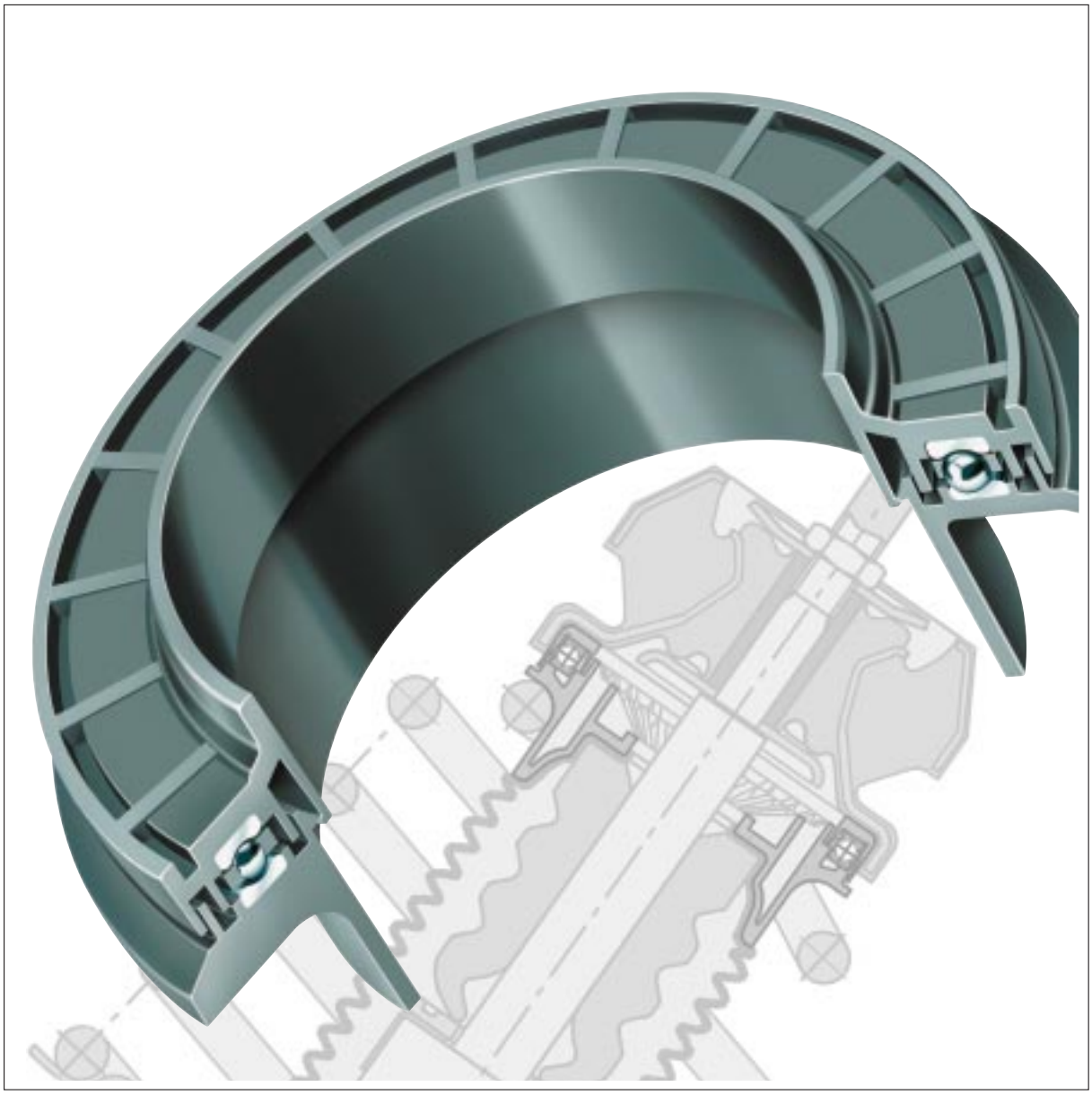

Suspension Strut Bearings

Rolling Bearings and Components for Passenger Car Chassis

Automotive Product Information API 08

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Suspension Strut Bearings

Strut bearings form part of the wheel suspension in independent suspension systems. The wheel suspension has the task of ensuring maximum driving safety and ride quality while providing accurate steering. It must also transfer tire-road contact forces to the vehicle frame and isolate the body from road noise, while being as lightweight as possible.

To accomplish these objectives, the components in the suspension system must be correctly matched to one another, which requires close cooperation between the suspension or chassis manufacturer and the system supplier.

Proven competence and experience in the design, analysis, and manufacture of suspension strut bearings have long established INA as a winning partner in designing solutions for a wide range of technical applications.

Working closely with customers, INA has developed strut bearings that:

- Absorb radial and axial forces
- Ensure low-friction and distortion-free movement of the shock-absorber spring during steering and deflection, enabling the spring to operate without self-aligning torque
- Locate the shock-absorber spring and form a support surface for full deflection of the shock absorber
- Can be used with coupled and uncoupled suspension struts
- Are rigid and lightweight
- Help isolate the body from road noise
- Have a compact design that has been optimized for limited mounting space and are supplied as a sealed unit
- Are easy to assemble and can be installed using robots
- Are maintenance-free

Extensive testing using special test rigs and defined test standards, as well as stringent process and function controls, ensure that all customer requirements are met.

Suspension strut bearings from INA represent chassis components that contribute substantially to the comfortable, safe, reliable, and economical operation of automobiles around the world.

INA-Schaeffler KG
Herzogenaurach (Germany)

MacPherson Strut

Absorption of shock absorber and spring forces

The suspension strut bearing is usually mounted at the top of the shock absorber, between the shock-absorber spring and the car body.

It allows torsional movement of the shock absorber with low friction and has a positive influence on the steering characteristics of the vehicle.

There are two types, distinguished by the load distribution of the suspension system:

- Shock absorber forces F_S and spring forces F_F are absorbed by the bearing (Figure 1)
- Only the spring forces F_F pass through the bearing; shock absorber forces are supported by the body (Figure 2)

The second type is the preferred design, as it reduces the forces on the bearing and has a positive influence on the kinetic relationships.

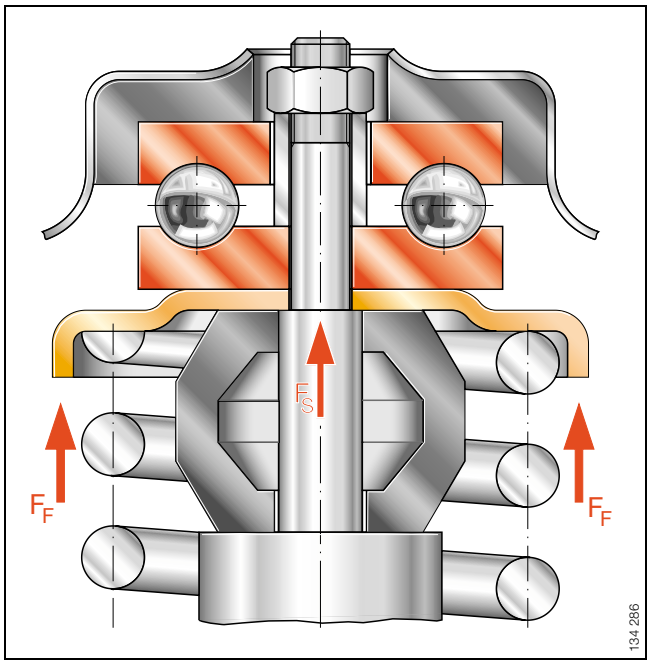

Figure 1 · Bearing receives shock absorber and spring forces

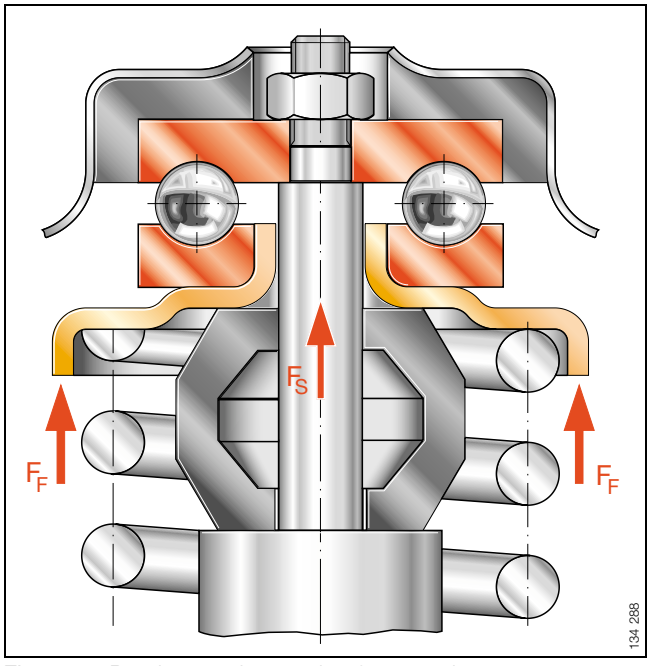

Figure 2 · Bearing receives spring forces only

Suspension Strut Bearings

Basic design

Standard INA suspension strut bearings consist of (Figure 3):

- Two formed washers ①
- Ball complement ②
- Encapsulating sleeve ③

Features

Suspension strut bearings have the following features:

- Permanent lubrication
- High static load carrying capacity due to a full complement of rolling elements
- Effective protection against contamination
- Optimized design in terms of mounting space and costs

Key to Figure 4

① Basic design of suspension strut bearing

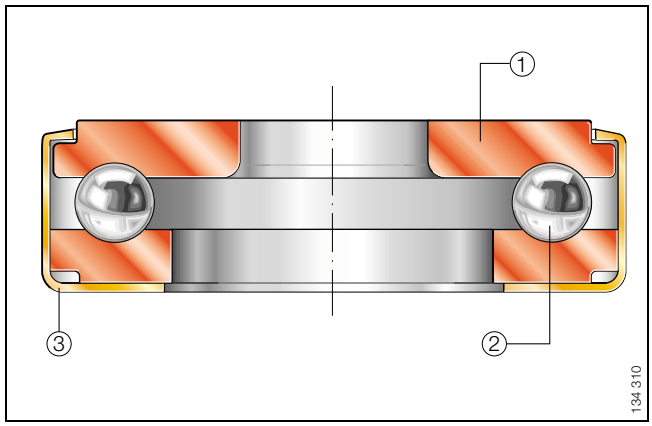

Figure 3 · Suspension strut bearing – basic design

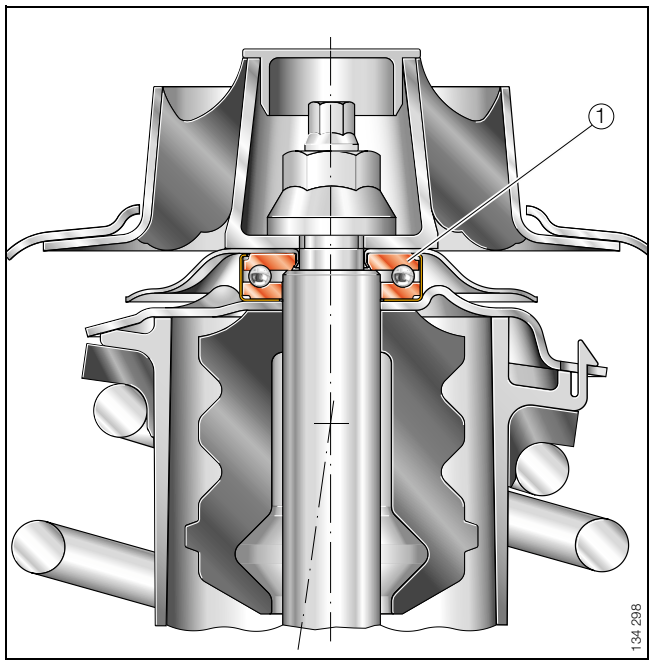

Figure 4 · Mounted suspension strut bearing – basic design

To allow increased lateral forces F_R, the raceway contours in the basic design can have a defined contact angle α (Figure 5).

The internal plastic sealing ring ① provides additional protection to the roller system against contaminants.

The spherical outer profile of the washers allows the bearing to be tilted and adapted to the surrounding structure. This provides improved load distribution in the bearing and the top mount.

Key to Figure 6

① Modified suspension strut bearing

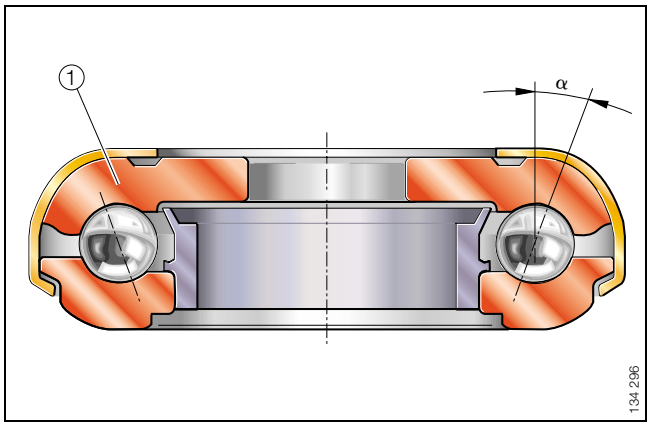

Figure 5 · Suspension strut bearing – design with angular-contact ball bearing

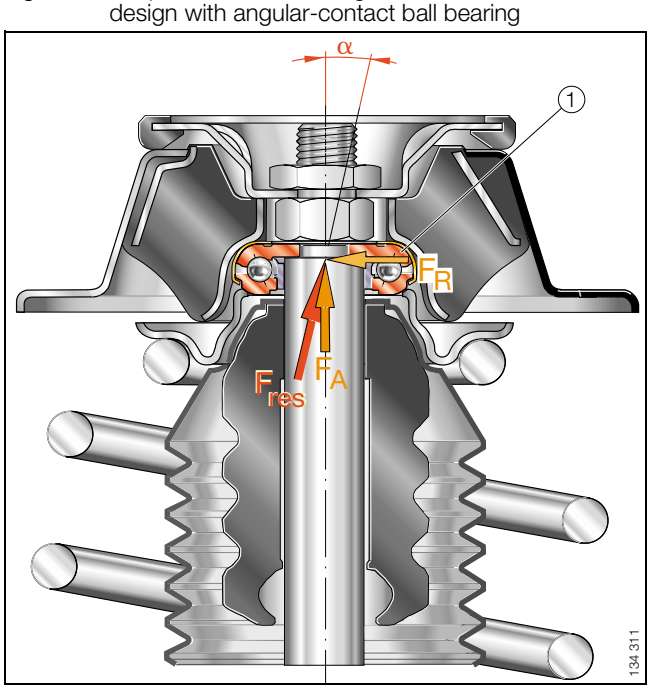

Figure 6 · Mounted thrust angular-contact ball bearing

In the development of suspension struts, there is a tendency toward the use of shock-absorber springs with larger diameters.

As a result, full-complement bearings with small pitch diameter are being replaced by larger cage-guided suspension strut bearings (Figure 7, ①).

These bearings are encapsulated in plastic housings, which protect them from contaminants. The cage provides an adequate grease reservoir, and the grease ensures a longer service life of the bearings.

The variable design of the plastic parts allows them to be adapted to the surrounding structure.

The spring can be supported directly on the bearing if the lower housing is sufficiently rigid. In this case, the spring support plate is not required.

Figure 8 shows the spring supported by a spring plate ①.

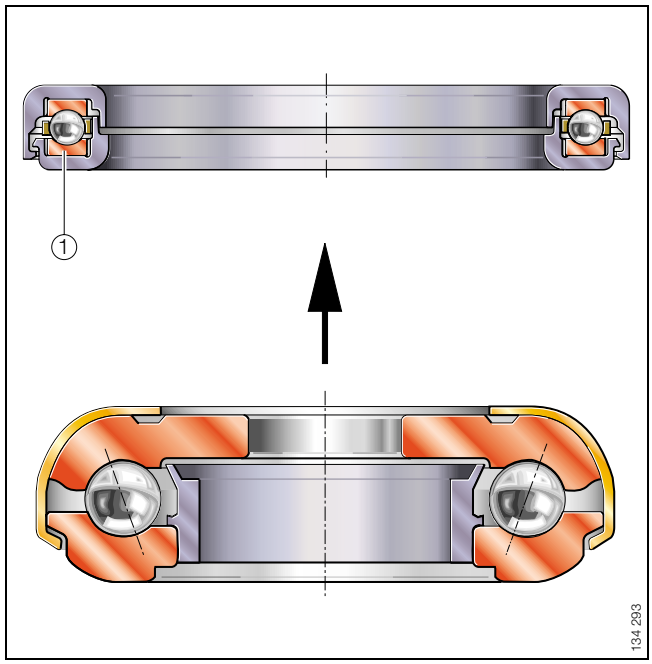

Figure 7 · Design trend

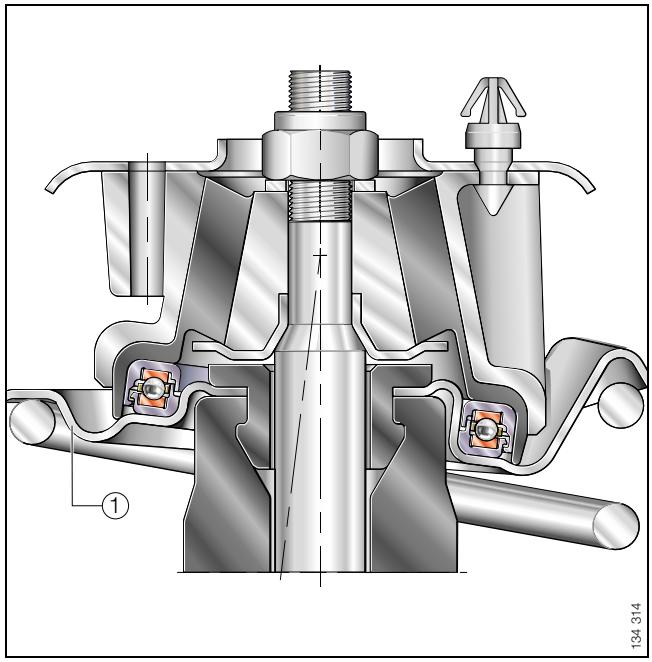

Figure 8 · Spring supported by spring plate – encapsulated suspension strut bearing

Suspension Strut Bearings

Spring supported directly at the bearing housing

The bearing in Figure 9 has a reinforced plastic housing ①. This allows the spring to be supported directly on the bearing without an additional spring plate.

Figure 10 shows a housing with a simulated spring pitch ①. This design is optimized in terms of mounting space and costs.

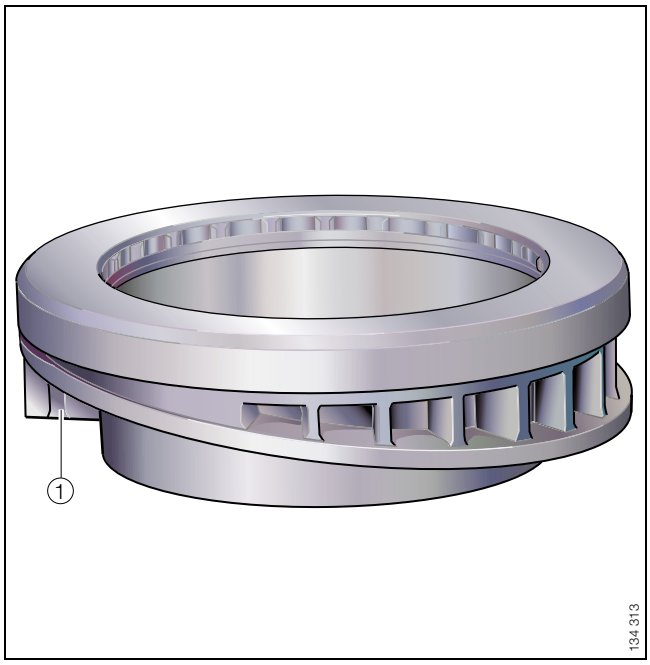

Figure 9 · Suspension strut bearing with reinforced plastic housing

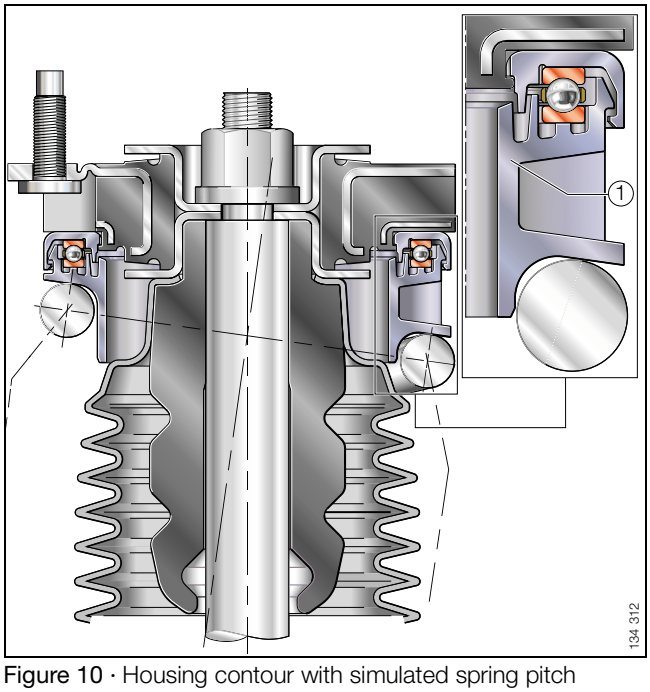

Figure 10 · Housing contour with simulated spring pitch

In this design the spring is also supported directly by the bearing housing (Figure 11).

The housing has extra reinforcement to support the spring and full deflection of impact forces.

Key to Figure 11

① Top mount
② Suspension strut bearing with reinforced housing
③ Bump stop

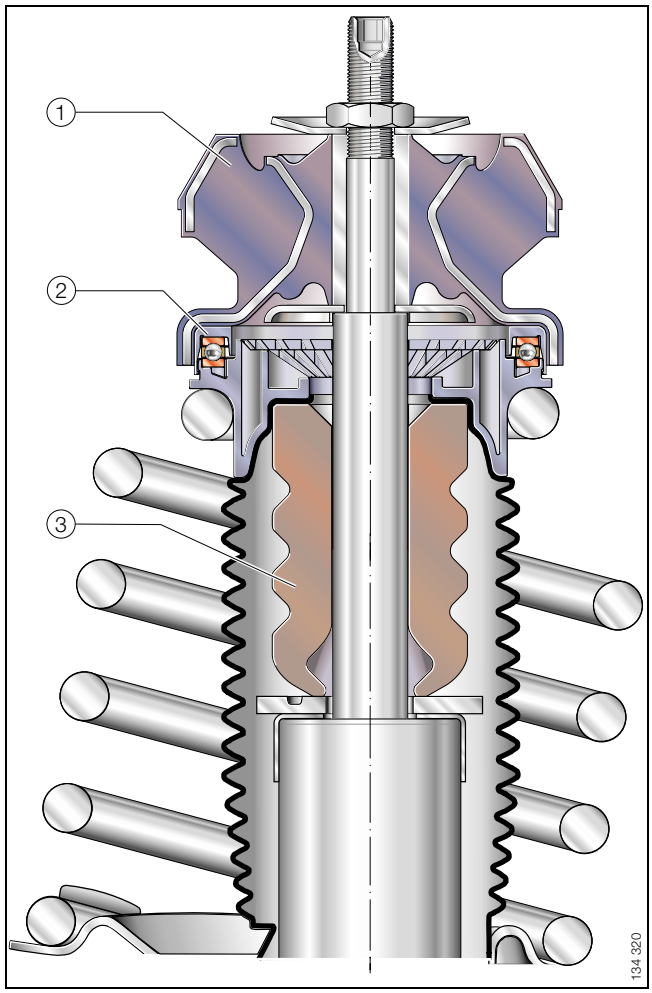

Figure 11 · Reinforced bearing housing capable of supporting spring and full deflection forces

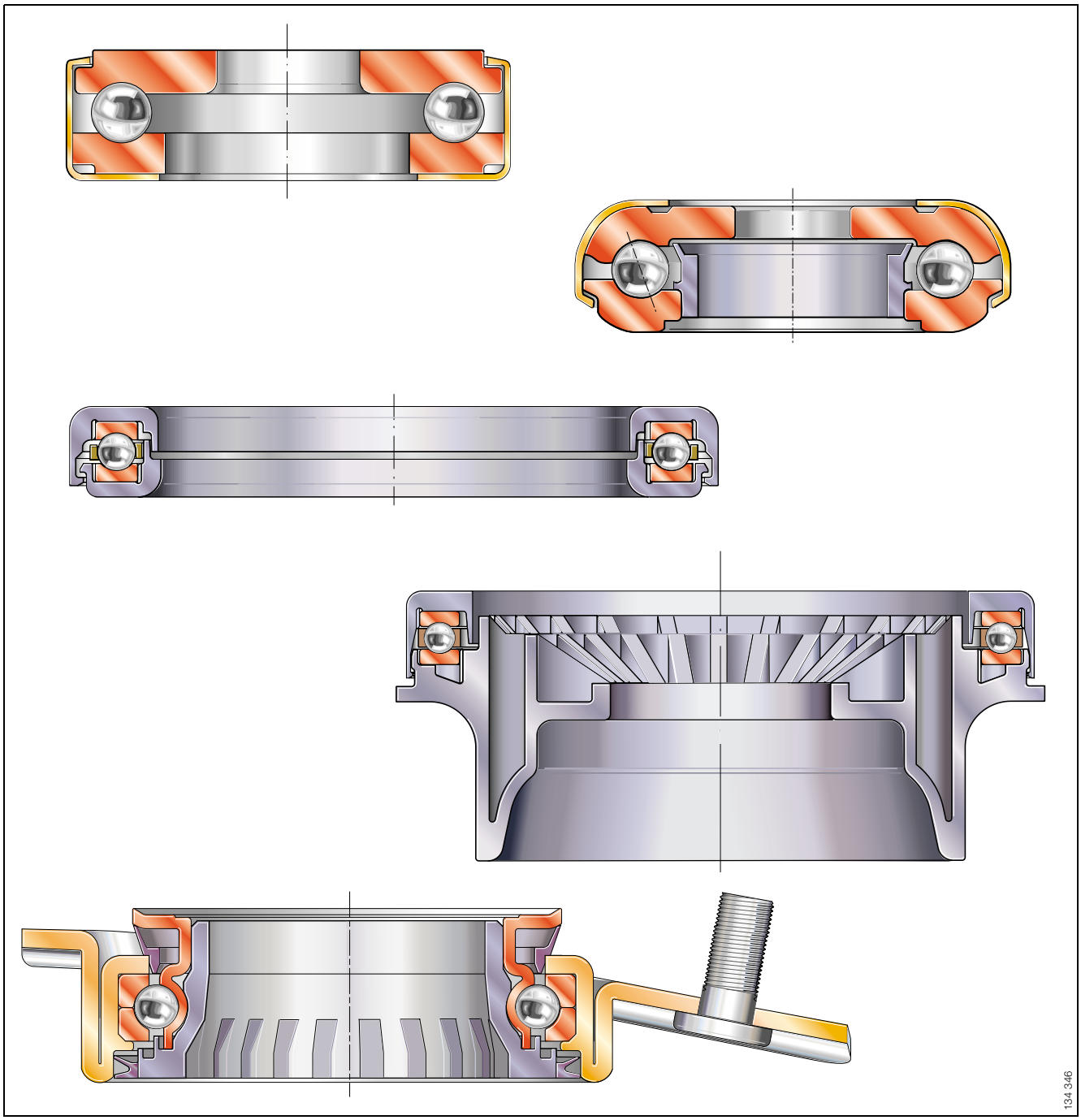

Figure 12 · Suspension strut bearing types

Modern developments in rolling bearing technology would be inconceivable without an FE analysis of the bearing and the adjacent components. The goal in the development of rolling bearings is to achieve the best possible design in terms of rigidity, mounting space, and costs (Figure 13).

For this analysis, the exact load distribution at the interface of the bearing and the shock-absorber spring must be determined.

INA has developed a procedure to determine the forces in relation to the original springs.

Figure 14 shows the measured load distribution on a suspension strut bearing.

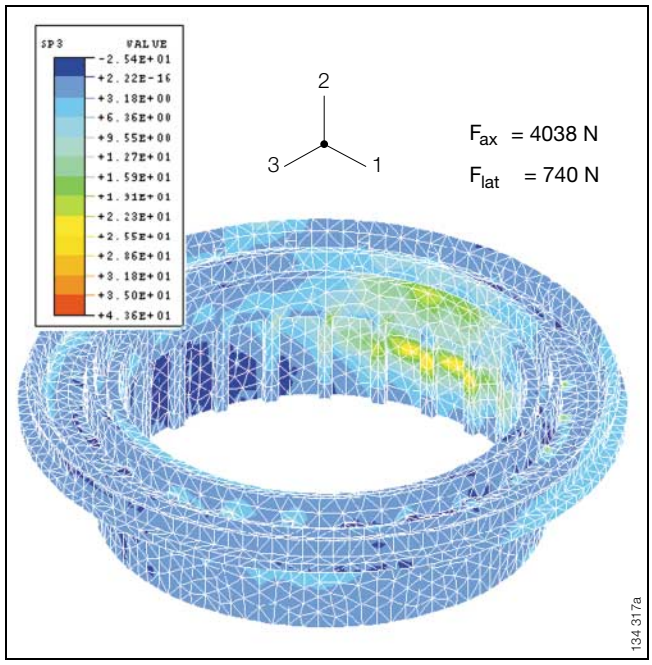

Figure 13 · FE analysis of the bearing housing rigidity

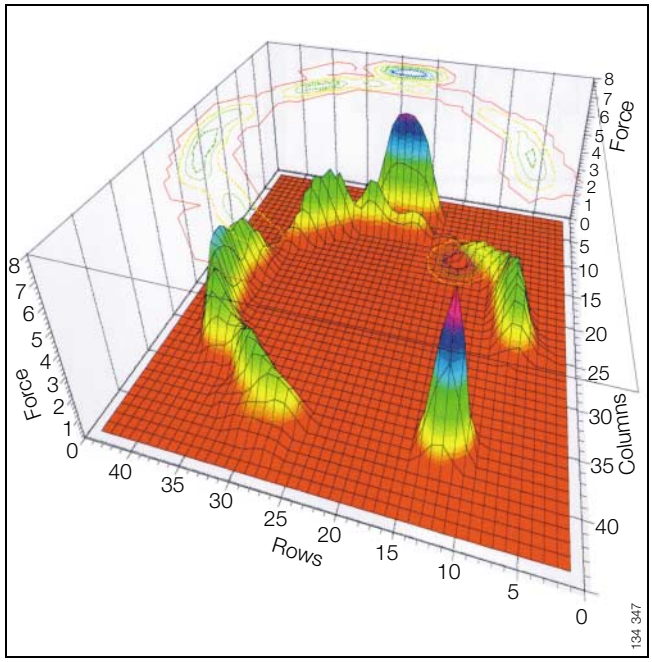

Figure 14 · Load distribution on the suspension strut bearing

Endurance Test Rig

After calculations and design, prototype bearings are subjected to the following tests:

- Frictional torque measurements
- Test of static load carrying capacity
- Endurance tests
- Leak tests

Figure 15 shows the basic type of endurance test rig.

Parameters

- Number of test bearings 2, 4, 6
- Max. oscillating frequency 10 Hz
- Max. pivoting angle 45°
- Max. axial load 8 kN (1 798 lbs.)
- Max. tilting 15°

Measured Variables

- Axial force
- Pivoting angle
- Run time
- Frictional torque

Key to Figure 15

① Disk springs
② Adapter for oscillating drive
③ External bearing seat with angular adapter
④ Tilting of the suspension strut bearing
⑤ Suspension strut bearing

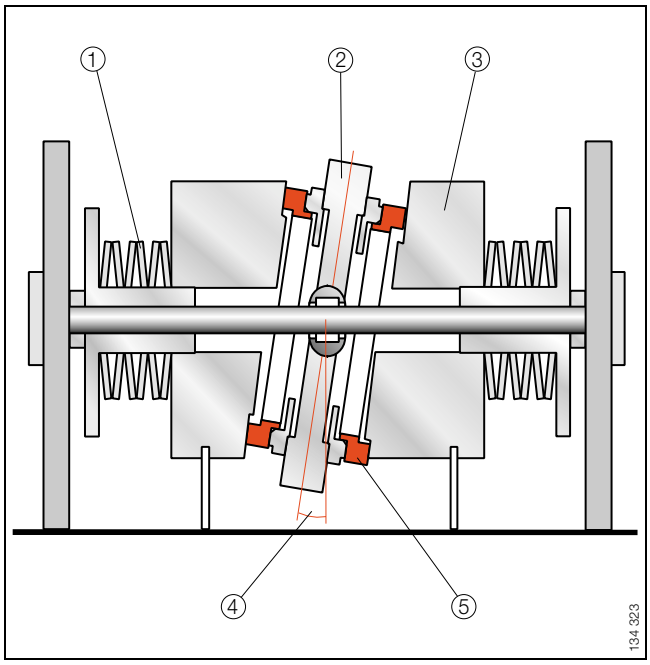

Figure 15 · Endurance test rig

Semidynamic Test Rig

The semidynamic endurance test rig allows the use of original suspension parts:

- Shock-absorber spring
- Top mount plate
- Upper and lower spring plate

The bearing layout and the test cycle simulate bearing operation under virtually identical conditions to those in the vehicle.

Parameters

- Number of test bearings 2, 4, 6
- Max. spring force 15 kN (3 372 lbs.)
- Pivoting angle no restriction
- Max. oscillating frequency 12 Hz

Measured Values

- Axial load
- Frictional torque
- Run time
- Pivoting angle

Key to Figure 16

① Drive belt
② Original spring plate
③ Shock-absorber spring
④ Top mount substitute
⑤ Torque transducer

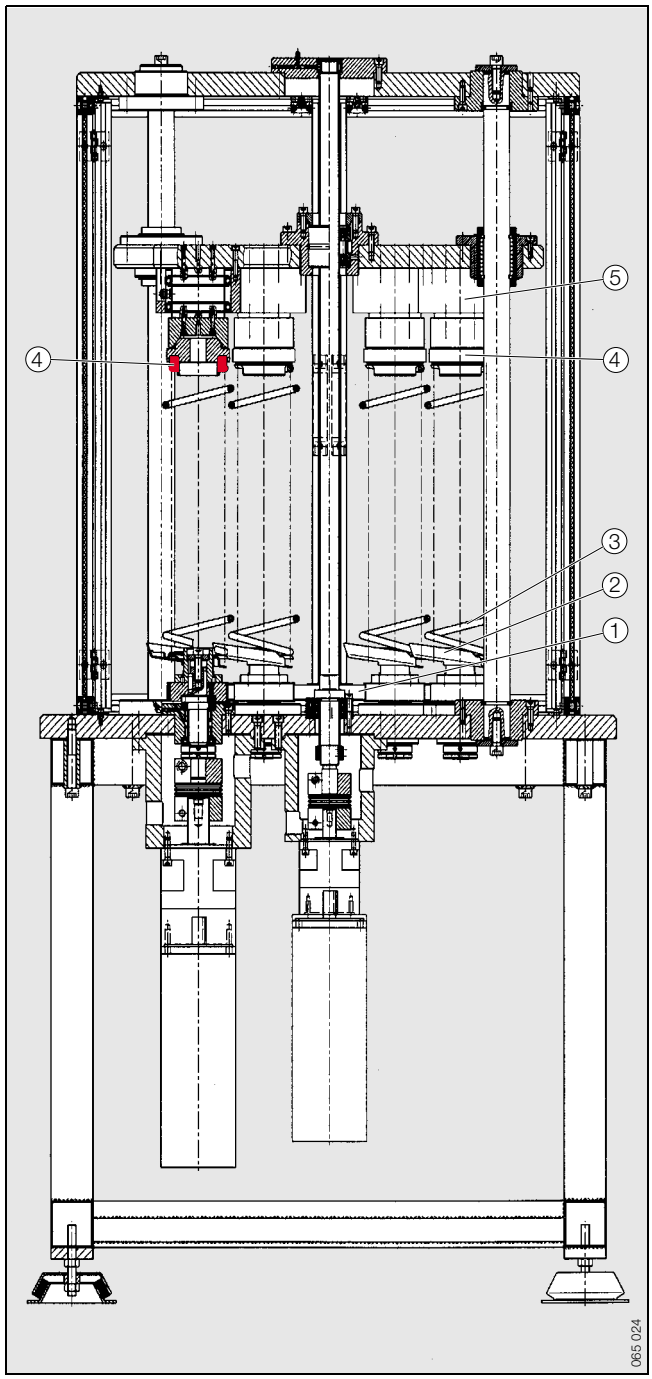

Figure 16 · Semidynamic test rig

Leak Test Rig

This test rig is used to test the effectiveness of the suspension strut bearing seal (Figure 17).

The bearings are sprayed with water or saltwater solution in the test chamber while in motion and under load.

Parameters

- Oscillating frequency 1.5 Hz
- Max. axial load 5 kN (1124 lbs.)
- Pivoting angle 8° to 40°
- Spray cycles programmable dry/saltwater solution

Measured variables

- Frictional torque
- Oscillating frequency
- Corrosion status

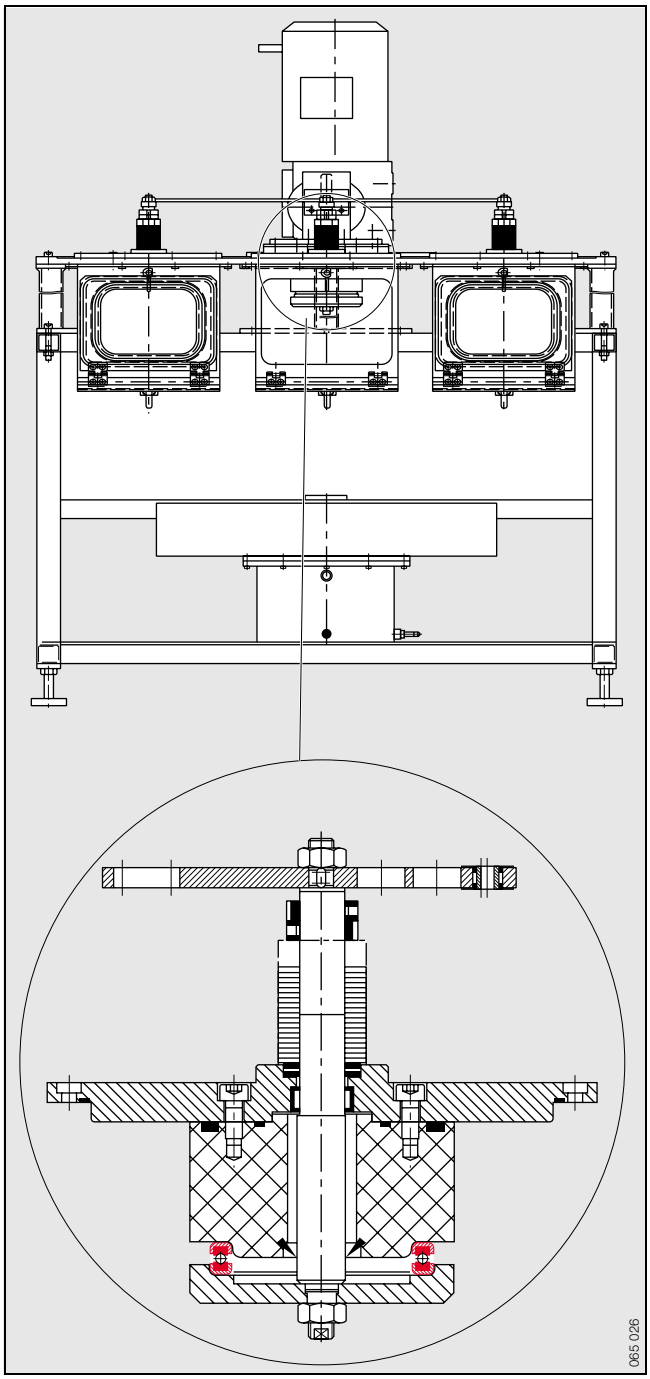

Figure 17 · Leak test rig

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