

ROLLING RESISTANCE

In the current commercial vehicle sector, achieving operational efficiency presents significant challenges, primarily due to rising fuel prices, overhead costs, and various operational expenditures. To effectively manage these expenses, it is essential to seek cost-efficient products, minimize overhead, and optimize benefits from operational spending.

On a global scale, fuel expenses constitute approximately 35-50% of a fleet's total costs. Additionally, rolling resistance is a crucial factor in decreasing overall fuel consumption.

Rolling Resistance plays an important role in reducing the overall fuel consumption of the commercial vehicle. What is Rolling Resistance? Let's Learn the subject today !!

What is Rolling Resistance?

- To roll an object, an energy is need to be applied
- In a motor vehicle, energy expenditure dictates fuel consumption.
- Rolling resistance is mainly due to the Visco-elastic properties of the rubber compounds used to make tyres. When being deformed, this type of material dissipates energy in the form of heat.
- When rolling, a tyre is deformed by the load exerted on it, flattening out in the contact patch.

This repeated deformation causes energy loss known as ROLLING RESISTANCE.

Let us take a simple example: -

To move a wheelbarrow forward, A push is needed. In other words, everyone must make an effort. The required effort increases if the load is heavier, if you are pushing it up a steep incline, against the wind or if the wheelbarrow hub has not been greased.

There are four forces which resist the movement of a vehicle or an object:


- **Inertial forces:** which depend on the vehicle's mass and variations in speed.
- **Gravitational forces:** which depend on the slope and mass.
- **Aerodynamic forces:** which depend on the wind, the speed of movement and the vehicle's shape,
- **The internal friction of rotating parts.**

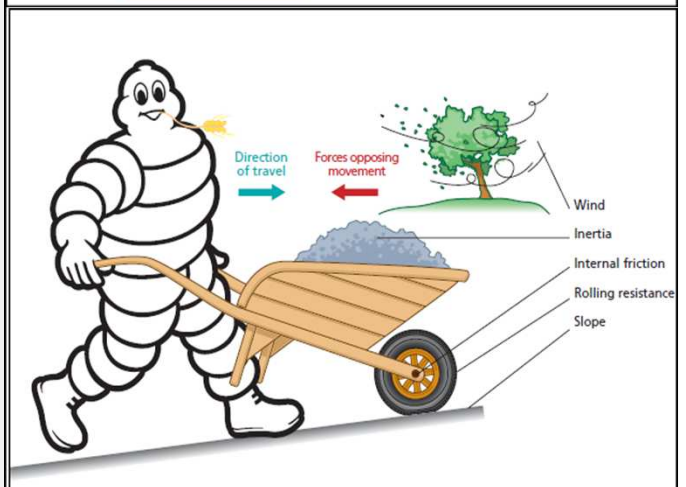
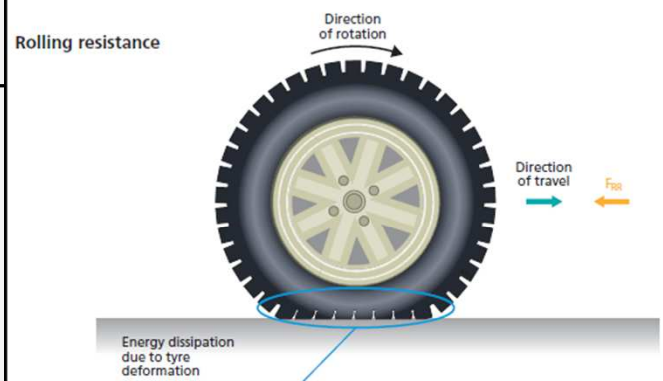
The effort to be made also depends on the ground and the wheelbarrow wheel. We all know that it is easier to push a wheelbarrow over hard ground than over soft ground. Similarly, a wheelbarrow with a metal-rimmed wheel or a properly inflated pneumatic tyre is easier to push than one with an under-inflated tyre(as shown in right pic).

The fifth resistive force comes in: ROLLING RESISTANCE

Rolling resistance is defined as the energy consumed by a tyre per unit of distance covered ⁽¹⁾.

Rolling resistance can only be overcome by expending energy.

 In the case of a motor vehicle, the energy is supplied by fuel. Rolling resistance thus has a direct effect on fuel consumption.



WHAT IS ROLLING RESISTANCE OF TYRES AND ITS MECHANISM



Rolling resistance of tyres refers to the force that resists the motion of a tyre as it rolls over a surface. It is caused by the deformation of the tyre as it makes contact with the ground, as well as the energy lost due to the friction with contact surfaces like road and wheel rim. Here's a more detailed breakdown of the factors involved:

1. Deformation: As the tyre rolls, the contact patch (the area where the tyre touches the road) constantly deforms. The rubber compresses as it makes contact with the ground, and then it rebounds as it leaves the ground. This deformation requires energy, which contributes to rolling resistance.

tyre flattening in the contact patch causes three main kinds of deformation:

Bending of the crown, the sidewalls and the bead area.

Compression of the tread. **Shearing** of the tread and sidewalls.



2. Friction: tyre during rolling tries to maintain contact with wheel rim and road surface, and as wheel rim and road surface are not part of tyre, they exert frictional forces on each other.

3. tyre Pressure: Under-inflated tyres cause more deformation of the rubber, which increases rolling resistance. Proper tyre inflation helps maintain a more efficient shape, reducing the resistance.

4. tyre Composition: Different materials in the tyre, such as the rubber compounds, can affect the amount of energy lost. tyres designed for low rolling resistance often use materials that reduce internal losses.

5. Road Surface: The type of road also affects rolling resistance. Smooth roads will

generate less rolling resistance than rough or uneven surfaces, as rough surface deforms the tyre more making in contact patch.

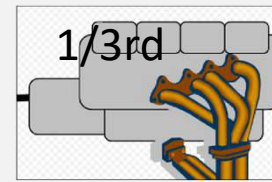
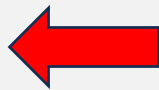


HOW LOW ROLLING RESISTANCE HELPS TO SAVE FUEL



Rolling resistance affects fuel consumption in the same way as natural phenomena like wind, slope and vehicle inertia, which must be overcome in order to move. On the other side, Fuel is consumed by ENGINE on the requirement of driving and other four forces of resistance.

tyres with high rolling resistance cause the engine to work harder to overcome that resistance, which uses more fuel. 1/3rd fuel consumed by the engine is due to the rolling resistance of the tyre.



On an average in truck tyres, if rolling resistance is reduced by 20%, it can save fuel 5-8%.

Significant fuel savings can be made by using tyres with low rolling resistance, which is important both for the economy and the environment.

Lower rolling resistance means less energy is lost to heat and deformation, which translates to better efficiency.

Truck and bus operators are increasingly concerned with reducing fuel consumption and carbon emissions.

tyres with lower rolling resistance can lead to:

- **Improved Fuel Economy:** Even small reductions in rolling resistance can significantly reduce fuel consumption, especially in vehicles that travel long distances.
- **Lower Carbon Emissions:** By improving fuel efficiency, lower rolling resistance tyres help reduce greenhouse gas emissions, which is important for meeting environmental regulations.

C3 tyres		
	RRC in kg/t	Energy efficiency class
A	RRC ≤ 4,0	A
B	4,1 ≤ RRC ≤ 5,0	B
C	5,1 ≤ RRC ≤ 6,0	C
D	6,1 ≤ RRC ≤ 7,0	D
E	7,1 ≤ RRC ≤ 8,0	E
F	RRC ≥ 8,1	F
G	Empty	G

In truck and bus tyres, rolling resistance is mainly affected by the tyre's load-bearing capacity or dimension, construction, inflation, tread design and material. While lower rolling resistance improves fuel efficiency, the tyre also needs to balance durability, safety, and traction. Maintaining proper tyre pressure and using the right tyre type for the job is essential to optimizing rolling resistance with tyre life and achieving cost-effective and environmentally friendly operation.

NOTE:- Its Contribution depends on multiple parameters, such as the type of trip, the type of driving, the vehicle's characteristics and engine efficiency.