Oil, grease and wheel seals

Wheel-bearing failure risks bearing failure and wheel fire. This article discusses the types of wheel seals that are used on heavy trucks and trailers and considers the installation and service requirements that they need. It also tackles that age-old question – oil or grease?

The wheel seal is a critical element, because the bearings will not survive without reliable seal performance. Wheel seals must achieve five functions. One, they must keep the dirt and water out of the hub. Two, they must keep the lubricant inside the hub without substantial leaks. Three, they must allow some in-out movement of the wheel without deterioration. Four, they must resist deterioration due to temperature and lubrication. Five, they must have low rubbing friction, to avoid drag loss and friction heating.

Nearly all truck and trailer axles have a unitised (one-part) seal that needs to be pushed onto the wheel. Some of the features of two designs for unitised wheel seals are shown in Fig. 1. The rubber-ribbed type has the rubbing surfaces internal. It is easier to install and more tolerant of wheel and axle imperfections. The rubbing surfaces are internal and protected. The metal band type has the metal band pushed directly into the wheel. The sealing (rubbing) surfaces are on the axle spindle.

There are two categories of unitised wheel seals – with metal installation surfaces or with ribbed elastomer installation surfaces. The former must be installed with a manufacturer's tool and the latter can be tapped in. The seal has to be installed into the wheel. If the wheel has been damaged when the old seal was removed, you will probably be better off with an elastomer surface seal because it is more tolerant of divots and lifts. Always clean up the hub surfaces gently.

A great seal has multiple sealing points that keep the contaminants on the outside and pumps a minute quantity of lubricant into the seal parts to keep them lubricated. The elastomer part is designed to provide multiple sealing surfaces, trap contaminants and pump water one way and oil the other way. The pumping action can be produced by centrifugal pressures that occur in tapered galleries when the wheel spins.

A great seal also allows internal hub pressure to vent without remaining open to let contaminants in. The most common contamination is water. Don't make life hard for the wheel seal by pressure washing the inside of the wheel and forcing dirt in.

A great seal is easy to install. It is likely to have grooved polymer surfaces on both inner and outer surfaces so that it can be pushed in without requiring an installation tool. Smooth metal ring surfaces do require a push-in tool.

A great seal will also survive the lifespan of the bearings and therefore only need to be changed with the bearings. Everything has to be right to achieve this. In particular,

Fig. 1. Rubber-ribbed type

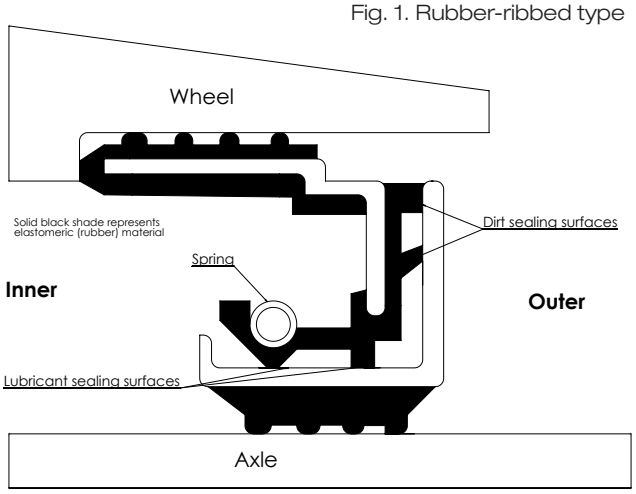
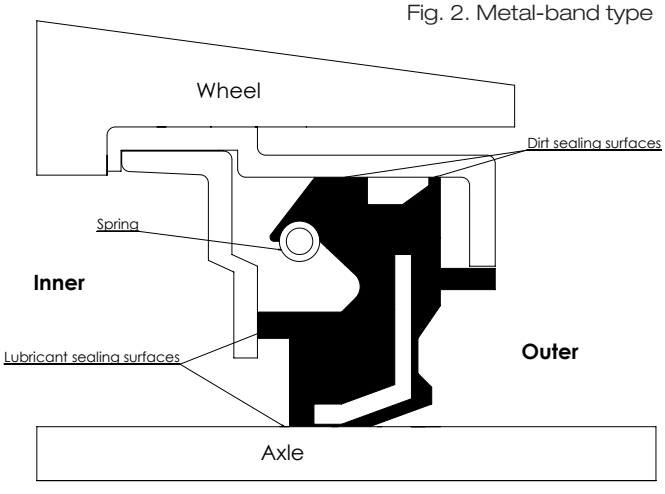


Fig. 2. Metal-band type



advanced elastomer materials that resist temperature and the additives likely to be used in grease and oil are needed. A seal life of 500,000km is a good effort. A surprisingly complex design is needed to achieve this.

The enemies of seal performance are defects on the wheel and axle surfaces, poor initial lubrication of a unitised seal so that the rubbing parts wear out, attack of the seal polymer parts from additives in the lubricant, poor temperature withstand performance of the polymer materials in the seal and excessive heat from close-by disk brakes resulting in deterioration of the seal polymer materials.

Problems with leaking wheel seals have a long history. This has driven axle manufacturers to change from oil-bath lubrication to grease lubrication. Oil gets out where grease doesn't. Leaking seals can result in oil getting into drum brakes, which reduces effectiveness. Oil getting onto the disc of a disc brake runs another risk – fire.

Wheel seals can be used with either grease or oil lubrication of the hub. Grease is more forgiving than oil, but oil provides better lubrication. Oil gets right into the bearing and gets splashed up against the seal. It also leaks out when there is a seal or hub-cap problem.

Seals need to be kept moist. If the vehicle is not used for weeks or months, then the seal on an oil-filled hub could dry out. This is less likely to happen with grease. Grease sticks, but oil runs away.

Impending bearing failure is likely to damage the wheel seal. In an oil-filled hub, the oil will leak out. This can be observed. Oil leaks are like the canary in the coal mine and must not be ignored.

Grease leaks from damaged wheel seals are less likely to be seen, so diligent inspection of greased wheel hubs is a must.

Many drive axles need to be tilted side-to-side to ensure that the differential oil runs into both wheel hubs. If the tilting is not done when the axle oil is changed, then bearing failure and potentially fire due to dragging brakes will result.

Telltale oil-leak marks up close and personal with a brake disc.

Grease does not run but it also doesn't get into the bearing unless it is forced to do so. Careful packing of grease around the bearings is essential. It is a good practice to clean the bearings and repack them whenever the brake shoes are changed. The seal should also be changed.

Seal manufacturers offer three or four different 'quality' seal designs. Why? Price differential. If the seal is changed whenever the brake shoes or pads are changed then maybe a mid-quality seal will be acceptable, because the seal is not worn out when it is changed.

Talking about grease, it starts life as oil – 80–90 per cent of the volume, either mineral or synthetic, which is just highly refined mineral oil with additives. The better the starting oil the better the grease. The oil is there to lubricate.

Then the grease is thickened with a type of soap (a molecule that is soluble in water at one end and oil at the other end) – 10–15 per cent of the volume. Thickener is there to solidify the grease. Lithium-based thickener has traditionally been used but other basic thickeners, usually calcium based, exist. 'Calcium sulphonate' thickeners are preferred but also make the grease more expensive than 'lithium-complex' thickeners.

Additives are used to enhance the properties and make the grease unique – 10–15 per cent of the volume is property-changing 'additive'. Additives are chemicals that are used to deliver high temperature stability, rust inhibition, anti-oxidation and to protect against water ingress that can emulsify the grease and reduce its effectiveness.

In Europe and US conditions, freezing of the grease (or oil) is a serious problem. The anti-freeze additives are not needed here. The Australian challenge is to achieve high temperature resistance and water resistance simultaneously. There is a lot of science in grease. The benefit of getting the right grease is reduced wear levels, increasing service intervals.

Dr Peter Hart
Chairman, ARTSA