



FAG

**added
competence**

Rolling bearings for textile machinery

SCHAEFFLER GROUP
INDUSTRIAL

Foreword

Schaeffler Group Industrial is a leading worldwide supplier of rolling bearings, spherical plain bearings, plain bearings, linear products, accessories specific to bearings and comprehensive maintenance products and services. It has approximately 40 000 catalogue products manufactured as standard, providing an extremely wide portfolio that gives secure coverage of applications from all 60 designated industrial market sectors.

Economical solutions for textile machinery

Schaeffler Group Industrial offers manufacturers of textile machinery a comprehensive range of precision products for the reliable and cost-effective support of rotary and linear motion. Increasingly, there is a requirement for inventive and economical solutions that often cannot be met simply by using “off the peg” bearings. As a result, system components matched precisely as complete systems to the specific application are increasing in importance.

This development is also reflected in this publication “Rolling bearings for textile machinery”: In this publication, you will find a significantly larger number of application examples using dedicated solutions for textile machinery than in the past. Behind every one of these solutions lie many years of knowledge and experience in the textile machinery industry.

The first few pages of the publication present high quality standard bearings that reliably perform their duty in many applications. In many cases, these bearings allow highly economical solutions and are readily available.

The engineers in our application engineering and external sales functions are available to support you as a development partner worldwide. In order that your machines work more quickly, more reliably and more economically.

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Technical principles

Lubrication

Caution! Lubricants undergo ageing as a result of environmental influences. The information provided by the lubricant manufacturer should be adhered to.

Schaeffler uses greases with a mineral oil base. Experience shows that these greases can be stored for up to three years.

The preconditions for storage are:

- closed room or store
- temperatures between 0 °C and +40 °C
- relative atmospheric humidity not exceeding 65%
- security against chemical agents such as vapours, gases or fluids
- sealed rolling bearings.

After a long period of storage, the start-up frictional torque of greased bearings may be temporarily higher than normal. The lubricity of the grease may also have deteriorated.

Caution! The characteristics of greases may vary, even if supplied from a single source.

Rolling bearings for textile machinery

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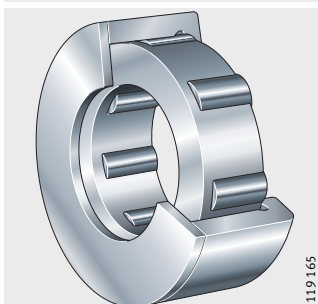
Product overview Rolling bearings for textile machinery

Spindle neck bearings

With separate end washer,
type 1

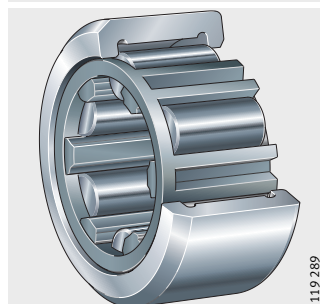
With double rib,
type 2

SPL



119 165

SPL



119 289

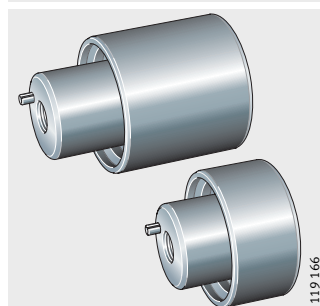
Tape tension pulleys and pulley bearings

BSR



119 006

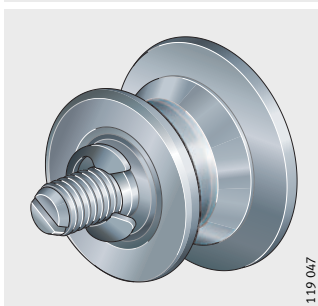
RLBSR...-100



119 166

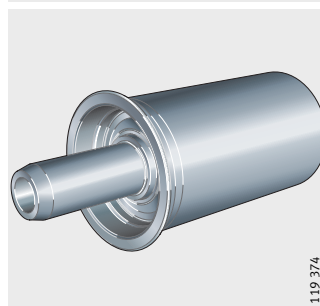
Thread guidance rollers

FRM



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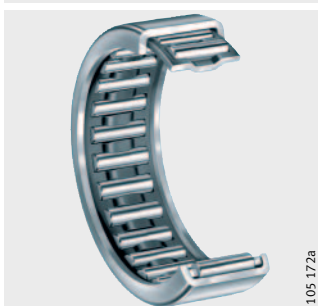
FRM



119 374

Drawn cup needle roller bearings for weaving machines

HK



105 172a

Spindle neck bearings

- Features

Spindle neck bearings are cylindrical roller bearings with very high load carrying capacity for the radial guidance of spinning and twisting spindles. They allow high speeds.
The cylindrical rollers are guided in spindle neck bearings by
 - a separate end washer for an inside diameter of 10 mm
 - a double rib for an inside diameter of 12 mm.

Design and safety guidelines

Lubrication

Spindle neck bearings are lubricated using oil. Good results have been obtained using oils CLP to DIN 51 517 with ISO-VG 10 to ISO-VG 46. Spindle neck bearings are supplied coated with a preservative.

Caution!

If grease lubrication is to be used, consultation with the INA engineering service is required in order to determine the speeds and grease type.

Accuracy

Mounting tolerances

The table shows recommended mounting tolerances.

	Mounting tolerances
Housing	N7
Shaft	j5

Tape tension pulleys and pulley bearings

Features

Tape tension pulleys

Tape tension pulleys BSR are high precision ball bearings with one or two rows of rolling elements. The outer ring half-cups are made from sheet steel. Due to their low mass moment of inertia, the spindles can be rapidly accelerated up to operating speed. Friction is low due to the use of gap seals.

The pulleys are matched to the normal belt dimensions and mounting conditions.

Pulley bearings

Pulley bearings RLBSR...-100 are high precision ball bearings with one or two rows of rolling elements. Due to their low mass moment of inertia, the spindles can be rapidly accelerated up to operating speed. Friction is low due to the use of gap seals.

Pulley bearings RLBSR...-100 are also suitable for the design of tape tension pulleys that require special tyres.

Application

Tape tension pulleys are used to guide and tension the drive belts in textile machinery, especially in spinning, texturing and twisting machines.

Design and safety guidelines

Sealing

On the pin side, the pulleys have a gap seal.
On the outer side, the pulleys are sealed by a spring diaphragm.
The lubrication hole is located at the centre of the diaphragm.

Lubrication

Tape tension pulleys and pulley bearings have an initial greasing of grease K3K-30 to DIN 51 825. This grease is a lithium soap grease with a mineral oil base and has a base oil viscosity of ISO-VG 100.

Relubrication

The grease used for relubrication should be the same as that used for the initial greasing. The pulleys are relubricated via a lubrication hole in the fixing screw or via the lubrication hole in the end washer. For this lubrication hole, a metering gun with a tapered nozzle should be used, *Figure 1*.

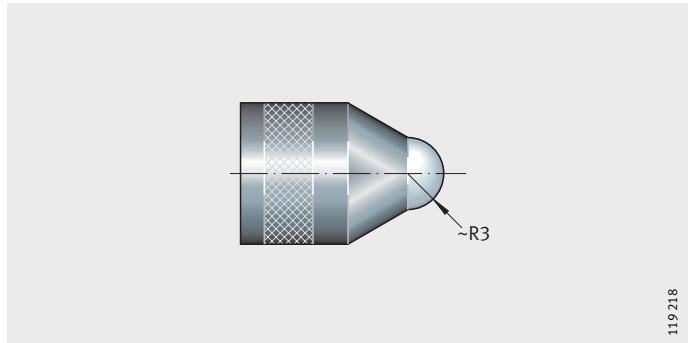


Figure 1
Tapered nozzle

The bearing should be rotated by hand in order to ensure uniform distribution of the grease.

The relubrication quantity is:

- 0,5 g to 0,8 g for single row bearings
- 1,0 g to 1,5 g for double row bearings.

The guide values for relubrication intervals in operating hours are:

- approx. 30 000 h with little fly
- approx. 12 000 h with heavy fly.

For information on the storage life of lubricants, see Technical principles, Lubrication, page 4.

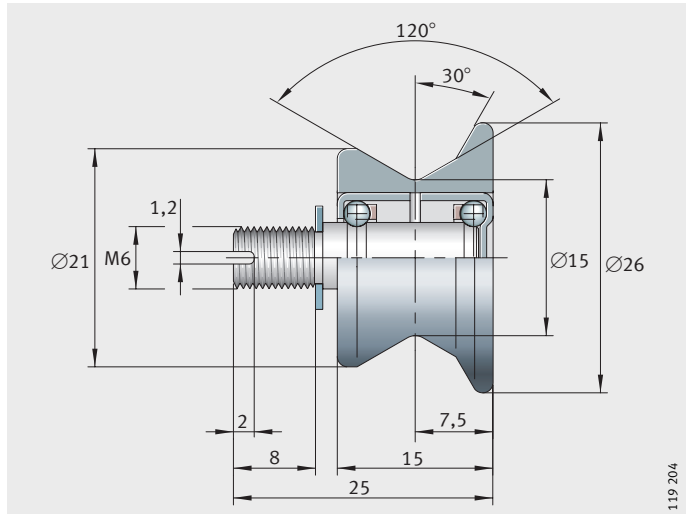
Thread guidance rollers

Features Thread guidance rollers have an outside surface with hard chromium plating. They run extremely easily and are therefore used in spooling, twisting and texturing machines.

Speeds The maximum permissible speed is $5\,000\text{ min}^{-1}$ for thread guidance roller F-87530.5, *Figure 1* and $22\,500\text{ min}^{-1}$ for thread guidance roller F-558472, *Figure 2*.

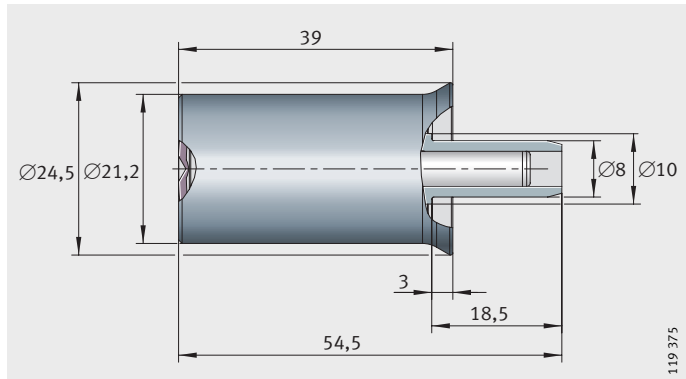
Ordering designation: F-87530.5

Figure 1
Thread guidance roller FRM



Ordering designation: F-558472

Figure 2
Thread guidance roller FRM
(separator roller)



Design and safety guidelines

Lubrication

Thread guidance rollers with the ordering designation F-87530.5, see *Figure 1*, page 10, are greased for life with a lithium complex soap grease. There is no relubrication facility.

Thread guidance rollers with the ordering designation F-558472, see *Figure 2*, page 10, must be relubricated after 4 000 h. A conventional syringe is used to press in 0,2 ml of oil to DIN 51 502 through the depression in the sealing washer. In order to ensure uniform distribution of the lubricant into the front and rear rows of balls, the thread guidance roller should be set vertical by approx. 30 angular minutes. The pin must face downwards.

For information on the storage life of lubricants, see Technical principles, Lubrication, page 4.

Drawn cup needle roller bearings for weaving machines

Features	<p>Drawn cup needle roller bearings are units comprising thin-walled, formed outer rings with needle roller and cage assemblies. They conform to DIN 618-1/ISO 3 245 and are available for shafts from 40 mm to 70 mm.</p> <p>Drawn cup needle roller bearings HK are not sealed on either side.</p>
Particularly low cross-section height	<p>Due to the thin-walled outer cup and the design without an inner ring, drawn cup needle roller bearings have extremely small radial dimensions. They have high load carrying capacity, are suitable for high speeds and are particularly easy to fit. If axial location by shoulders, snap rings etc. is not used, the housing bore can be produced easily and particularly economically.</p> <p>However, drawn cup needle roller bearings require a shaft raceway that is hardened and ground. If the shaft cannot be used as a raceway, they can be combined with inner rings IR or LR. For suitable inner rings, see Catalogue HR1, Rolling Bearings.</p>
Operating temperature	<p>Drawn cup needle roller bearings without seals can be used at operating temperatures up to +140 °C.</p>
Cages	<p>Drawn cup needle roller bearings for weaving machines have sheet steel cages.</p>

Design and safety guidelines
Raceway for bearings without inner ring

Where bearings without an inner ring are to be used, the rolling element raceway on the shaft must be hardened and ground. The surface hardness of the raceway must be at least 670 HV, the hardening depth CHD or Rht must be sufficiently large.

Shaft and housing design: see the table and the section Design of bearing arrangements, Catalogue HR1, Rolling Bearings.

Caution! In order to utilise the load carrying capacity of the bearings to the full, rigid support must be provided for the thin-walled outer ring.

Note the recommended bore tolerances in the table.

Tolerances for the shaft raceway/housing bore

Housing material	Shaft tolerance for bearings without inner ring	Bore tolerance
Steel or cast iron	h6	N6
Light metal Al		R6
Mg		S6

Surface for shaft raceway/housing bore

Surface quality	Shaft raceway for bearings without inner ring	Housing bore
Roughness max.	R _a 0,2 (R _z 1)	R _a 0,8 (R _z 4)
Roundness	IT 3	IT 5/2
Parallelism	IT 3	IT 5/2

Static load safety factor

$$S_0 = \frac{C_{0r}}{P_0}$$

S₀ – Static load safety factor

C_{0r} – Basic static load rating according to dimension tables

P₀ – Equivalent static bearing load.

Caution! In order to achieve sufficiently smooth running, a static load safety factor S₀ ≥ 3 is necessary.

Radial location

Drawn cup needle roller bearings are pressed into the housing bore and require no further axial location.

Drawn cup needle roller bearings for weaving machines

Installation with fitting mandrel

The bearings should be installed using a special fitting mandrel, *Figure 1*. The shoulder of the fitting mandrel should rest on the bearing end face marked with the designation.

A toroidal ring ① for retention of the bearing must be provided. The length and oversize of the toroidal ring must be matched by the customer to the dimensions and mass of the bearing.

Before installation, the bearings should be lubricated with grease, if grease lubrication is to be used.

Caution!

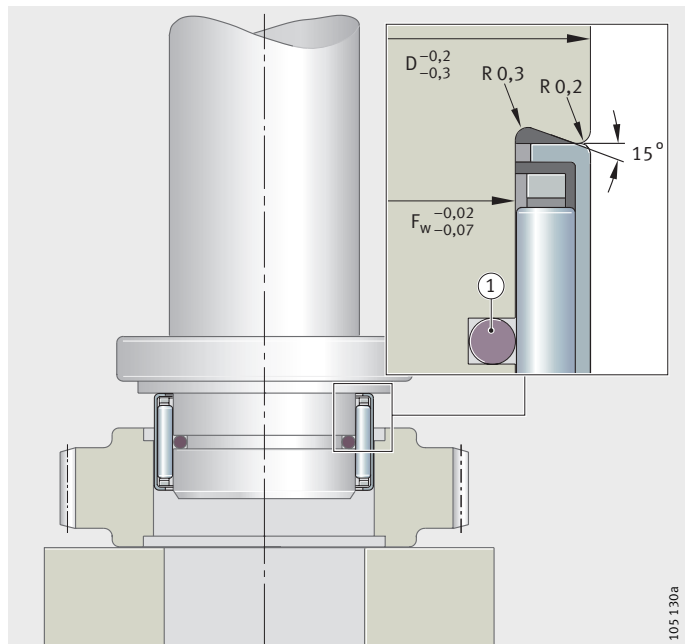
Drawn cup bearings should not be tilted during fitting.

Forces occurring during the fitting process are dependent on several variables. The fitting situation should be arranged so that the bearing rib on the end face is not deformed.

① Toroidal ring

Figure 1

Installation using a fitting mandrel



Accuracy

The main dimensions of the bearings conform to DIN 618/ISO 3 245.

The thin-walled outer rings adapt to the dimensional and geometrical accuracy of the housing bore.

Enveloping circle

In the case of bearings without an inner ring, the dimension for the enveloping circle F_w is used instead of the radial internal clearance.

The enveloping circle is the inner inscribed circle of the needle rollers in clearance-free contact with the outer raceway.

Once the bearings are fitted, the enveloping circle F_w is approximately in tolerance zone F8 (assuming bore tolerances according to table Tolerances for the shaft raceway/housing bore, page 13).

The enveloping circle is determined on the basis of the inspection dimensions in the table.

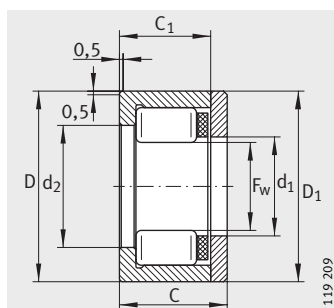
Caution!

Bearings intended for enveloping circle measurement should not be repeatedly pushed in and out of the gauge. Bearings which have been checked in the ring gauge should not be used again.

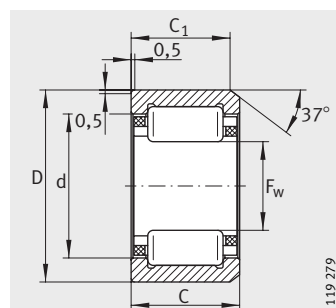
Inspection dimensions for drawn cup needle roller bearings

Enveloping circle diameter F_w mm	Bearing outside diameter D mm	Ring gauge bore Actual dimension mm	Enveloping circle diameter	
			Upper deviation μm	Lower deviation μm
40	47	46,972	+50	+25
45	52	51,967	+50	+25
50	58	57,967	+50	+25
55	63	62,967	+60	+30
60	68	67,967	+60	+30
70	78	77,967	+60	+30

Spindle neck bearings



SPL
Type 1



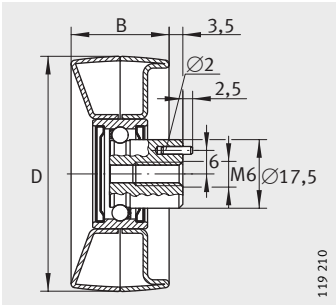
SPL
Type 2

Dimension table · Dimensions in mm

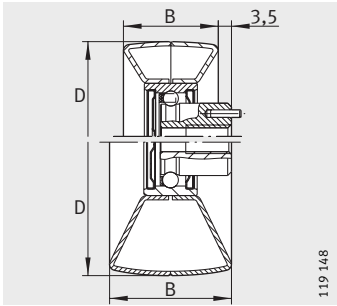
Designation	Type	Mass m ≈g	Dimensions							Basic load ratings		Limiting speed ¹⁾ n _G min ⁻¹
			F _w	D	D ₁	C	d ₁	d ₂	C ₁	dyn. C	stat. C ₀	
				-0,009						N	N	
SPL10.22	2	13,5	10	22	–	11,3	–	16,3	10,2	7 100	5 300	35 000
SPL12.24	1	19,5	12	24	23,95	11	12,7	17	10	6 500	4 800	33 000

¹⁾ Limiting speed for oil lubrication.

Tape tension pulleys



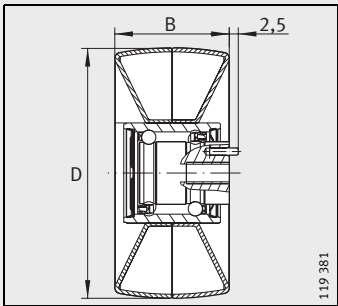
BSR61



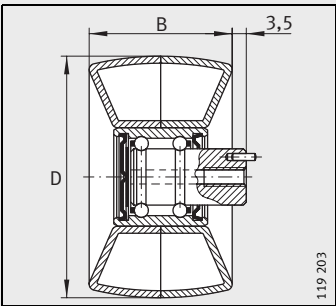
BSR51, BSR71
BSR72

Dimension table - Dimensions in mm				
Designation	Mass m ≈g	Dimensions		Limiting speed ¹⁾ n _G min ⁻¹
		D	B	
BSR51	133	50	25	8 000
BSR61	133	60	25	8 000
BSR71	155	70	25	8 000
BSR72	170	70	32	8 000
BSR720	203	70	32	15 000
BSR73	241	70	45	15 000

1) Limiting speed for grease lubrication.

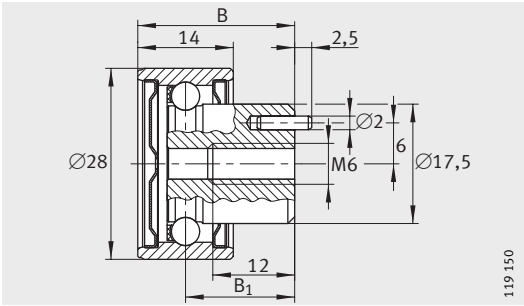


BSR720



BSR73

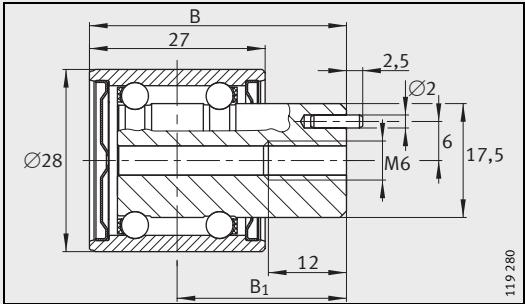
Pulley bearings



RLBSR71-100

Dimension table · Dimensions in mm						
Designation	Mass m ≈g	Dimensions		Basic load ratings		Limiting speed ¹⁾
		B	B ₁	dyn. C N	stat. C ₀ N	n _G min ⁻¹
RLBSR71-100	55	23	16	4 050	1 980	8 000
RLBSR73-100	104	39,5	26	6 200	3 950	15 000

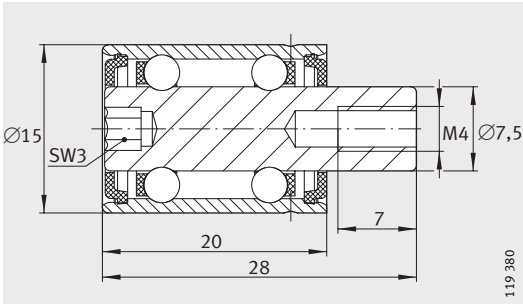
¹⁾ Limiting speed for grease lubrication.



RLBSR73-100

Tape tension pulleys and pulley bearings

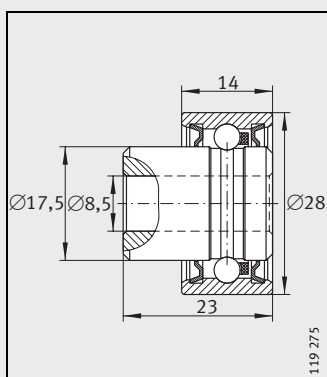
Special designs



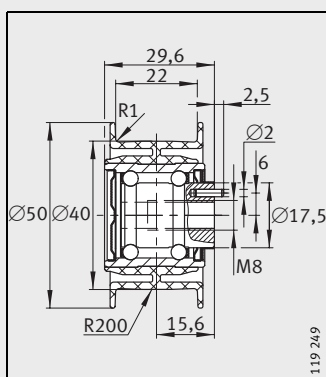
F-229181.01

Dimension table · Dimensions in mm						
Designation	Mass m ≈g	Dimension D	Belt width	Basic load ratings		Limiting speed ¹⁾ n _G min ⁻¹
				dyn. C N	stat. C ₀ N	
F-229181.01	20	15	20	2 900	1 350	15 000
F-80491	55	28	14	4 050	1 980	8 000
F-201997	100	40	22	6 200	3 950	15 000
F-56202	84	42	30	4 050	1 980	8 000
F-50230	202	50	30	6 200	3 950	15 000
F-56618	167	50	21	6 200	3 950	15 000
F-238287	330	50	26	14 800	9 600	8 000
F-207228	500	69	28	8 800	6 600	11 000
F-211420	560	69	42	8 800	6 600	11 000
F-201995	199	70	32	6 200	3 950	15 000

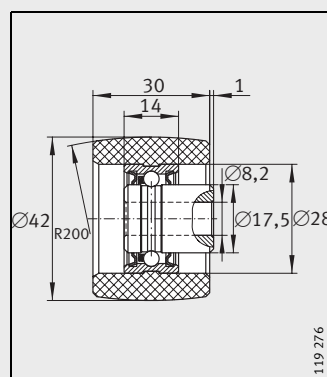
1) Limiting speed for grease lubrication.



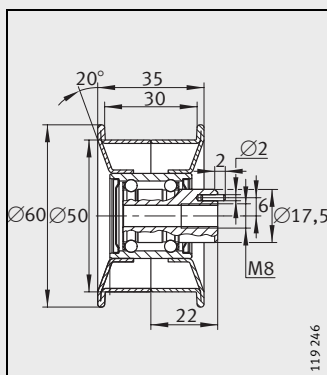
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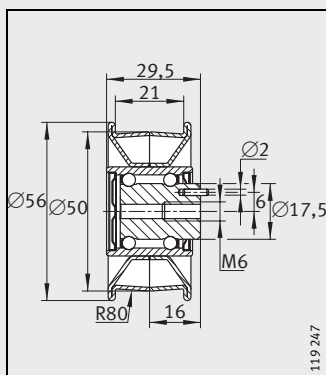
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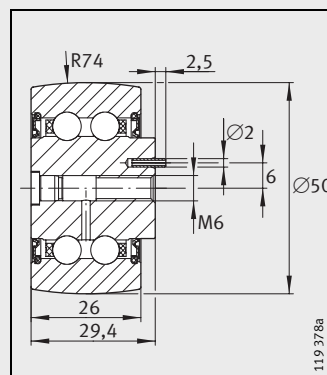
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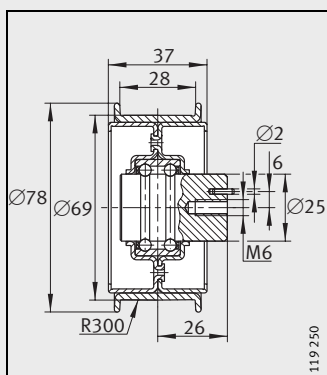
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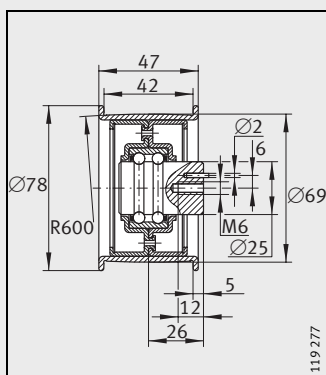
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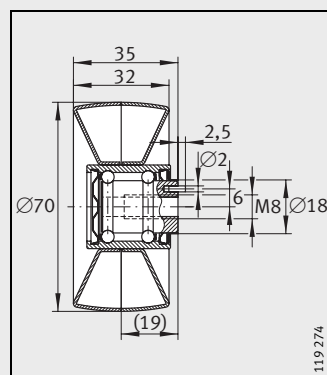
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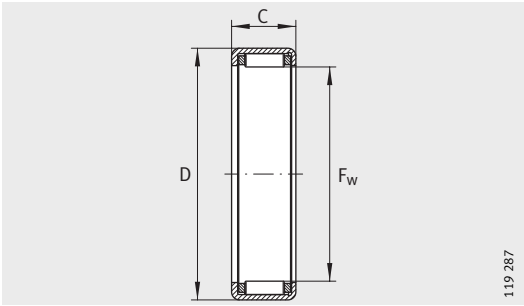
F-211420



F-201995

Bearings for weaving machines

Bearings for heald frame drive



HK

Dimension table - Dimensions in mm						
Designation	Mass m ≈g	Dimensions			Basic load ratings	
		F _w	D	C	dyn. C N	stat. C ₀ N
HK4012	30	40	47	12	14 000	24 300
HK4512	33	45	52	12	14 900	27 500
F-33412	45	50	58	12	16 900	29 900
HK6012	49	60	68	12	17 400	32 000
F-229134	69	70	78	12	19 900	40 000

For further sizes, see Catalogue HR1, Rolling Bearings.

Application examples

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Fibre processing in a carding machine

Fibres that are still disordered are processed in high performance revolving flat cards to form a strip for drafting arrangements or direct spinning machines. Such cards lay the disordered cotton and synthetic fibres parallel to each other. Fibres that are too short are separated out and contaminant particles are removed.

The card is fed with fibres of differing origin and various materials. Several million card clothing points on the roll known as a carding cylinder separate the disordered fibres and lay them parallel.

A further roll, the stripper roll, also has several million card teeth.

The stripper roll rotates more slowly than the carding cylinder.

As a result, the stripper roll draws the fibres off the carding cylinder as nonwoven tissue.

Pinch rolls transport the nonwoven tissue uniformly onward and guide it to the funnel. Calender rolls ensure compaction of the strip so that it can be deposited in an ordered manner in the can.

In the can, the strip is conveyed for further processing.



Figure 1

High performance revolving flat card

Requirements

A carding cylinder with card points runs at a circumferential speed of approx. 26 m/s. The nonwoven tissue must be guided at this speed over the stripper rolls, pinch rolls and calender rolls into the can.

The calender rolls run at a speed of up to 2 000 min⁻¹.

The requirement is for maintenance-free running for 40 000 h.

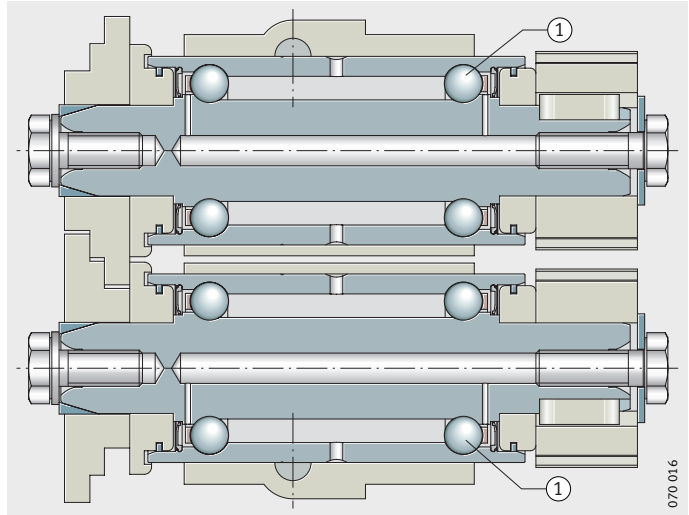
In spite of this requirement, the bearing arrangement must run smoothly and precisely.

Design solution

The Schaeffler Group has developed an optimised roll bearing arrangement for this task. It achieves the required values and is a compact unit.

The calender roll comprises a double row ball bearing arrangement in which the balls run directly on the shaft of the bearing arrangement. The roll is pushed on the shaft of the compact unit. The roll is clamped on one side using a locking collar. The gear on the opposite side to the drive is located by means of a feather key and screw.

① Special ball bearing LWTX
Figure 2
Roll bearing arrangement



Schaeffler Group products used

① Special ball bearing LWTX.

Flyer

High quality roving makes a major contribution to the problem-free running of ring spinning machines. A flyer is therefore used to process a uniform sliver to produce roving with the necessary characteristics, see *Figure 3*.

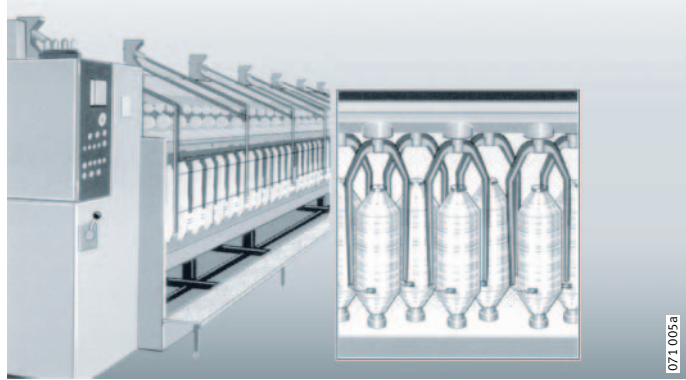


Figure 3
Flyer

Requirements

The drafting arrangement and flyer are the principal components of the flyer spinning frame. As a first step, the sliver is stretched. Then the flyer twists the sliver to produce roving for the ring spinning machine. The flyer spinning frame rotates at approx. 1800 min^{-1} .

The bearings are subjected to high centrifugal forces but must nevertheless run smoothly and accurately. It is only in this way that roving of sufficiently high quality can be produced.

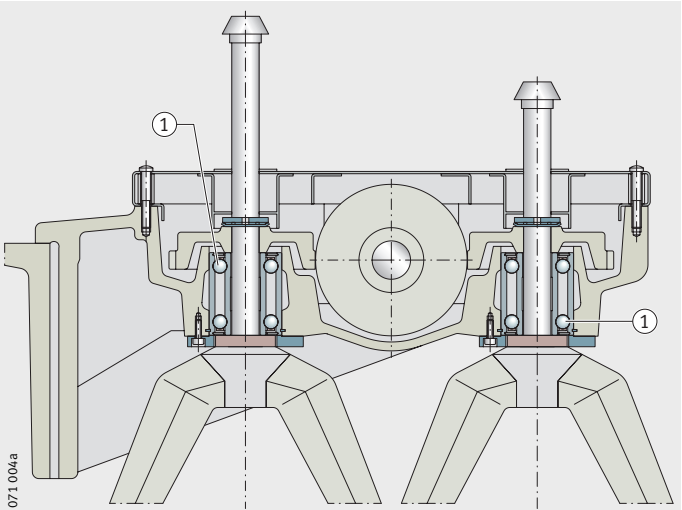
Design solution

The Schaeffler Group special ball bearing, containing ball and cage assemblies at a relatively large distance from each other, supports the high forces. Furthermore, the operating clearance of the bearing has been restricted. These measures ensure smooth running and thus high quality roving.

The ball bearing is lubricated for life and has highly effective sealing against dust and fly. Since the complete bearing arrangement of the flyer consists of this one bearing only, it is easy to fit.

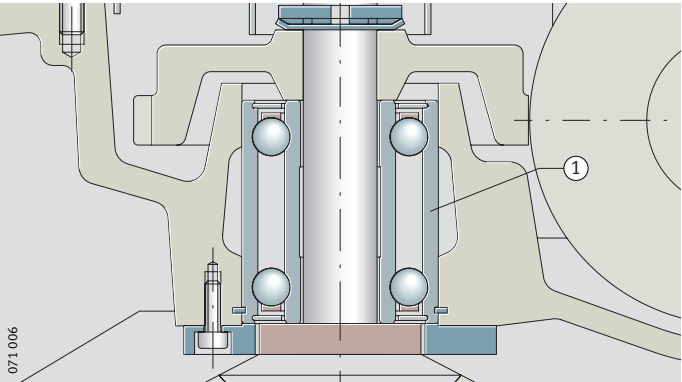
① Special ball bearing KLB

Figure 4
Flyer bearing arrangement



① Special ball bearing KLB

Figure 5
Detail: Flyer bearing arrangement



Schaeffler Group products used

- ① Special ball bearing KLB.

Rotor spinning machine

Turning fibres into yarn: rotor spinning is a particularly effective technique for this task. The opening roller separates the fibres which are then transported to the rotor. The rotor twists the fibres about each other, producing the yarn.

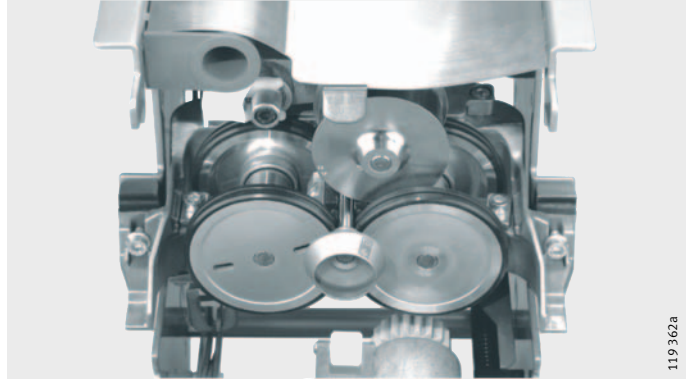


Figure 6
Rotor spinning machine

Requirements

The rotor is driven by a flat belt. A tape tension pulley pressures the belt against the rotor shaft. The shaft is supported on four large pulleys in the indirect rotor bearing arrangement. The speeds are high: $150\,000\text{ min}^{-1}$ at the rotor, $15\,000\text{ min}^{-1}$ to $21\,000\text{ min}^{-1}$ at the bearings and rolls.

At these high speeds, small masses and low-friction running are essential. Vibrations will impair the quality of the yarn produced, so the bearings and rolls must run smoothly.

Design solution

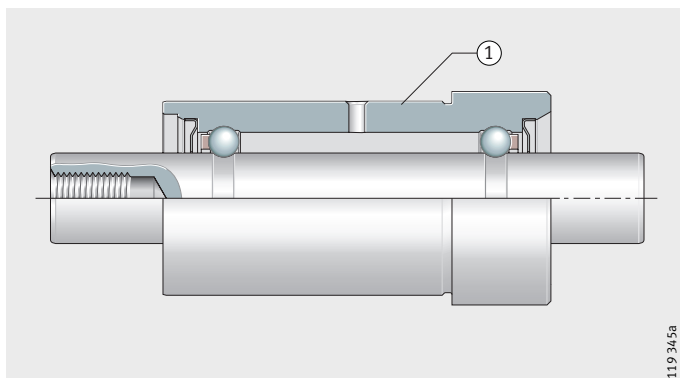
The opening roller and wharve are pressed onto a double row special ball bearing. The restricted axial and radial internal clearance give smooth, quiet running. Due to the large spacing between the two rows of balls, the bearing in the opening cylinder can support high loads. It is reliably protected against fibres by two sheet metal seals.

A double row special ball bearing is also fitted in the Schaeffler Group tape tension pulley. The pulley is pressed onto the shaft. In order to ensure quiet running of the tape tension pulley at $21\,000\text{ min}^{-1}$, it is dynamically balanced.

The special ball bearing in the indirect rotor bearing arrangement has protruding shaft ends on both sides. The support pulleys are pressed onto these ends. The radial runout must be close to zero once they are pressed on. In this case, extremely smooth running of the rotor is ensured.

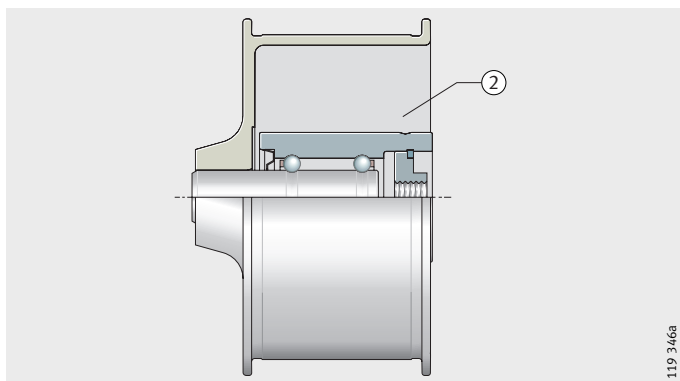
① Special ball bearing LWTX

Figure 7
Special ball bearing LWTX
for opening roller



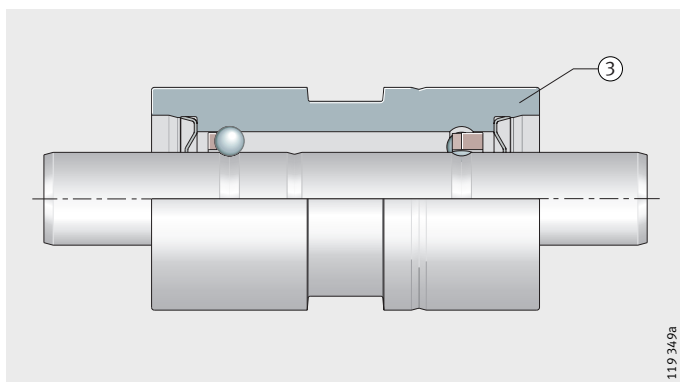
② Tape tension pulley BSR

Figure 8
Tape tension pulley BSR
in the rotor drive



③ Indirect rotor bearing arrangement RTL

Figure 9
Indirect rotor bearing
arrangement RTL



**Schaeffler Group
products used**

- ① Special ball bearing LWTX for opening roller
- ② Tape tension pulley BSR in the rotor drive
- ③ Indirect rotor bearing arrangement RTL.

Twisting machine

In the spindles of the twisting machine, two yarns are twisted together. The resulting doubled yarn is of higher quality and strength than a single yarn. The spindle on the wharve is driven by a flat belt that is pressed against the wharve by a tape tension pulley.

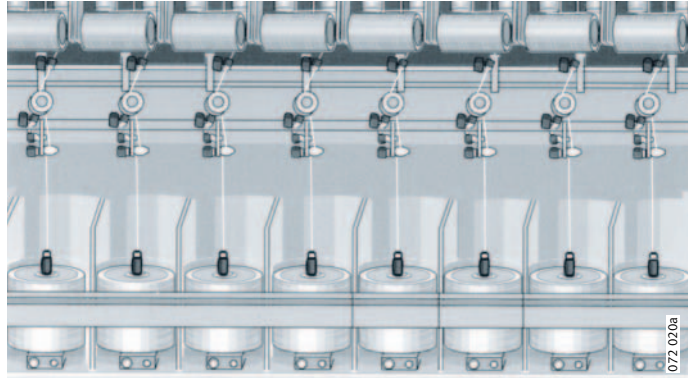


Figure 10
Twisting machine

Requirements

The bearing arrangements and the spindle and tape tension pulley must run with very high precision and very little noise. The smaller the diameter of the wharve that can be achieved, the more slowly and quietly the belt can run.

Design solution

Schaeffler Group manufactures the spindle, including the ball bearings, flange, housing and wharve, as a unit. The raceways of the bearing are ground directly on the shaft and the outer ring.

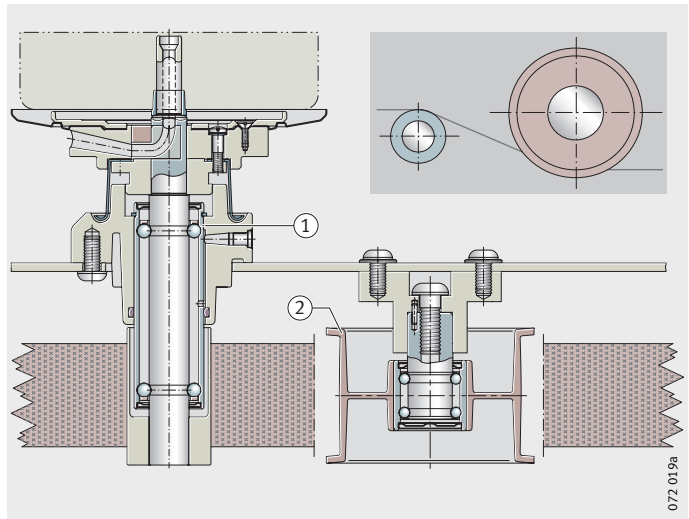
This gives a small outside diameter of the bearing and wharve – the belt runs quietly and at low speed.

The light tape tension pulley has a profiled running surface and thus holds the bearing in the centre. The dynamic imbalance of the plastic pulley is minimised by design measures.

These two precision elements contribute to achieving a high quality twisted yarn and quiet machine running.

- ① Spindle unit LWTX
- ② Tape tension pulley BSR

Figure 11
Spindle bearing arrangement



Schaeffler Group products used

- ① Spindle unit LWTX
- ② Tape tension pulley BSR.

Spinning line

Mountain climbers, hikers, runners and even walkers – everyone is now looking for practical clothing. Light yet robust, waterproof but breathable, clothing made from contemporary materials has displaced cotton, leather and other time-honoured materials.

Such clothing is woven from fully drawn synthetic filament yarns. These yarns are produced on spinning and drawing lines.

These lines carry out four process operations: they start with granulate feed and progress through melting and homogenising of the polymer melt. The further steps are spinning and drawing, after which the winders spool the yarn.

Drawing of the yarns ensures high strength and good mechanical characteristics. Once the polymer chains are spun, they are present in a disordered state in the unstretched filament and their strength is not adequate for direct further processing.



Figure 12
Spinning and drawing line

Requirements

The spun yarns are guided via several godets. Since the following godet always rotates more quickly than the previous one, the yarns are drawn to a multiple of their original length. The molecular chains are aligned to the axis of the fibres and the mechanical characteristics of the fibres are realised. The extent to which the threads are stretched can be adjusted by the ratio of the godet speeds to each other.

High speeds are required in the godet bearing arrangement together with smooth and uniform running. This has a direct effect on the quality of the drawn yarns. Furthermore, the bearing arrangement must withstand different temperatures since the godets run cold or hot depending on the filament.

Design solution

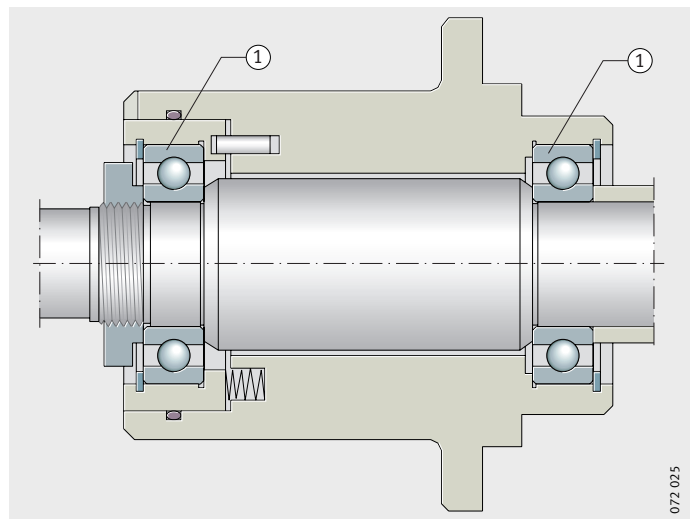
The godet shaft rotates in two deep groove ball bearings. These bearings are fitted in an X arrangement and are preloaded. The design gives high precision guidance of the godet shaft and prevents vibrations. In this way, it is ensured that the stretched yarn is of the required quality. If the godets run hot, the bearing arrangement must be matched to the higher operating temperatures. The bearing components undergo heat treatment and a high temperature grease is used.

A spring preload system ensures optimum contact between the rolling elements and raceways under all operating conditions. It also allows length compensation at the non-locating bearing, which is mounted with a push fit on the outer ring.

The bearings are sealed and greased for life with a high temperature grease.

① Special ball bearing
F-6013-2ZR-C4-L237

Figure 13
Godet
with deep groove ball bearings



Schaeffler Group products used

① Special ball bearing F-6013-2ZR-C4-L237.

Production of synthetic fibres

The dimensions of the production line for producing synthetic fibres from a polymer melt are enormous: over a length of 100 m, synthetic staple fibres are produced, from the spinning stage to the packed fibre.

The significant process operations are spinning, stretching, thermofixing, crimping, cutting and pressing. On its passage along the line, the melt is transformed into a fibre in textile form. This fibre can then be spun either alone or mixed with natural fibres.

Once the melt has been spun through very fine nozzles into filaments, several of these thin filaments are gathered into one yarn. Several such yarns give a fibre cable.

The cables produced in this way must then be refined. This means above all that they must have sufficient strength before they can be processed in the textile industry.

The first refining station on the fibre line is the drafting arrangement. The fibre cables are drawn between heatable drafting rolls. The molecular structure of the filaments is aligned in this way and the fibres acquire the necessary strength.



Figure 14
Production of synthetic fibres

Requirements

The fibre cable must be laid easily and quickly on the drafting roll, the so-called godet. Misalignments occur at the bearing position. The godet is deflected as a result of the drive force, drafting force and weight. The roll heats up during operation, making length compensation necessary in the bearing arrangement.

Operating data

Operating data		
Speed	min ⁻¹	100 to 200
Temperature	°C	90

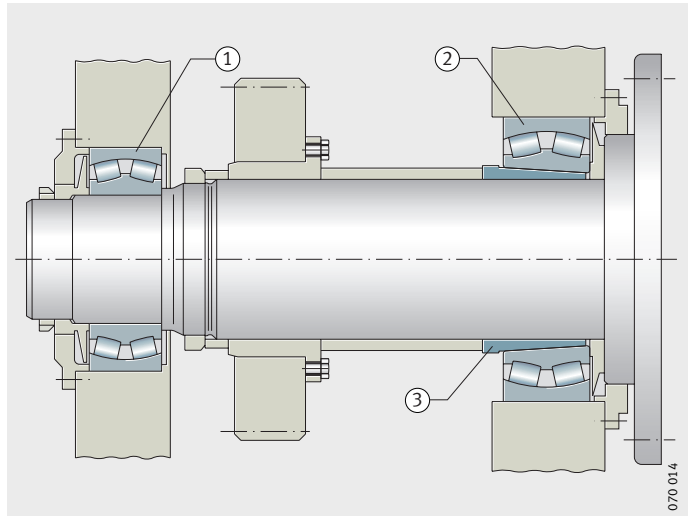
Design solution

The godets are supported in a floating arrangement which simplifies usability when laying the cable. Spherical roller bearings are selected since they are able to compensate misalignments. Spherical roller bearings also support the high forces that occur during drafting. In order to prevent the occurrence of stresses due to elongation at higher temperatures, the bearing arrangement comprises a locating bearing and a non-locating bearing. The non-locating bearing compensates for the elongation.

- ① Spherical roller bearing with cylindrical bore 23176-MB-C3
- ② Spherical roller bearing with tapered bore 23188-K-MB-C3
- ③ Extraction sleeve for hydraulic mounting AHX3188-H

Figure 15

Godet bearing arrangement



Schaeffler Group products used

- ① Spherical roller bearing with cylindrical bore 23176-MB-C3
- ② Spherical roller bearing with tapered bore 23188-K-MB-C3
- ③ Extraction sleeve for hydraulic mounting AHX3188-H.

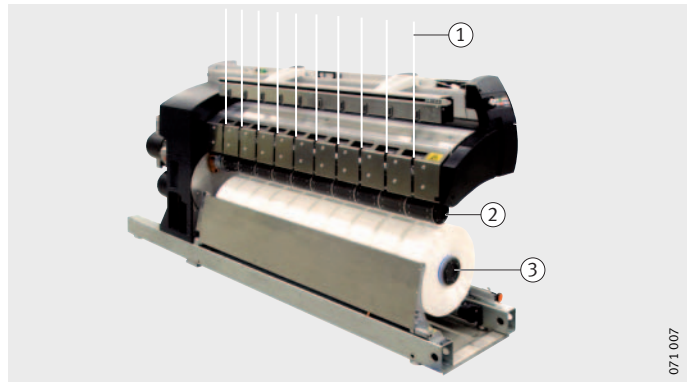
Chuck shaft

Clothing made from synthetic fibres, which is robust and waterproof yet breathable, has displaced time-honoured materials. The machines for synthetic fibre production are therefore increasing in importance compared to machines working with natural fibres. For synthetic fibre production, the Schaeffler Group has developed a new chuck shaft for spooling up of filaments.

In the Schaeffler Group, the chuck shaft has been calculated using the rotor dynamics module of the rolling bearing calculation software BEARINX[®]. The module was programmed in the development department of the Schaeffler Group. It is designed for the high requirements of chuck shafts.

- ① Filaments
- ② Chuck rotates, filaments are spooled up
- ③ Chuck is stationary, finished filament spools

Figure 16
Winding principle



Requirements

The chuck shaft rotates at approx. $15\,000\text{ min}^{-1}$ and has a rotor system with considerable masses. These operating data conceal the risk of resonance vibrations during operation. The vibration behaviour of the chuck shaft must therefore be precisely investigated.

High running accuracy, under which the shaft may only undergo radial wobble of a few micrometres, is a precondition for spooling with very high quality at high delivery speed. The vibration amplitude for the chuck shaft must be as small as possible. Orthotropic rigidity and damping in the bearings must also be taken into consideration in development, together with the damping elements, the gyroscopic effect and all six degrees of freedom in the motion formula.

Design solution

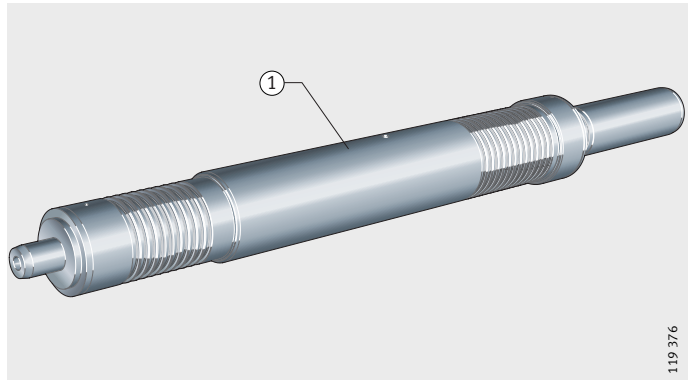
The chuck shaft is supplied as a ready-to-fit unit and mounting is therefore very simple and quick. The double row ball bearings preloaded free from clearance on the chuck shaft were designed for a rating life of more than 50 000 h.

During development, investigations were carried out into natural frequencies, critical speeds and the effect of imbalance excitation at defined measurement points.

The rotor dynamics module in the rolling bearing calculation software BEARINX[®] helps to reduce the number of test series. This reduces the development costs and allows cost-effective solutions.

① Special ball bearing LWTX

Figure 17
Chuck shaft



Schaeffler Group products used

① Special ball bearing LWTX.

Texturing machine

Going back just a few decades: textiles made from synthetic fibres were “sticky” and not at all pleasant to wear – even if the advertising claimed otherwise. This has changed fundamentally. Synthetic fibres have completely lost their sticky charm and this is due in part to texturing machines that give the fibres and thus the textiles some of their comfortable characteristics.

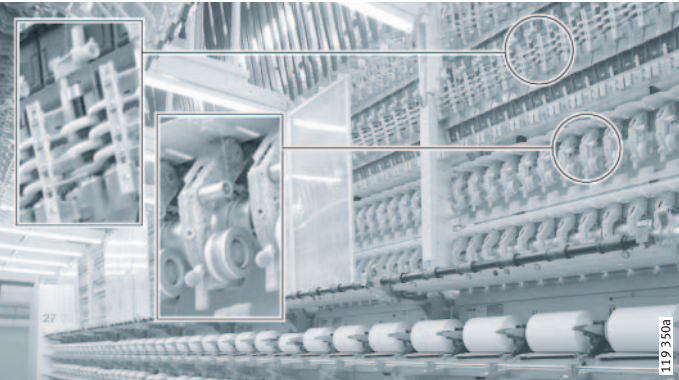


Figure 18
Texturing machine

Requirements

Texturing machines give the plain, untreated filament a crimped effect. The filament has a speed of up to 1 500 m/min, the spindle speed can reach 25 000 min⁻¹. Apron rollers, compacting rollers and thread guidance rollers guide the filament through the texturing machine.

Smooth, quiet running without vibrations is essential in the texturing machine.

Operating data

Product	Speed min ⁻¹
Friction spindle	25 000
Apron roller	8 200
Compacting roller	7 350
Thread guidance roller	22 500

Design solution

In the friction bearing, the upper bearing is suspended “elastically”. The friction spindle therefore runs uniformly and quietly even at $8\,000\text{ min}^{-1}$ to $25\,000\text{ min}^{-1}$.

The Schaeffler Group apron roller has a deep drawn pulley with a profiled running surface and is coated with Corrotect®. The roller has two ball bearings pressed in, is fitted with sealing shields and runs with little friction. It has only a small mass and a low mass moment of inertia, therefore little energy is required.

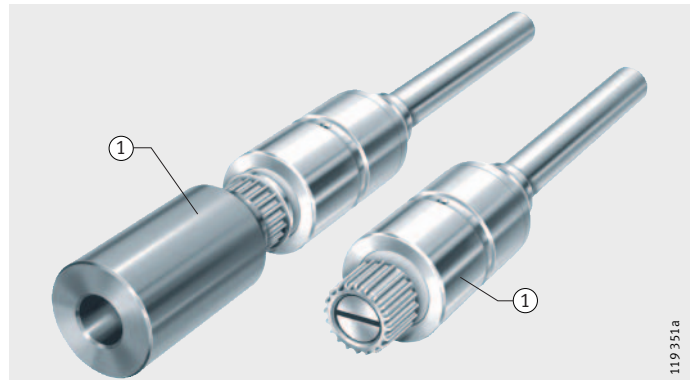
The compacting roller is a special bearing with a tilting mechanism for the pin. This mechanism allows the roller to tilt in precisely one plane. If the compacting roller tilted in more than one plane, thread running would become imprecise. Like the apron roller, the compacting roller is lightweight and can accelerate quickly when it contacts the delivery shaft.

For the thread guidance roller, the Schaeffler Group supplies a special ball bearing with a hard chromium surface plating. The bearing geometry and lubrication was selected by the Schaeffler Group such that the roller has a very low starting torque and can accelerate very easily.

Rollers and friction bearings – all the parts supplied by the Schaeffler Group – have effective protection against dust and the ingress of fibres that are generated in textile processing.

① Friction bearing FDS

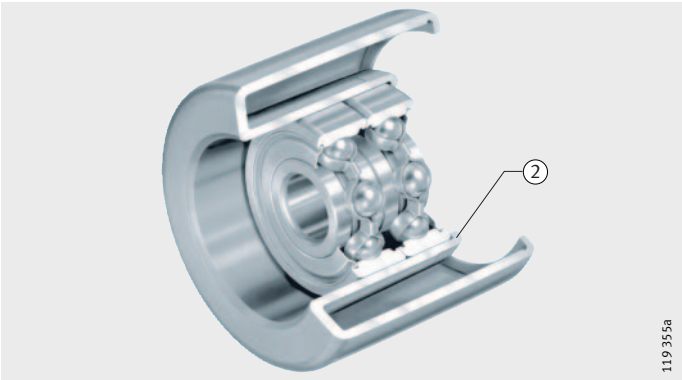
Figure 19
Friction bearing FDS



Texturing machine

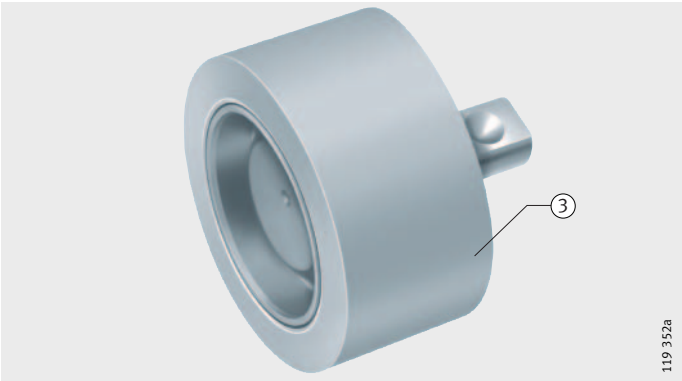
② Apron roller FRM

Figure 20
Apron roller FRM



③ Compacting roller OWA

Figure 21
Compacting roller OWA



④ Thread guidance roller FRM

Figure 22
Thread guidance roller FRM



**Schaeffler Group
products used**

- ① Friction bearing FDS
- ② Apron roller FRM
- ③ Compacting roller OWA
- ④ Thread guidance roller FRM.

Weaving machine

Rapier drive

Rapier weaving machines produce a large number of materials: from light materials that ideally will remain hidden in the airbag, to heavy materials such as terry towelling that is pleasant against the skin.

Two rapiers, one on each side, guide the thread through the shed. Each rapier must shoot in and out of the shed 600 times a minute. In the middle, the carrying rapier passes the thread to the drawing rapier.

Each rapier is pulled and pushed by an elastic belt via an oscillating pulley. In order to prevent the elastic rapier belt lifting from the pulley, a continuous belt presses the rapier belt against the pulley. The continuous belt is guided by two tape tension pulleys.

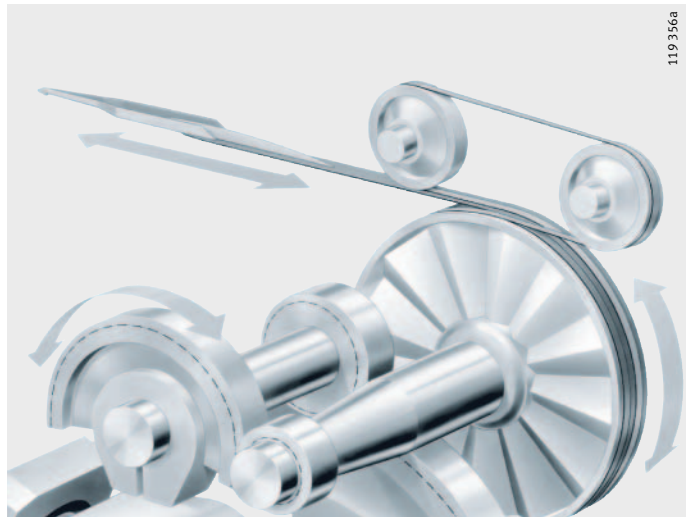


Figure 23
Rapier weaving machine

Requirements

These tape tension pulleys must have particularly low mass, since they undergo acceleration and braking 600 times a minute. This results in continual reverse bending load on the bearing cage in the tape tension pulley.

Design solution

The Schaeffler Group has fulfilled this requirement using very light tape tension pulleys comprising a ball bearing and a plastic pulley. The Schaeffler Group design and the special injection moulding process ensure permanent seating of the pulley on the bearing. This applies to both radial and axial loads.

Due to its design, the tape tension pulley is very light. It can therefore be easily reversed and requires little energy.

The tape tension pulley is sealed by the adjacent construction. The pulley can be relubricated via a hole in the inner ring.

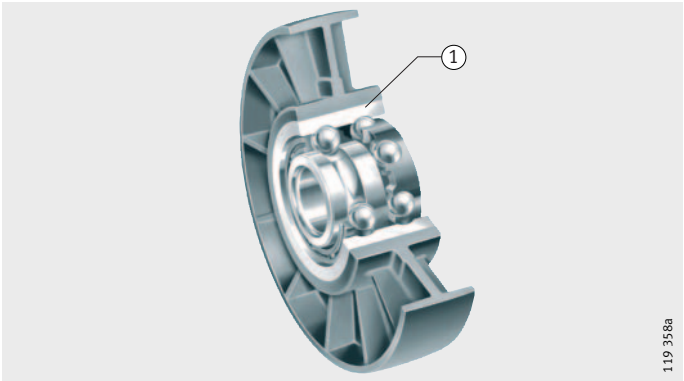
The running surface of the pulley has a slightly curved profile, so the continuous belt is pushed consistently towards the centre of the running surface and is thus guided securely.

① Tape tension pulley BSR

Figure 24
Tape tension pulley
in the rapier drive

**Schaeffler Group
products used**

① Tape tension pulley BSR.



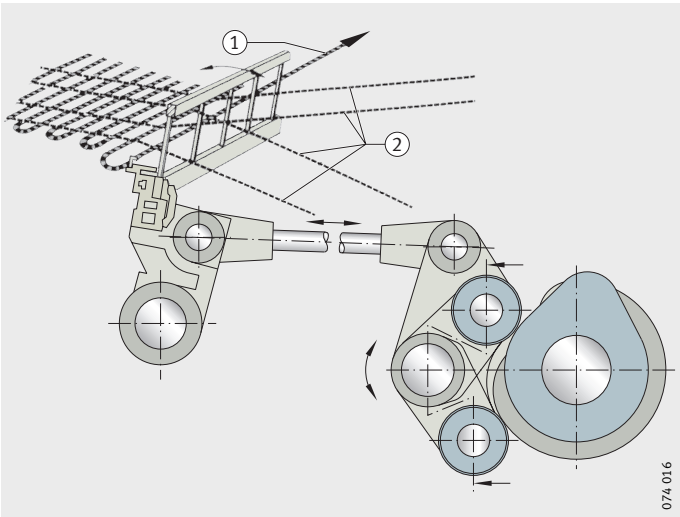
Weaving machine

Lay drive

The lay beats the weft thread which has been inserted between the warp threads. This process keeps the woven material tight and completes each entry of the weft. To beat the wefts threads, the lay is moved to the edge of the material and then returned to its original position. The lay is driven by a double eccentric.

- ① Weft thread
- ② Warp threads

Figure 25
Lay drive



Requirements Track rollers on a double lever run on both cams on the eccentric. The lever converts the rotation of the cams into an oscillating movement.

The high shock loads and the subsequent reversed bending stresses on the outer rings of the rollers require an optimised design for the track roller in order to achieve maximum operating life.

Operating data

Operating data		
Load ratio	$F_{r\ max}/P_r$	2,2
Speed of rollers	n	1 300 min ⁻¹ to 1 800 min ⁻¹

Design solution

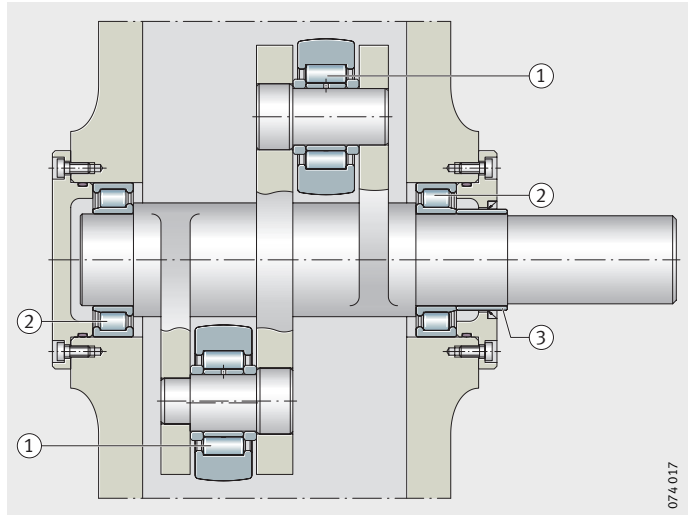
The double lever is supported at its centre by a cylindrical roller bearing of series NJ with optimized load carrying capacity. Two yoke type track rollers of series NUTR are attached to the lever, one to a cylindrical pin, one to an eccentric pin.

The track roller is preloaded against the cam by the eccentric pin. This preload prevents inertia forces lifting the track rollers at the return point of their oscillating movement.

The enclosed gearbox in which the rollers and the cylindrical roller bearings run is supplied with recirculating oil lubrication.

- ① Yoke type track roller NUTR
- ② Cylindrical roller bearing NJ
- ③ Inner ring IR..EGS

Figure 26
Lay drive
Section A – B



Schaeffler Group products used

- ① Yoke type track roller NUTR (special design)
- ② Cylindrical roller bearing NJ (special design)
- ③ Inner ring IR..EGS (special design).

Weaving machine

Heald frame drive bearing arrangements

In order that a weft can be inserted during weaving in weaving machines, a shed must be opened with the warp threads. The shed is formed by the heald frames holding the warp threads. The possible number of heald frames is between 2 and 28. The frequency with which the up and down movement of the heald frames are reversed determines the texture of the fabric. The movement of the heald frames is driven by the dobby. The dobby controls the heald frames through a system of linkages and articulated levers.

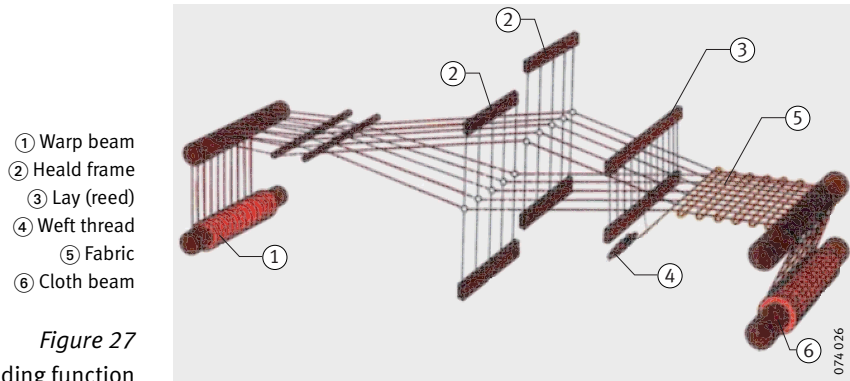


Figure 27
Shedding function

Requirements

In movement of the heald frames, rapid stroke and long shed opening are required since this is the only way to ensure sufficient weft insertion. This movement leads to high shock loads. The clearance in the power flow of the articulation points – in the bearings – should therefore be zero. A compact heald frame depth and small mass are required, so there is only a small design envelope for the width and diameter of the heald frame bearings.

Design solution

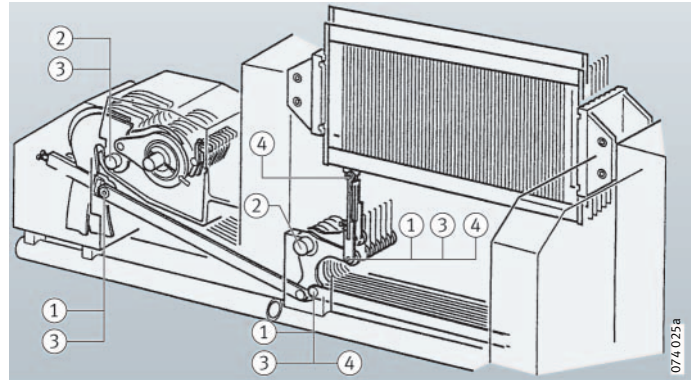
The heald frame lever unit comprises a drawn cup needle roller bearing HK and several bearings.

The drawn cup needle roller bearing has reduced enveloping circle tolerances and is lubricated via a lubrication duct in the shaft.

Several bearings for heald frame drives are full complement bearings and therefore have particularly high load carrying capacity. They are sealed on both sides and lubricated for life. The radial internal clearance was designed in order to achieve small operating clearance.

- ① Ball bearing KL
- ② Drawn cup needle roller bearing HK
- ③ Roller bearing N
- ④ Needle roller bearing HN

Figure 28
Heald frame



Schaeffler Group products used

- ① Ball bearing KL
- ② Drawn cup needle roller bearing HK
- ③ Roller bearing N
- ④ Needle roller bearing HN.

Needle felting machine

Almost everyone walks across them every day: needle felted carpets have “conquered” offices and homes. Furthermore, needled felt demonstrates its good characteristics not only in laid coverings but also in cars and upholstery.

In the needle felting machine, the loose pile is compacted to the firm, hard-wearing needled felt and the individual fibres are interlocked with each other.

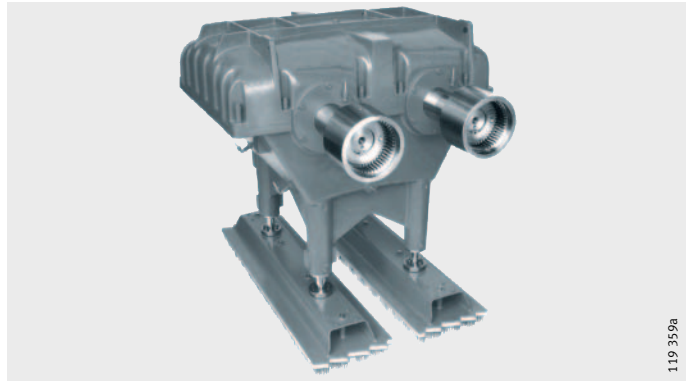


Figure 29
Needle felting machine

Requirements

The needle beams needle into the pile at up to 3 000 strokes per minute. The beam is moved up and down approximately 40 mm by a crankshaft.

The high speeds, large masses and the needling process place extreme loads on the bearings and lead to high temperatures. Nevertheless, a long operating life is required since replacement involves a considerable amount of work.

Design solution

The crankshaft rotates in cage-guided cylindrical roller bearings. The connecting rod pin from which the needle beam is suspended swivels in a full complement cylindrical roller bearing.

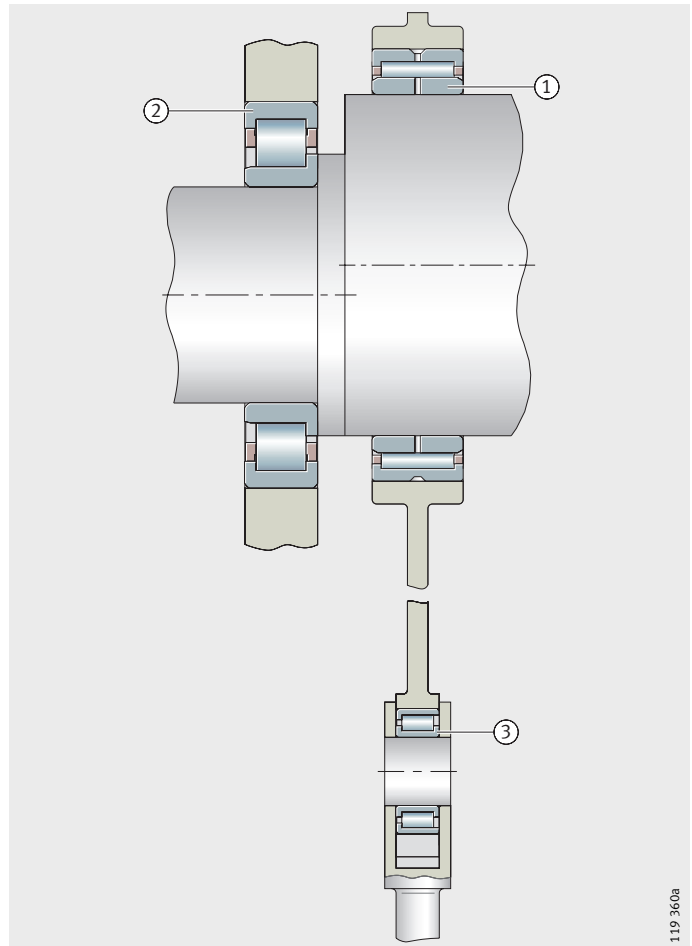
One crankshaft has two connecting rods, each supported by a needle roller bearing. The needle roller bearing has an optimised steel cage and is stabilised for high temperatures.

Needle roller bearings are particularly advantageous in this case since they allow high basic load ratings within a very small space. The bearing gives very effective support for the accelerations and high speed.

The Schaeffler Group needle roller bearings run for long periods in three-shift operation in the needle felting machine.

- ① Special needle roller bearing NA
- ② Special cylindrical roller bearing NCF..-V
- ③ Special cylindrical roller bearing NU

Figure 30
Products



**Schaeffler Group
products used**

- ① Special needle roller bearing NA
- ② Special cylindrical roller bearing NCF..-V
- ③ Special cylindrical roller bearing NU.

Impregnating machine

In those cases where absorption of moisture by textiles is not desirable, these materials are impregnated. In the impregnating machine, the lengths of fabric are fed through chemical baths by means of rolls.

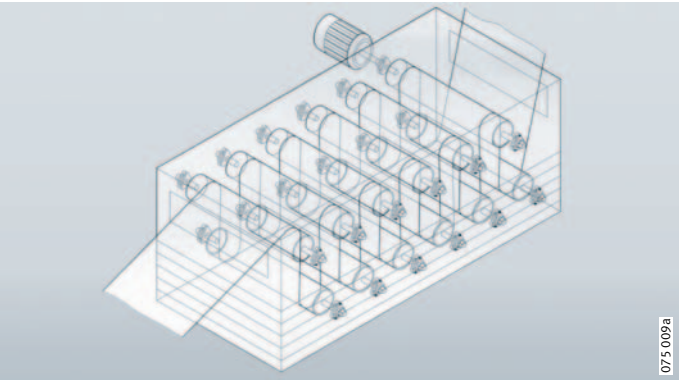


Figure 31
Impregnating machine

Requirements The bearings in the rolls are subject to demanding requirements. While the shafts are sealed at the housing bore by means of floating ring seals, leakage is still to be expected. The bearing arrangement must therefore be well protected against corrosion. Fluids should also be able to flow away. The floating ring seals must be replaced regularly, so it must be possible to quickly change the bearings.

Operating data

Operating data		
Speed	min ⁻¹	600
Radial load	N	1 200
Temperature	°C	95

Design solution

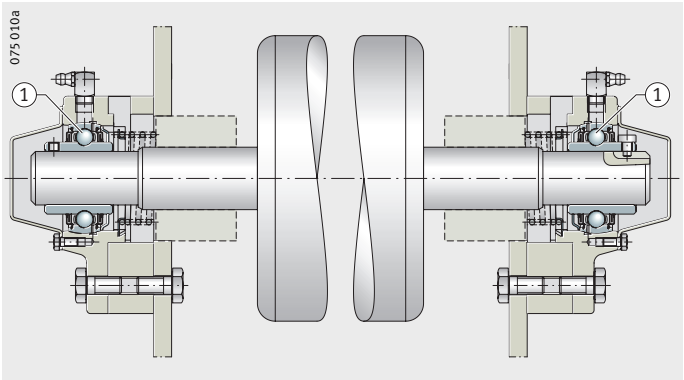
A flanged housing unit LCFTRY is flange mounted onto the container from the outside. A flanged spacer for centring the bearing is screw mounted from the inside. As a result, it is not necessary to realign the rolls when the bearings are changed.

The flanged spacer has openings to allow water to run out; it is protected against corrosion by a special coating.

The bearing is also protected by labyrinth seals and is filled with a water-repellent grease. The bearing can be relubricated through rust-resistant lubrication nipples.

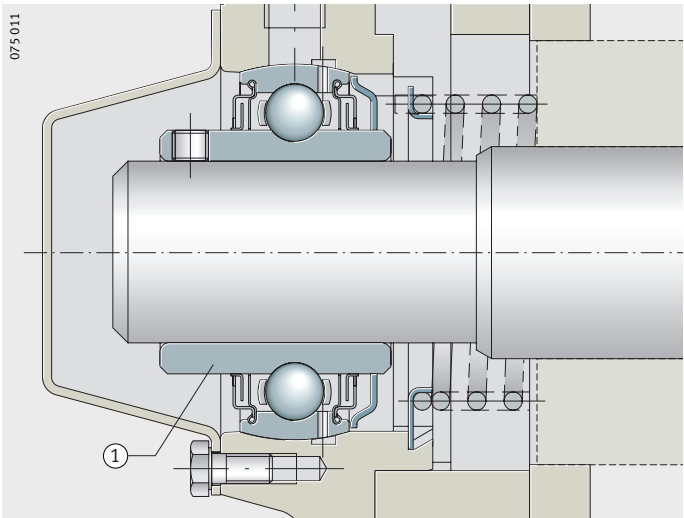
① Flanged housing unit LCFTRY

Figure 32
Float unit



① Flanged housing unit LCFTRY

Figure 33
Detail: Float unit



**Schaeffler Group
products used**

① Flanged housing unit LCFTRY.

Embroidery machine

The reduction of costs by the use of complete units is an increasingly important subject in the textile machinery industry. An example of one such complete unit is the eccentric bearing arrangement in this embroidery machine. The eccentric bearing arrangement must convert rotary motion into oscillating motion.

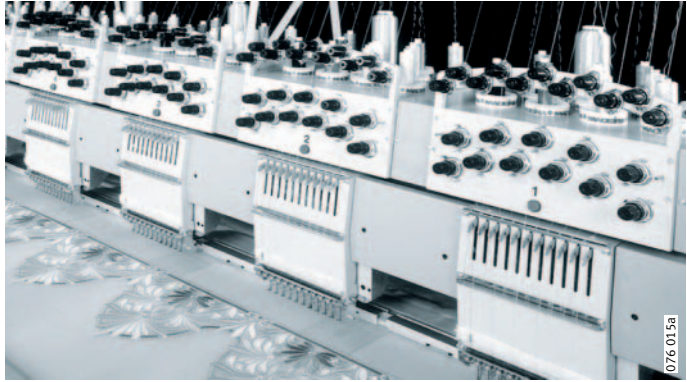


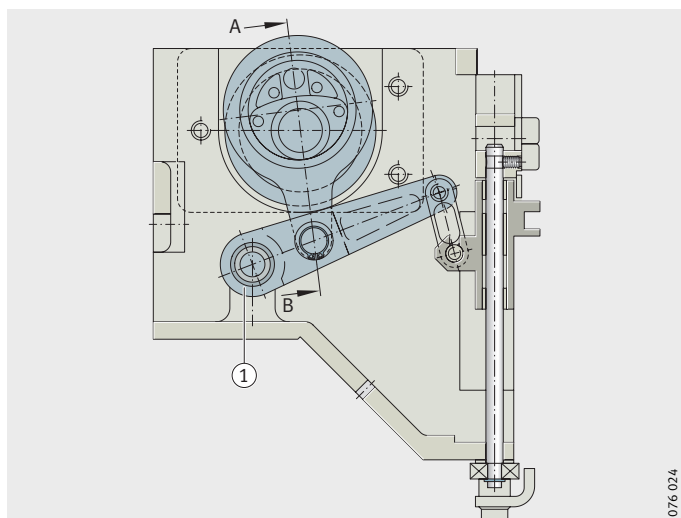
Figure 34
Embroidery machine

Requirements

The oscillating motion provides the up and down motion of the needle bar to which the embroidery needle is fixed. The eccentric bearing is subjected to only slight loads by the dynamic forces. The speed of the eccentric is approx. 1 000 revolutions per minute.

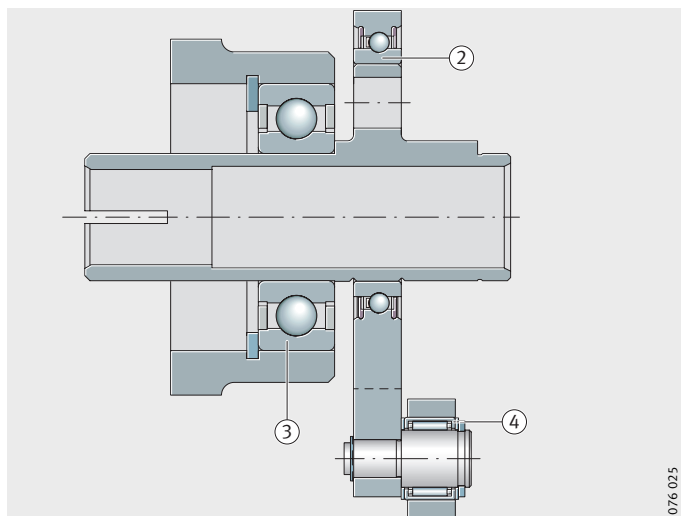
Design solution

The eccentric bearing arrangement on the embroidery machine is a complete unit comprising a lever, an eccentric, a connecting rod and a flange. The eccentric is supported by a special ball bearing integrated in the connecting rod. This ball bearing is sealed on both sides and greased for life. The flange incorporates a single row ball bearing sealed on both sides. The lever bearing arrangement includes a compact drawn cup needle roller bearing HK and a needle roller bearing NK.



- ① Needle roller bearing NK

Figure 35
Eccentric bearing arrangement



- ② Eccentric bearing ELG (special design)
③ Deep groove ball bearing
④ Drawn cup needle roller bearing HK

Figure 36
Detail:
Eccentric bearing arrangement,
section A – B

Schaeffler Group products used

- ① Needle roller bearing NK
② Eccentric bearing ELG (special design)
③ Deep groove ball bearing
④ Drawn cup needle roller bearing HK.

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