited for high operating requirements with respect to rotation speeds and indexing frequencies.

### Service life oil lubrication

GMN Complete freewheel clutch units:

Series FPD, FND and RA with GMN rubber seals

GMN Complete freewheel clutch units are sealed on both sides and have lifetime oil lubrication (Shell Tellus S2 MA 32) suitable for operating temperatures from 15 °C to 90 °C.

Other oil types for different temperature ranges are available on request.

### Oil bath lubrication

Adequate pre-lubrication and re-lubrication is necessary for freewheel clutches in open housings. Such lubrication must accommodate the given freewheel clutch size and the structural characteristics of the mating parts.

For horizontal installation positions, the freewheel clutch should be about 1/3 submerged in the oil bath when at state of rest.

### Oil mist lubrication

Hydraulic oils HM 10 and HM 32 are suitable for oil mist lubrication with respect to operating temperature.

Oil mist lubricated applications are based on a constant supply of sufficient fresh oil during operation.

| Operating temperature  | -65 to 100 °C  | -35 to 160 °C  | 15 to 90 °C                     |
|------------------------|--|--|---------------------------------|
| Manufacturer           | Klüber<br>Isoflex PDP 38<br><br>LUBCON<br>Turmofluid SF 48 | Klübersynth<br>GH 6 oils<br><br>LUBCON<br>Turmopoloil HT | Shell<br>Tellus S2 MA 32        |
| Oil type <sup>1)</sup> | Diester oil based  | Polygl.oil based   | mineral oil                     |
| Characteristics        | synthetic<br>long term oils                                | synthetic<br>transm. and<br>high temp. oils              | high perform.<br>hydraulic oils |

<sup>1)</sup> Lubricants of the given oil type can be mixed. Mixing combinations of different oil types is not permissible.

### Lubricant qualification

Selected common commercial motor oils are suitable for reliable re-lubrication.

HD motor oils SAE 10 W or SAE 30 conform to "API SF/CC" as well as "MIL-L46152B".



## Grease lubrication

Economically efficient grease lubrication is sufficient for ordinary performance requirements.

Grease types are distinguished by special characteristics which, because of their specific composition, fundamentally make them differ from one another.

The selection of a suitable grease is to be made on the basis of specific operating conditions.

### Lubricant qualification

GMN has chosen suitable grease types for differing operating conditions from DIN 51818 consistency classes NLGI 1 and NLGI 2.

### Service life grease lubrication

GMN Ball bearing freewheel clutch units:

Series FK 2RS, FKN 2RS, FKNN 2RS with RS seals

The lubricating grease chosen by GMN for greasing sealed ball bearing freewheel clutches (Klüber ISOFLX LDS 18 Special A) is intended for applications under normal operating conditions. Other grease types for different operational conditions are available on request.

### Pre- and re-lubrication

Adequate pre-lubrication and re-lubrication are necessary for freewheel clutches in open housings. Such lubrication must accommodate the given freewheel clutches size and the structural characteristics of mating parts. All-over distribution of an adequate amount of grease (about 30–60% of the available volume in the freewheel) ensures an adequate lubricating effect.

Too much grease can result in functional failures at low temperatures.

| Operating temperature | -50 to 120 °C   | -40 to 180 °C  | -40 to 200 °C  | -40 to 260 °C  |
|-----------------------|---|--|--|--|
| Manufacturer          | Klüber Isoflex<br>LDS 18 Special A<br><br>LUBCON Turmogrease<br>Highspeed L 252 | Klüber Asonic<br>GHY / HQ 72–102<br><br>LUBCON Turmogrease<br>PU 703 | Klübersynth<br>BHP 72–102<br><br>LUBCON Turmogrease<br>NBI 300 P | Klüber Barrierta<br>L 55/2<br><br>LUBCON Turmotemp<br>II/400 RS2 |
| Base oil              | Mineral oil<br>Diester oil  | Diester oil  | Perfluoropolyether oil<br>Diester oil                            | Perfluoropolyether oil   |
| Thickener             | Lithium soap  | Polyurea   | Polyurea, PTFE   | PTFE   |
| Characteristics       | Dynamically light<br>long-term lub. grease                                      | Synthetic<br>long-term lub. grease                                   | High temperature<br>long-term lub. grease                        | High temperature<br>long-term lub. grease                        |



# Service Life Applications

## Freewheel-clutch service life

GMN Freewheel clutches are the result of setting maximum demands on materials and processing in order to achieve the longest possible service life.

However, the basic functionality of freewheel clutches cause material stresses which result in a limit on service life.

### Idle operation

The constant friction contact of sprags with mating parts during idle operation causes material wear which limits the service life of sprag type freewheel clutches.

Freewheel clutches with a tension spring offer outstanding operating conditions for applications with high idle operation rotation speed requirements (backstops, overrunning clutches).

### Indexing operation

Torque-dependent distortion forces (Hertzian pressures) act on relevant freewheel clutch components during indexing operation and these lead to material fatigue over the long-term.

In particular, applications in which there are continuous high indexing frequencies can produce micro cracks and material chipping.

GMN has an analysis program which can project freewheel clutch service life under special consideration for indexing frequency and torque requirements.

The results of service life time calculations for specific application profiles are available on request.

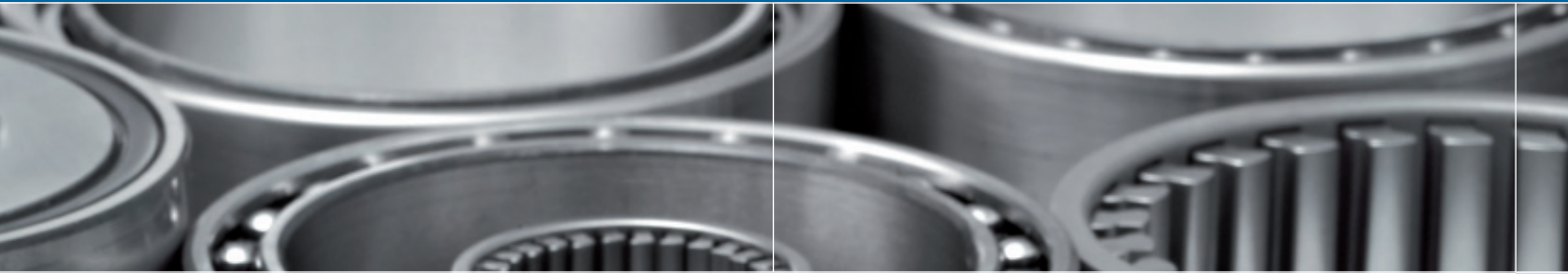
## Backstop



A Backstop application is where rotation is allowed in one direction and stopped in the opposite direction.

### Application examples:

- Conveyor equipment
- Mixers
- High voltage switches
- Furniture industry
- Turnstiles and revolving doors
- Geared motors
- Winches
- Elevators
- Cranes
- Strap/belt tighteners
- Bucket conveyors
- Belt reversing locks
- Fans
- Automatic doors (subway)
- Fire damper flaps
- Aviation technology
- Roller plants
- Summer skiing
- etc.



## Indexing clutch



A repeated drive and idle motion will be transformed step by step into rotary motion in a single direction.

### Application examples:

- Paper processing (advance)
- Seeding machines
- Staplers (staples)
- Conveyor belts (drive)
- Ratchets
- Ratchet wrenches
- Roller advance
- Installation tools
- Automation technology
- etc.

## Overrunning clutch



If the speed of the driven side exceeds the speed of the driving side, the freewheel clutch disengages (drive and driven) by switching from torque transmit to idle.



### Application examples:

- Copier machines
- Printing machines
- Conveyor equipment
- Transport equipment (speed matching)
- Starters for combustion engines
- Ergometers
- E-bikes
- Bicycle hubs
- Starters
- Emergency power aggregates
- Generators
- Hybrid applications (E-mobility)
- Palletizing and storage systems
- Model helicopters
- Hand operated sirens
- Roller coasters
- Washing systems
- Continuous ovens
- Compressors
- Compensating gearboxes
- Gas turbine drives
- Pump drives
- Belt drives
- Wheelchairs
- etc.

# GMN Freewheel Clutches Selection Table












## GMN Sprag type freewheel clutches

|   | COMPLETE FREEWHEEL CLUTCH UNITS   |   |   |   |  | BALL BEARING FREEWHEEL CLUTCH UNITS with seals                                      |   |   |
|---|---|---|---|---|--|---|---|---|
|   | with seals  |   |   | without seals   |  |   |   |   |
|   |  |  |  |  |  |  |  |  |
| GMN series  | FPD   | FND   | RA  | FP  | FN   | FK 2RS  | FKN 2RS   | FKNN 2RS  |
| Sprags  | Series 400  | Series 400  | Series 400  | Series 400  | Series 400   | Series 400  | Series 400  | Series 400  |
| Sprag cage  | St/PA   | St/PA   | St/PA   | St/PA   | St/PA  | St/PA   | St/PA   | St/PA   |
| Spring  | M/Z   | M/Z   | M/Z   | M/Z   | M/Z  | Z   | Z   | Z   |
| Ball bearings   | +   | +   | +   | +   | +  | +   | +   | +   |
| Roller bearings                                       | +   | +   | +   | +   | +  |   |   |   |
| Seals   | +   | +   | +   |   |  | +   | +   | +   |
| Pre-lubrication                                       | Oil   | Oil   | Oil   |   |  | Grease  | Grease  | Grease  |
| IR press fit  | +   |   |   | +   |  | +   |   |   |
| IR key way <sup>1)</sup>                              |   | +   | +   |   | +  |   | +   | +   |
| OR press fit  | +   | +   |   | +   | +  | +   | +   |   |
| OR keyway   |   |   |   |   |  |   |   | +   |
| OR mounting tab                                       |   |   | +   |   |  |   |   |   |
| Installed width [mm]                                  | 34  | 34  | 34  | 27  | 27   | 12 ... 18   | 12 ... 18   | 12 ... 18   |
| ∅ inner [mm]  | 15 ... 60   | 15 ... 45   | 15 ... 45   | 10 ... 60   | 15 ... 45  | 17 ... 40   | 17 ... 40   | 17 ... 40   |
| ∅ outer [mm]  | 31 ... 78   | 41 ... 78   | 65 ... 110  | 26 ... 78   | 41 ... 78  | 40 ... 80   | 40 ... 80   | 40 ... 80   |
| Operating temperature <sub>max</sub> [°C]             | 110   | 110   | 110   | 170/140   | 170/140  | 110   | 110   | 110   |
| Indexing frequency [Hz] <sup>2)</sup>                 | 60/10   | 60/10   | 60/10   | 60/10   | 60/10  | 10  | 10  | 10  |
| Rotation speed n <sub>max</sub> [rpm] <sup>3)</sup>   | 2,000   | 1,700   | 1,700   | 10,100  | 4,800  | 3,700   | 3,700   | 3,700   |
| Load capacity C <sub>dyn max</sub> [N] <sup>3)</sup>  | 14,128  | 14,128  | 14,128  | 14,128  | 14,128   | 8,902   | 8,902   | 8,902   |
| Load capacity C <sub>stat max</sub> [N] <sup>3)</sup> | 19,896  | 19,896  | 19,840  | 19,896  | 19,896   | 7,752   | 7,752   | 7,752   |
| Torque T <sub>nom max</sub> [N] <sup>3)</sup>         | 588   | 588   | 543   | 588   | 588  | 267   | 267   | 267   |
| Bearing necessary                                     |   |   |   |   |  |   |   |   |
| Hardened mating parts necessary                       |   |   |   |   |  |   |   |   |

## Custom solutions

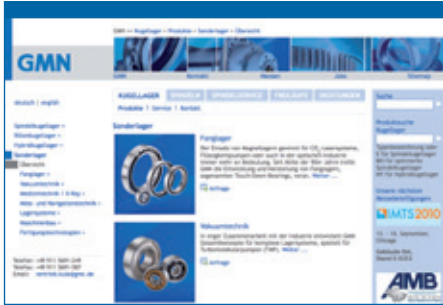
Customer-specific solutions can be produced on request.



| BALL BEARING FREEWHEEL CLUTCH UNITS without seals                                 |   |   | FREEWHEEL CLUTCH INSERT ELEMENTS  |   |   |   |   |   |  |
|---|---|---|---|---|---|---|---|---|--|
|   |   |   | with rings  |   | without rings   |   |   |   |  |
|  |  |  |  |  |  |  |  |  |  |
| FK  | FKN   | FKNN  | FR  | FRN   | FE 400 M  | FE 400 Z  | FE 400 Z2   | FE 8000   | GMN series                                 |
| Series 400  | Series 400  | Series 400  | Series 400  | Series 400  | Series 400  | Series 400  | Series 400  | Series 8000   | Sprags                                     |
| St/PA   | St/PA   | St/PA   | St/PA   | St/PA   | St  | St/PA   | St/PA   | St  | Sprag cage                                 |
| Z   | Z   | Z   | M/Z   | M/Z   | M   | Z   | Z   | Z   | Spring                                     |
| +   | +   | +   |   |   |   |   |   |   | Ball bearings                              |
|   |   |   |   |   |   |   |   |   | Roller bearings                            |
|   |   |   |   |   |   |   |   |   | Seals                                      |
|   |   |   |   |   |   |   |   |   | Pre-lubrication                            |
| +   |   |   | +   |   |   |   |   |   | IR press fit                               |
|   | +   | +   |   | +   |   |   |   |   | IR key way <sup>1)</sup>                   |
| +   | +   |   | +   | +   |   |   |   |   | OR press fit                               |
|   |   | +   |   |   |   |   |   |   | OR keyway                                  |
|   |   |   |   |   |   |   |   |   | OR mounting tab                            |
| 12 ... 18   | 12 ... 18   | 12 ... 18   | 12  | 12  | 12  | 12  | 7   | 16 ... 25   | Installed width                            |
| 17 ... 40   | 17 ... 40   | 17 ... 40   | 10 ... 60   | 10 ... 45   | 14 ... 80   | 4 ... 240   | 2 ... 60  | 38 ... 220  | ∅ inner                                    |
| 40 ... 80   | 40 ... 80   | 40 ... 80   | 26 ... 78   | 31 ... 78   | 22 ... 88   | 12 ... 248  | 10 ... 68   | 44 ... 236  | ∅ outer                                    |
| 170/140   | 170/140   | 170/140   | 170/140   | 170/140   | 170   | 170/140   | 170/140   | 170   | Operat. temp. <sub>max</sub>               |
| 10  | 10  | 10  | 60/10   | 60/10   | 60  | 10  | 10  | 5   | Indexing freq. <sup>2)</sup>               |
| 10,800  | 10,800  | 10,800  | 10,100  | 7,400   | 10,100  | 27,000  | 52,600  |   | Rot. speed <sub>max</sub> <sup>3)</sup>    |
| 8,902   | 8,902   | 8,902   |   |   |   |   |   |   | Load capacity <sub>max</sub> <sup>3)</sup> |
| 7,752   | 7,752   | 7,752   |   |   |   |   |   |   | Load capacity <sub>max</sub> <sup>3)</sup> |
| 267   | 267   | 267   | 539   | 539   | 715   | 2,673   | 277   | 14,060  | Torque T <sub>max</sub> <sup>3)</sup>      |
|   |   |   | +   | +   | +   | +   | +   | +   | Bearing necessary                          |
|   |   |   |   |   | +   | +   | +   | +   | Hardened mating parts necessary            |

M = meander spring · Z = tension spring · St = steel cage · PA = plastic cage  
 1) key way per DIN 6885 · 2) spring specific · 3) size dependent





**Internet**

Our Internet website [www.gmn.de](http://www.gmn.de) contains comprehensive product information for downloading.

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At its Nuremberg plant facility, GMN Paul Müller Industrie GmbH & Co. KG produces high-precision ball bearings, machine spindles, sprag type freewheel clutches and non-contact seals for a wide spectrum of applications.

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High Precision Ball Bearings  
Spindle Technology  
Sprag Type Freewheel Clutches  
Non Contact Seals

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