vessels have 4-stroke diesel motors. The world's largest passenger liners such as the *Queen Mary II* or the *Freedom of the Seas* are driven by diesel engines supported on Zollern plain bearings. The drive does not act directly on the propeller, but on electric motors called POD drives. Via generators, the diesel engines generate the power required for the drive and operation of the entire ship.

Apart from these maritime applications, diesel engines are increasingly in demand in power plant construction. Firstly, they can be used as emergency generators. And secondly, in regenerative hybrid power plants, they can also cover demand peaks or compensate for unfavourable weather conditions (e.g. gales, lulls, water shortages).

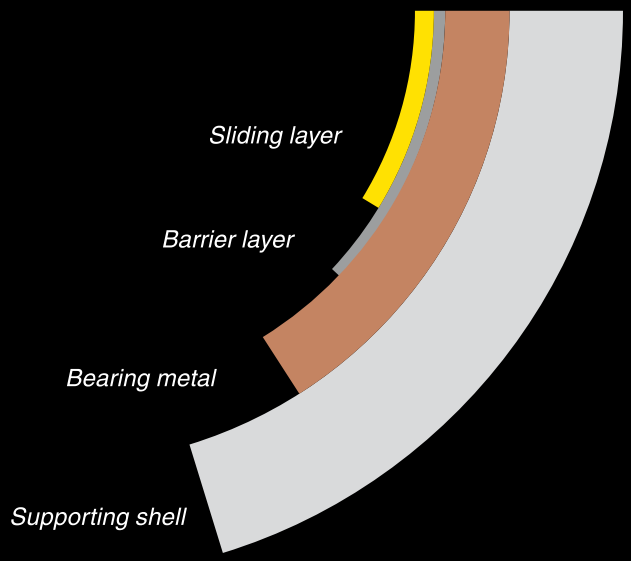
Tilting into balance

The speed of rotation or amount of slide in a bearing directly influences the level of hydrodynamic pressure and in turn the thickness of the lubricant film. At very high speeds, the shaft tends towards the centre of the bearing. This makes the plain bearing dynamically unstable. That's why plain bearings with grooved bearing faces have proved so successful in high-speed applications such as turbo-charged machines and steam and gas turbines. Each of the bearing faces creates its own hydrodynamic pressure which stabilises the rotating shaft against misalignment.

A tilting pad bearing consists of various sections of bearing elements. These are also called bearing jewels or tilting pads. Tilting pads are able to adjust to operating conditions depending on the bearing load and shaft rate of rotation. The possible number of pads varies. Four or five tilting pads are usual in radial bearings. However, there are also versions with 7 or more pads. Axial bearings can have many more tilting pads.

Axial bearings are mostly used in applications with high axial thrust, for instance hydropower turbines weighing several hundred tons or large steam turbines and high-speed gas turbines.

Multilayer composite materials



Because engines and machines are constantly being developed with more and more power, plain bearings must withstand ever higher static and dynamic loads while still achieving longer service lives. These demands can only be met by combining the specific properties of different materials as effectively as possible and by selecting special design principles. The technical solution is a plain bearing made of multilayer composite material. A supporting shell, generally made of steel or cast iron, gives the plain bearing mechanical stability.

In its simplest form, the plain bearing consists of a bimetal, or composite of steel-white metal, steel-bronze or steel-aluminium. The thin layer of bearing metal on the supporting shell provides a much higher static and dynamic load bearing capacity than a single-material bearing. Bimetal plain bearings that have to meet further demands are additionally provided with extra layers of material which are applied by casting, galvanising or other processes. This is how multi-layer composite material plain bearings are made.

Diagram of bearing shell with layers of composite materials