

# Effect of tyre pressure difference on bearing and tyre life, and fuel economy, on trailer axles with dual tyres using the Vigia Constant Tyre Inflation system



**TRANSPEC**  
ENGINEERED TO LAST



# Bearing Life

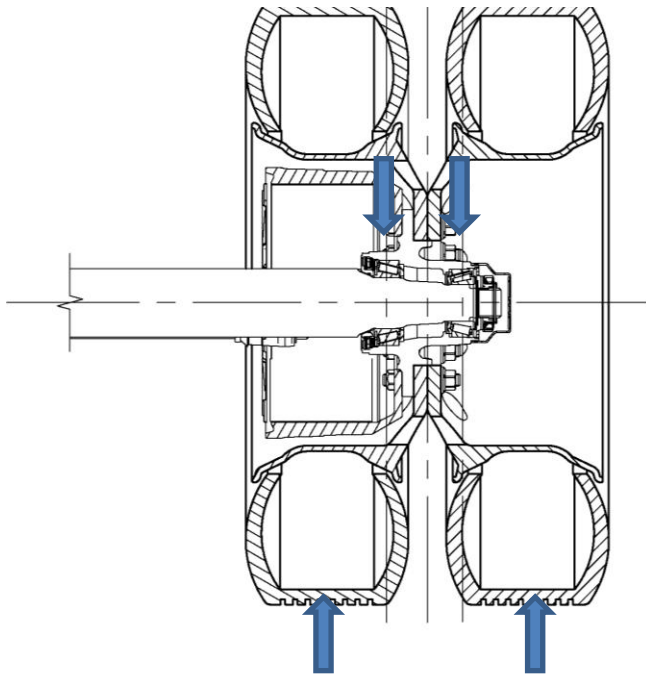
Commonly understood factors that affect bearing life:

- ⦿ load
- ⦿ lubrication
- ⦿ bearing adjustment
- ⦿ ingress of moisture or dirt
- ⦿ mishandling of the bearing

However, a lesser known factor that affects bearing life on axles fitted with dual tyres is the pressure difference between the inner and outer tyre



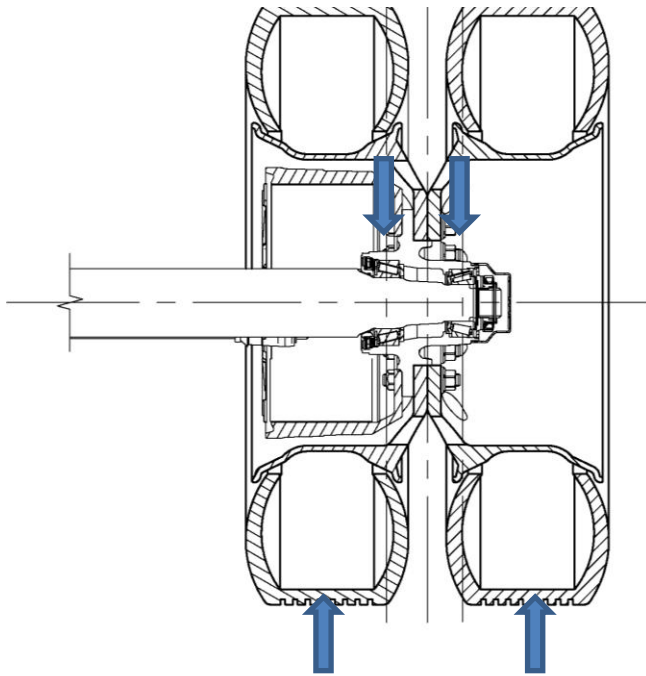
# Bearing Life



With the vehicle travelling in a straight line over a flat road with equal tyre pressure and tyre size, the inner and outer bearing carry the same load as each of the tyres.



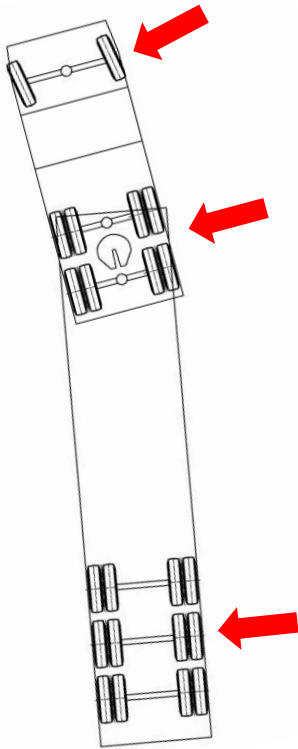
# Bearing Life



Axle designers have empirical experience and theoretical tools to determine bearing life, assuming typical cornering, flat roads, perfect adjustment and lubrication, and equal tyre pressures.



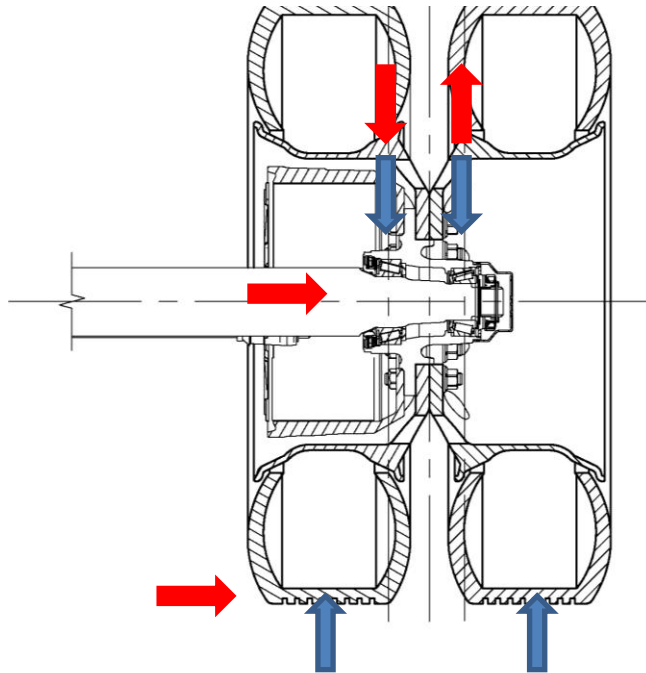
# Cornering



When negotiating a corner there is an additional side load that is applied to the tyre.



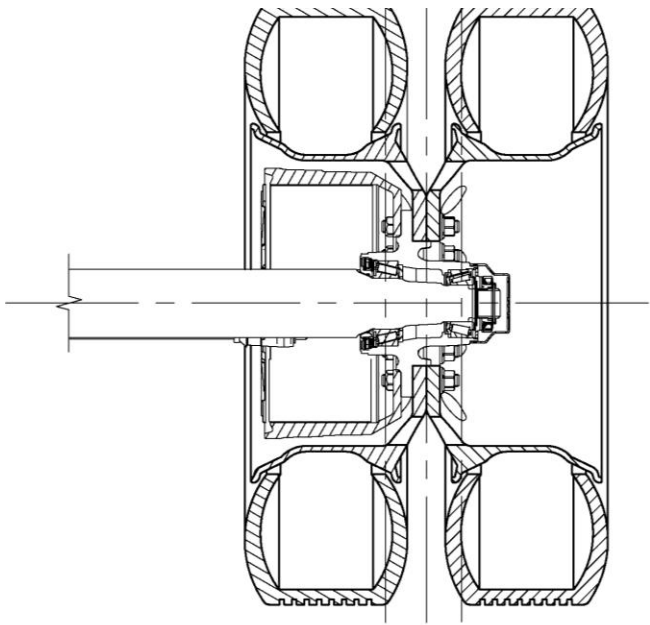
# Cornering



The side force on the tyre when cornering is transmitted through the bearings. The inner bearing has an increased load and the outer bearing has a reduced load.



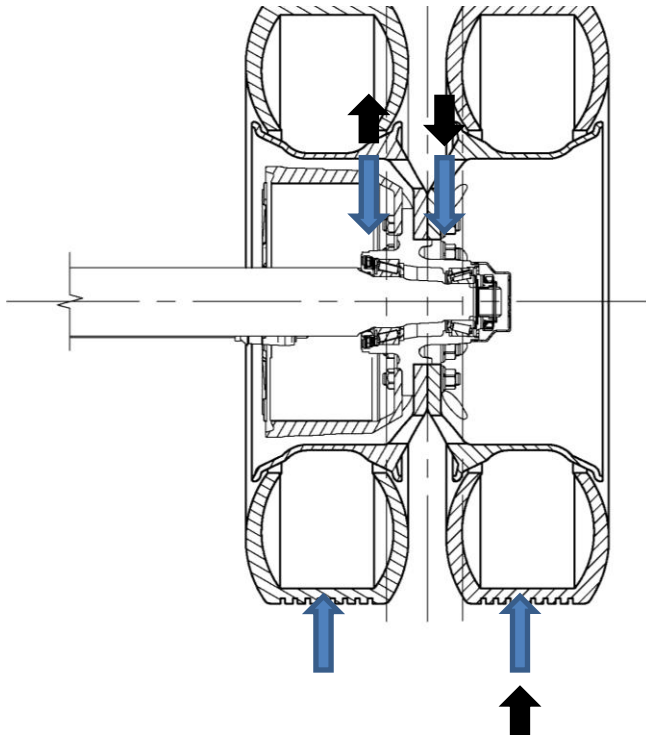
# The effect of tyre pressure difference on bearings



Different tyre pressures between the inner and outer dual tyre has a similar effect to cornering, though with lower forces, but with longer duration.



# The effect of tyre pressure difference on bearings



With the following tyre pressures:

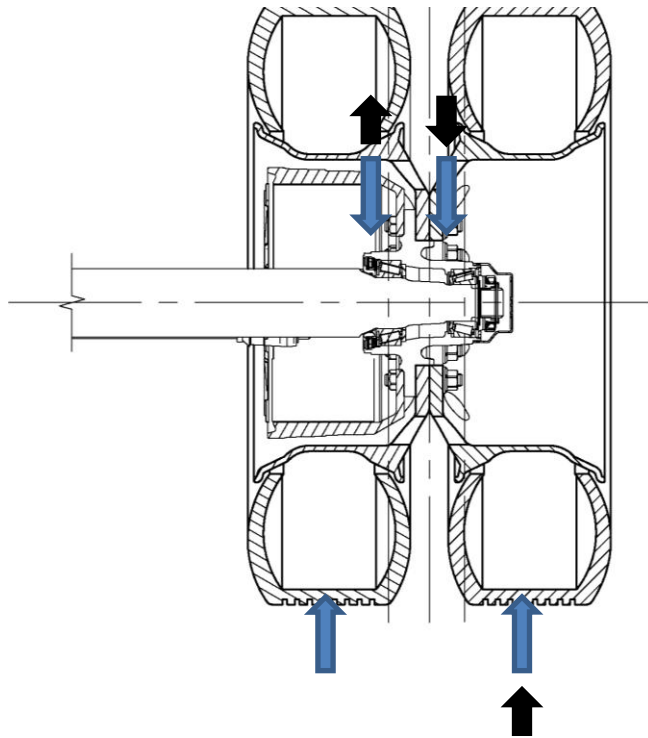
- inside tyre 87psi (6bar)
- outside tyre 92psi (6.3bar)
- a differential of 5psi (0.3bar)

The bearing life is reduced by approx. 10%.





# The effect of tyre pressure difference on bearings



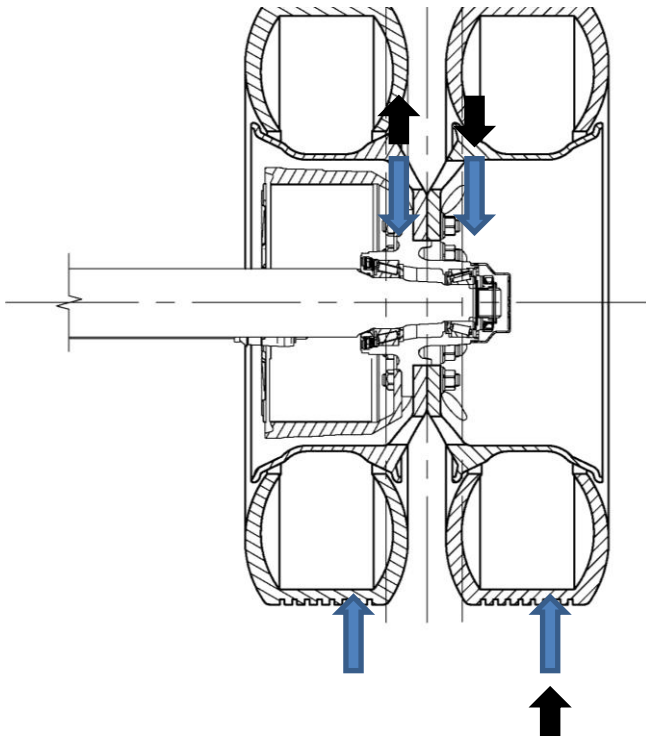
With the following tyre pressures:

- inside tyre 87psi (6bar)
- outside tyre 97psi (6.7bar)
- a differential of 10psi (0.7bar)

The bearing life is reduced by approx. 20%.



# The effect of tyre pressure difference on bearings



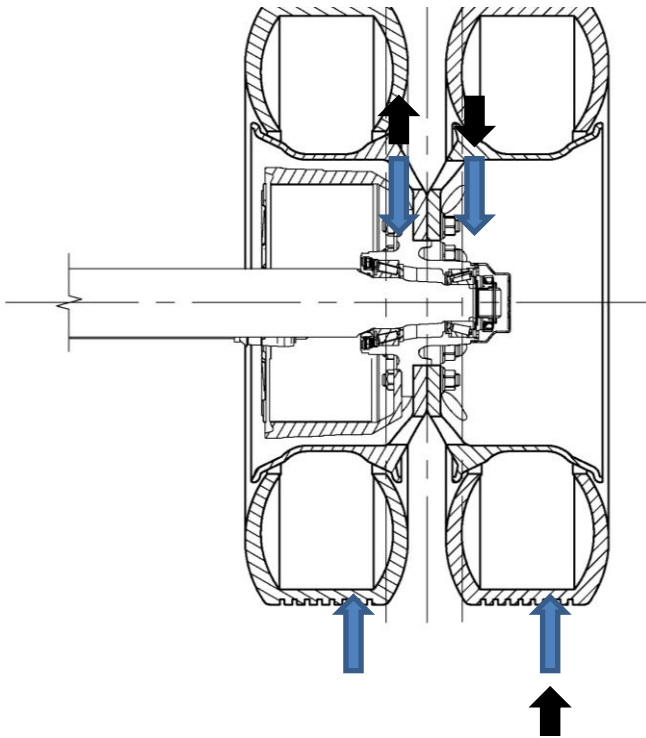
With the following tyre pressures:

- inside tyre 87psi (6bar)
- outside tyre 107psi (7.3bar)
- a differential of 20psi (1.3bar)

The bearing life is reduced by approx. 40%.



# The effect of tyre pressure difference on bearings



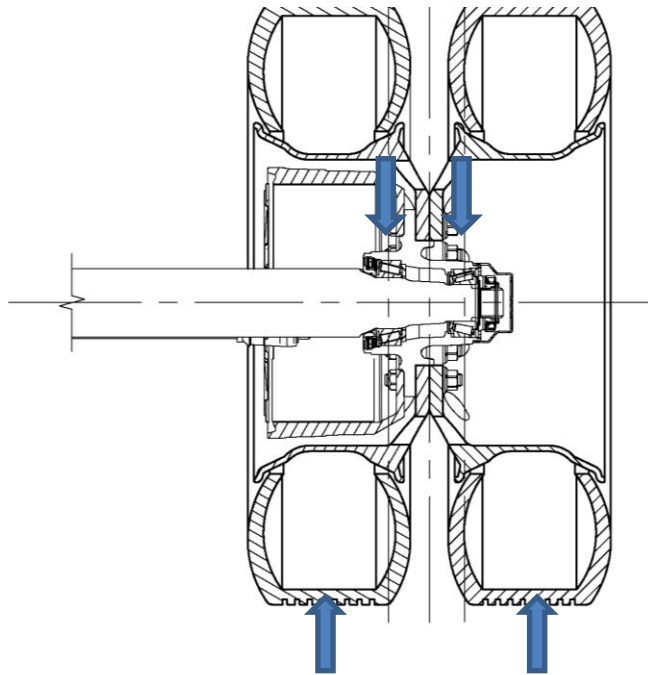
With the following tyre pressures:

- inside tyre 65psi (4.5bar)
- outside tyre 100psi (6.9bar)
- a differential of 35psi (2.4bar)

The bearing life is reduced by approx. 70%.



# The effect of tyre pressure difference on bearings



The 35psi (2.4bar) pressure differential in the last slide has the effect of moving the Load Line Centre from the centre of the two bearings a further 50mm to the outer bearing, a LLC shift of 41%.



# The effect of tyre pressure difference on bearings, tyres and fuel

The result of differential tyre pressure across dual tyres leads to accelerated bearing and lubricant wear, and the effect is cumulative.

Tyre pressure maintenance is important not only for bearing life, but also to increase tyre life and improve fuel economy. The combined result is to help avoid costly breakdowns and control operating costs.



# The effect of tyre pressure difference on Tyres

## Under inflation or overloading leads to:

- ⦿ Larger footprint that causes uneven and fast shoulder wear and affects vehicle handling. Just 20% under inflation reduces tyre life by more than 25%
- ⦿ Increased tyre deflection causes excessive heat build up and an increase in tyre failure due to fatigue
- ⦿ Bead and sidewall separations, deformed and imprinted beads
- ⦿ Reduced re-treadability and repair failure
- ⦿ **Correct inflation leads to optimal tyre life**



Information provided by Bridgestone Tyres Australia



# The effect of tyre pressure difference on Tyres

**Cases where the outside tyre is over inflated to compensate for an under inflated inside tyre can lead to:**

- ⦿ A smaller footprint that will cause uneven and fast centre wear and will reduce traction/ braking force on smooth surfaces e.g. roads, and affect general handling performance, wheel spin (tread cuts) and poor braking. Tyres 20% over inflated reduce the tyres life by 12%
- ⦿ Reduced deflection causes reduced resistance to impact damage and penetrations
- ⦿ Reduced re-treadability and repair failures and the casing being over stressed
- ⦿ An increase in maintenance costs, increased wear to suspension, bearings and other mechanical parts

Information provided by Bridgestone Tyres Australia



# The effect of tyre pressure difference on Tyres

**In cases where there is a 5psi (0.3 bar) pressure differential between the inside and outside standard dual tyres:**

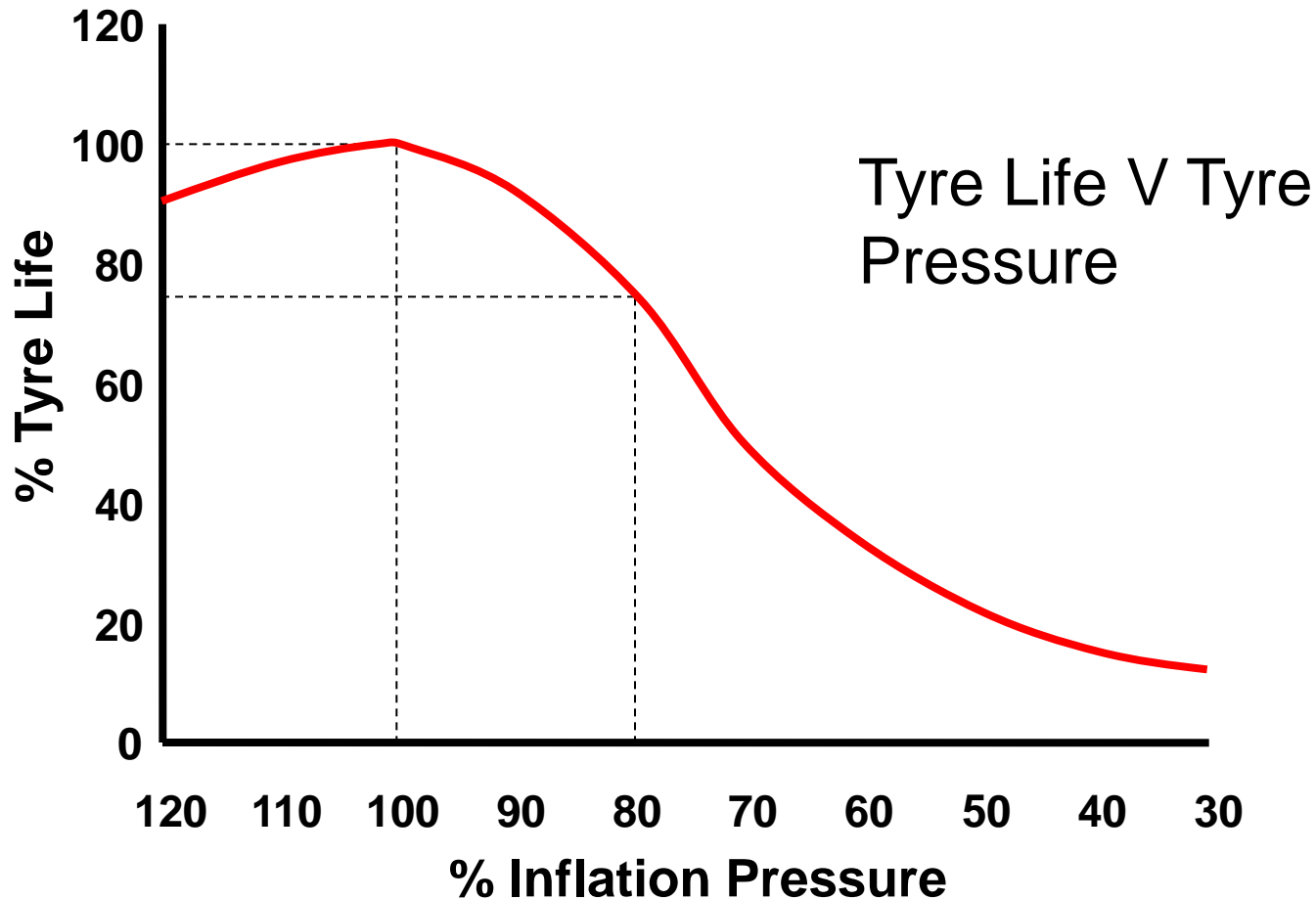
- ⦿ The under inflated tyre will have a circumference that is 8mm less than the correctly inflated tyre, which leads to the larger tyre dragging the smaller tyre
- ⦿ Every kilometre travelled means the under inflated smaller tyre is being dragged 7.4 metres
- ⦿ Over a week covering 4,000kms, the under inflated tyre is dragged 29.6kms
- ⦿ And over a year, more than 1,540kms
- ⦿ The only way to ensure dual tyre sets operate at the same pressure is to “share air” using a Vigia Constant Tyre Inflation System

Information provided by Bridgestone Tyres





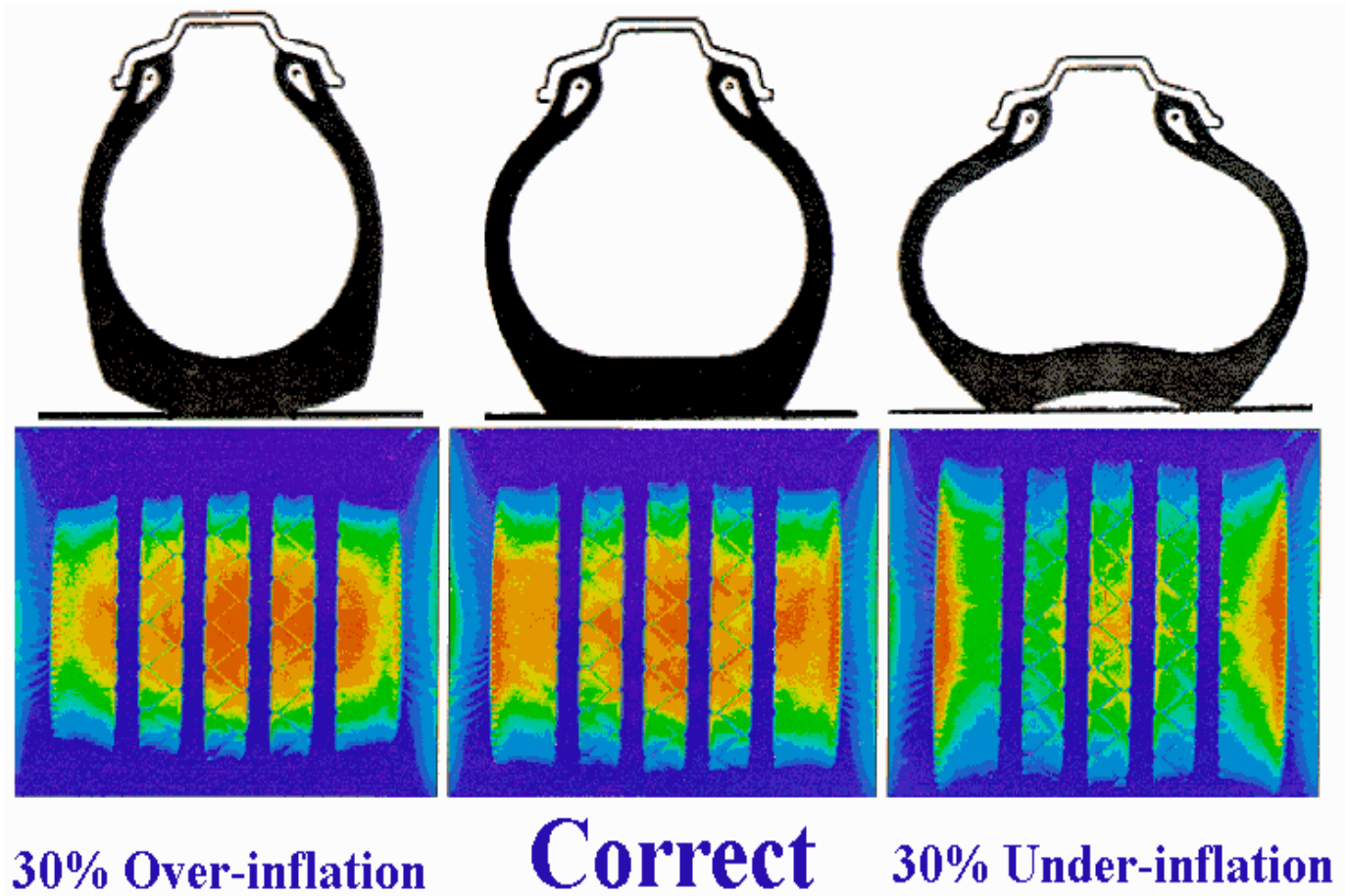
# The effect of tyre pressure difference on Tyres



Information provided by Bridgestone Tyres Australia



# The effect of tyre pressure difference on Tyres



Information provided by Bridgestone Tyres Australia



# The effect of tyre pressure difference on Tyres

## When is a tyre considered Flat?

Due to the extra flexing a tyre can be considered running flat if the tyre is 20% or more under inflated for the load being carried.

<b><u>INFLATION PRESSURE</u></b>						
<b><i>Recommended</i></b>	90	95	100	105	110	120
<b><i>Flat Below</i></b>	72	76	80	84	88	96

*This chart indicates the “flat” threshold for the most common tire inflation pressures. The bottom line indicates 80 percent of the recommended inflation pressure.*

Information provided by Bridgestone Tyres Australia



# The Effect of Tyre Under Inflation on Fuel Consumption

**Studies in the USA have found that a tandem prime mover pulling a tandem trailer with tyres under inflated by 15% increases fuel consumption by up to 2.5%**

- ⦿ Assuming under inflation by 15% travelling 4,000kms per week with fuel consumption of around 1.0 litre per 1.5 kms travelled, the additional weekly cost per combination would be, at least, \$100.00
- ⦿ And over each year each combination would consume an additional \$5,200.00 of fuel
- ⦿ The only way to ensure dual tyre sets operate at the same pressure and reduce fuel consumption is to ensure dual tyres sets “share air” using a Vigia Constant Tyre Inflation System

Information provided by Goodyear USA



# Summary

**The previous slides have shown that correct tyre inflation is important to maximise on the life of wheel bearings and tyres, and improve fuel economy. If we were to calculate the additional operating costs of a triaxle trailer over a distance of 1 million kilometres, based on 4,000kms per week, with a tyre pressure differential (or under inflated) by 20%, it would result in:**

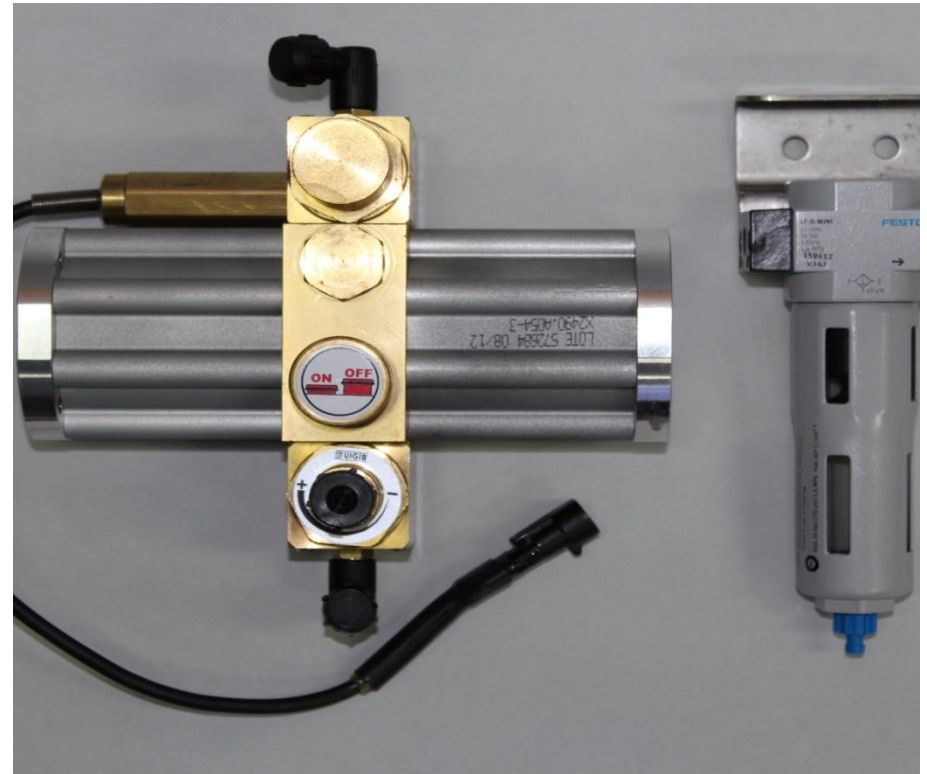
- ⦿ Reduced life of bearings by up to 40% which will add at least \$600 to the operating costs of each trailer
- ⦿ Increased fuel consumption of \$120 per week over 250 weeks, will add, at least, \$30,000 to the operating costs of each trailer
- ⦿ Assuming an average trailer tyre life of 300,000kms (subject to following correct tyre rotation procedures), poor inflation can reduce the tyre life by more than 25%, which will add at least \$2,700 to the operating costs of each trailer
- ⦿ **Therefore, by using the Vigia Constant Tyre Inflation system, operating costs could be conservatively reduced by more than \$33,000 for each standard combination over a distance of 1 million kilometres**



# Constant Tyre Inflation Systems

## Vigia NM247 Mechanical System

- The mechanical system relies on the trailer air to operate a reciprocating piston that elevates the air stored in the trailer air tanks up to a maximum pressure of 175psi (12 bar), if required
- The system is autonomous and does NOT rely on any electric signal from the prime mover
- If the pressure in the trailers air tanks drops to 85psi (5.8 bar), the tyre inflation system is isolated



# Constant Tyre Inflation Systems

## Vigia NM247 Mechanical System

- ⦿ The mechanical system is supplied with grey hoses to the valve stems
- ⦿ When the grey hoses are used, the valve core stays in the valve stem
- ⦿ The hoses are protected from damage by being positioned inside the dish of the rim
- ⦿ If the hoses are cut, a one-way check valve prevents air from escaping from the tyre(s)
- ⦿ The rotary union is fitted with a ceramic valve that has a service life of more than 500,000kms



# Constant Tyre Inflation Systems

- ⦿ Warning (status) light
- ⦿ No light being emitted indicates that everything is operating correctly
- ⦿ Slow yellow blinking light indicates either inflating to required pressure or a slow leak
- ⦿ If the yellow light is constantly on a major leak exists





# Constant Tyre Inflation Systems

- ⦿ BPW axle stub drilling information

