

Self-aligning ball bearings for guide rolls in calenders



Examples of Application Engineering

WL 13 514 GB-D



Calender with guide rolls

Guide rolls turn the paper web as it passes through a calender. Depending on the specific requirements, a calender consists of 8 to 14 rolls for smoothing the paper surface.

The guide rolls usually consist of three segments; each of the individual segments is supported by two spherical roller bearings. The spherical roller bearings take up the deflection of the roll, but due to increased friction they also generate heat. This additional heat around the bearings alters the web in an unwanted manner.

FAG has developed special self-aligning ball bearings as a substitute for the spherical roller bearings. These bearings produce less friction and consequently less heat so that they meet the special requirements of this application better than the previously used spherical roller bearings.

Technical data

Roll diameter	360 mm
Roll length (3 segments)	8 500 mm
Weight	
per roll segment	400 kg
Wrap angle	168 °
Web tension (equivalent to 2,78 kN per segment)	0,5 kN/m
Web speed	1 800 m/min
Tilting resulting from deflection	0,5°
Rotating bearing outer ring	

Special requirements

- If the calender is integrated into the paper machine, a shutdown must not result in production loss.
- In a separate calender the roll can be replaced more easily – relatively slight production losses result.
- No heat – which produces streaks (discoloured, differently smoothed surface) in the paper web – must be generated at the bearing locations.

Bearings

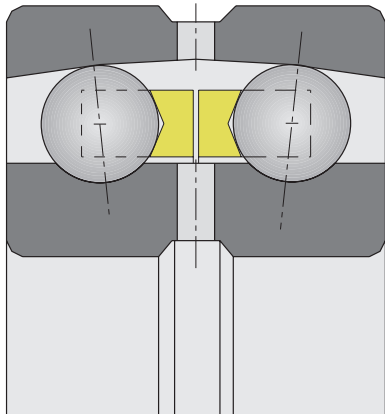
Each segment (O. D. = 360 mm, L = 2 800 mm) is supported by two FAG self-aligning ball bearings **F-804501.P-C3** (with an increased bearing clearance). The bearing dimensions (dxDxB) 220 x 300 x 60 mm are identical with those of spherical roller bearings **23944**.

The bearings are loaded by the segment weight of 400 kg and by the web tension of 2,78 kN, which acts at a 90° angle to this weight. The maximum speed is 1 593 min⁻¹.

Bearing type

FAG self-aligning ball bearings are best suited for the special requirements of this application such as compensation of misalignment, minimal revolving masses and low friction.

Today, self-aligning ball bearings in six sizes are available for guide rolls. They have the same main dimensions as the spherical roller bearings of designs 23030, 23036, 23938, 23940, 23944 and 23948.



The central roll segment is supported by the shaft; it can-not be adjusted. The two outer segments are adjusted laterally to ensure that the paper web is not creased.

The deflection of the shaft causes the bearing's inner ring to tilt. At the same time the roll shell tilts as well, although more slightly. This results in a 0,5° tilt of the inner ring relative to the rotating outer ring (dynamic misalignment).

While the rolling elements are rolling in circumferential direction they must simultaneously shift axially in the outer ring raceway.

These axial sliding effects are compensated more smoothly by the self-aligning balls than by barrel rollers.

With rollers, these axial motions would produce sliding friction and consequently higher temperatures inside the bearing.

Due to the low load of 2,44 kN, slippage hazard occurs when the rolling elements enter and pass through the deloaded zone.

A spherical roller bearing of the same size and a load rating of $C_{dyn} = 600$ kN requires a minimum load of 12 kN. The special self-aligning ball bearing with a load rating of $C_{dyn} = 58,5$ kN requires a minimum load of only 0,585 kN.

The risk of slippage is reduced considerably by the smaller revolving masses of self-aligning ball bearings (low ball weight, reduced number of balls).

Bearing lubrication and sealing

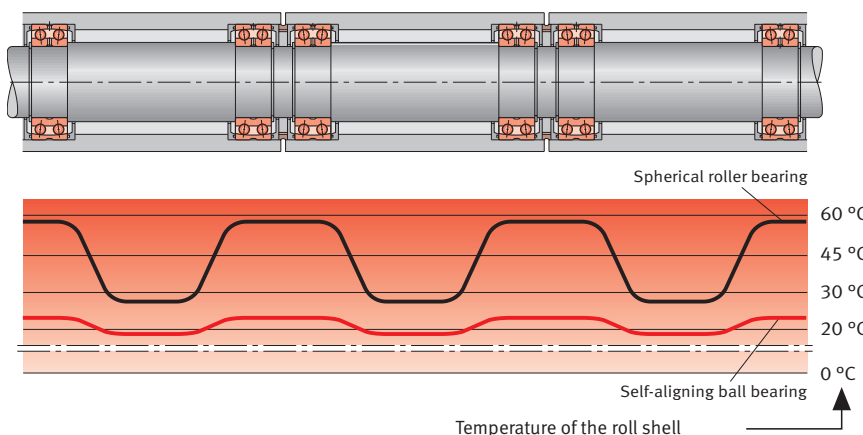
The self-aligning ball bearings are lubricated with a low-friction grease, which also contributes to a reduction of the overall friction.

Re-lubrication is effected through the lubricating groove and the six lubricating holes in the stationary inner ring and supplies fresh grease directly to the contact areas in the bearings. Large amounts of grease can be stored in cavities on both sides of the bearings.

As the outer ring rotates with a speed index of $n \cdot d_M = 400\,000 \text{ min}^{-1} \cdot \text{mm}$, effective seals (pressed-on shields with an inserted O-ring toward the outer ring faces) are required. They prevent base oil extracted from the grease by centrifuging from escaping.

Customer benefits

- Reduced operating temperatures
The following diagram shows graphically the clearly lower temperatures that develop in self-aligning ball bearings (F-804501.P) as compared with spherical roller bearings (23944).
- Higher paper web quality
- Longer bearing service life time
- Direct replacement for spherical roller bearings "drop-in solution"



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