

Drive axles and bearings – Russell Walsh

This discussion follows on the previous Technical Bulletin; Preventing Wheel Loss. It discusses drive axle bearings and their application.

Alive or dead?

From time to time, we often hear of rear, (drive), axles referred to as “fully floating,” but what does mean?

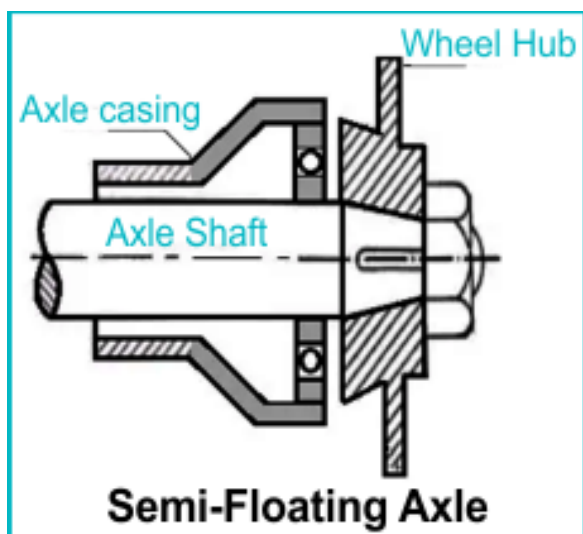
There are two common types of axles, dead and live. Dead axles are ones that do not rotate such as those fitted to trailers, live axles are ones that provide the traction to move the vehicle. Front axles are usually considered to be dead axles although they have the vehicles’ steering connections fitted to them and they may also provide drive such as in a front wheel drive or four-wheel drive. For the purpose of this discussion however we will concentrate on rear, drive axles.

There are three common types of live rear drive axles arrangements, semi floating, three quarter floating and fully floating. Each has unique design characteristics that impact their application.

Note: The descriptions below refer to the end of the axles onto which the road wheels are mounted and transmit the power generated by the vehicle’s engine to the road surface. The inboard end of the axles is supported in the differential by the differential side gears and its bearings. The differential and the axles are often described as the final drive assembly.

Semi-floating axles.

In semi-floating axles the axle shaft protrudes through a bearing that is mounted inside the outboard end of the axle casing, the weight of the vehicle is carried by the axle shaft thus its use in commercial vehicles is limited to light to medium applications. The bearing is held in place by a retainer with a flange on the axle locating the axle as shown below.



Drawing retrieved from <https://testbook.com/mechanical-engineering/types-of-axles>

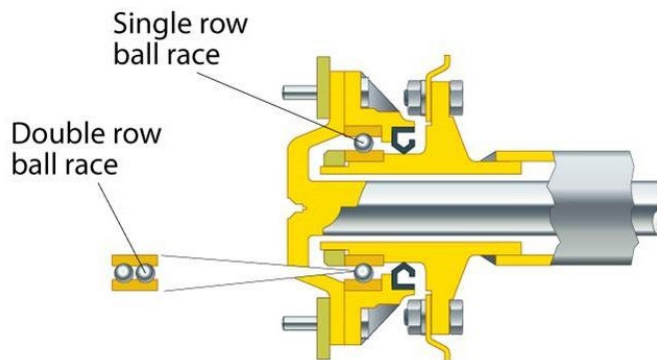
As the weight of the vehicle is supported on the axle, it does make the axle susceptible to cracking and even breaking if it is overloaded. If a breakage occurs this often takes place at the extreme end, outboard of the bearing, resulting in the hub and wheel assembly falling off.

The end of the axle shaft is usually tapered to fit a taper in the wheel hub. A woodruff key is also fitted to facilitate the drive from the axle to the hub. If the axle end nut is not kept tight this can result in movement between the axle, the wheel hub and woodruff key. Excessive movement can result in the woodruff key shearing off and all drive will be lost.

In addition to supporting the vehicle's weight the axle shaft is also subject to the forces of the drive torque transmitted to the road wheels, the retarding forces generated when the brakes are applied, and the side thrust imposed when the vehicle is cornering.

Three-quarter floating axle

These are similar in design to the semi-floating axle however the weight of the vehicle is carried by the axle housing not the axle. This reduces the susceptibility of the axle shaft to overloading and premature failure. The axle shaft however is still subject to driving, retarding and side thrust forces. Axle failure should not result in the wheel and hub assembly departing the vehicle.

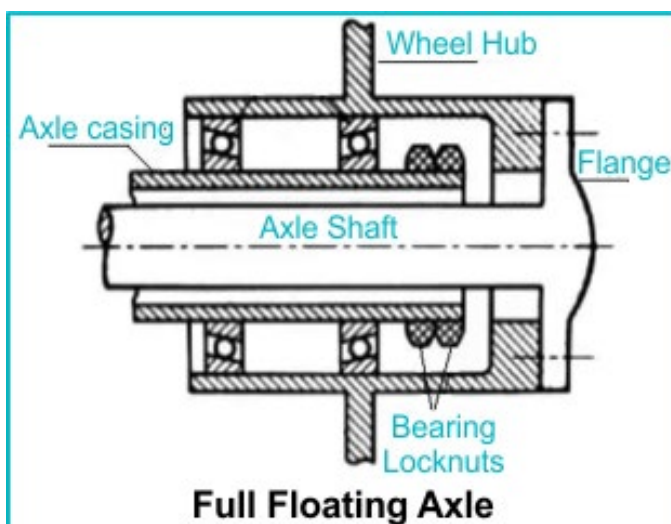


Drawing retrieved from:
<http://www.pearltrees.com/j.taylor/wheel-bearing/id12902013/item128561829>

The primary difference between the semi-floating is three-quarter floating axle is where the weight of the vehicle is taken.

Fully floating axles

The most common drive axle configuration used on heavy commercial vehicles. It is robust by necessity with the axle only susceptible to driving and retarding forces.



Drawing retrieved from
<https://testbook.com/mechanical-engineering/types-of-axles>

This configuration uses two ball or tapered roller bearings positioned between the axle housing and the wheel hub.

The outer end of the axle has a flange which allows it to be bolted to the wheel hub. This supports the outer end of the axle shaft whilst the inner end is supported by the differential side gears.

This axle type can be easily removed without lifting the wheel clear of the ground by removing the nuts securing the axle flange to the hub. Therefore, if it becomes necessary to move the axle shaft for example, if the vehicle needs to be towed without lifting the drive wheel off the ground this can be easily done.

Bearing arrangements

Axle manufacturers select a bearing, or combination of bearings, to suit the intended application whilst providing maximum service life. Under no circumstances should the type of bearing be swapped for another type without first talking to the axle supplier.

Bearing style selected may be:

Single or double row ball



Image retrieved from, [Differences Between Single Row and Double Row Ball Bearings \(slsbearings.com\)](https://www.slsbearings.com)

Taper roller

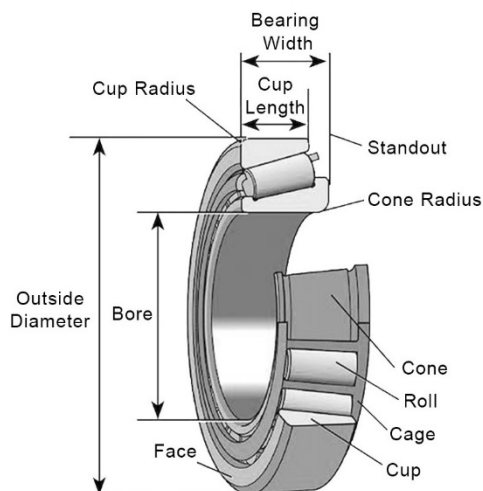


Image retrieved from, [Tapered Roller Bearing vs Spherical Roller Bearing | LILY Bearing \(lily-bearing.com\)](https://www.lily-bearing.com)

Tapered roller bearings are a common bearing style found in fully floating rear axles, they are also commonly used as front wheel bearings and in differentials.

Tapered roller bearings must be assembled and adjusted, pre-loaded, and lubricated according to the manufacturers specifications as failure to do and maintain these requirements can result in premature failure and/or overheating.

Lubrication

Depending on the application rear axle bearings me be lubricated with grease, either pre-packed in the bearing when it is purchased or manually packed before it is fitted. In fully floating axles the bearing may be lubricated by the differential oil. In these cases, it is important that the oil levels are kept at the correct level at all times.

Summary

The types of bearings referred to are made to high standard of precision. Provided they are fitted correctly, are not abused, subjected to excess loading and well lubricated they should give many thousands of kilometres of good service.