How Does Ride-On Help to Reduce Vibrations?

This is one of the most common questions asked by our distributors and customers. Without getting too technical, this White Paper is an attempt to describe the forces generated by spinning bodies (i.e., tires spinning around the axis), the effect upon the tire, and, in turn, on the Ride-On sealant inside the tire.

First a few definitions:

Centrifugal force (from Latin centrum "center" and fugere "to flee") is a term which may refer to two different forces which are related to rotation. Both of them are oriented away from the axis of rotation, but the object on which they are exerted differs.

Force which is oriented toward the axis of rotation is called a centripetal force.

Centrifugal force is an outward force on a body rotating about an axis, assumed equal and opposite to the centripetal force and postulated to account for the phenomena seen by an observer in the rotating body.

A **real** or "**reactive**" centrifugal force occurs in reaction to centripetal acceleration acting on a mass. This centrifugal force is equal in magnitude to the centripetal force, directed away from the center of rotation, and is exerted by the rotating object upon the object which imposes the centripetal acceleration in accordance with Newton's Third Law of Motion.

Centripetal force and centrifugal force is the action-reaction force pair associated with circular motion. According to Newton's First Law of Motion, a moving body travels along a straight path with constant speed (has constant velocity) unless it is acted upon by an outside force. For circular motion to occur there must be a constant force acting on a body, pushing it toward the center of the circular path. This force is the centripetal (“center-seeking”) force. For a planet orbiting the sun, the force is gravitational; for an object twirled on a string, the force is mechanical; for an electron orbiting an atom, it is electrical. The magnitude F of the centripetal force is equal to the mass m of the body times its velocity squared v 2 divided by the radius r of its path: F=mv2/r. According to Newton's Third Law of Motion, for every action there is an equal and opposite reaction. The centripetal force, the action, is balanced by a reaction force, the centrifugal (“center-fleeing”) force. The two forces are equal in magnitude and opposite in direction. The centrifugal force does not act on the body in motion; the only force acting on the body in motion is the centripetal force. The centrifugal force acts on the source of the centripetal force to displace it radially from the center of the path. Thus, in twirling a mass on a string, the centripetal force transmitted by the string pulls in on the mass to keep it in its circular path, while the centrifugal force transmitted by the string pulls outward on its point of attachment at the center of the path. The centrifugal force is often mistakenly thought to cause a body to fly out of its circular path when it is released; rather, it is the removal of the centripetal force that allows the body to travel in a straight line as required by Newton's First Law.

Newton's Third Law of Motion: For every action, there is an equal and opposite reaction.

How does this all apply to balancing with Ride-On?

In a perfect world where all tires and wheels are perfectly balanced, a spinning wheel and tire will have equal centrifugal and centripetal forces all the way around the tire. Thus balancing of the two counteracting forces would give the rider a nice smooth ride, and allow the tires to wear evenly (providing there were no problems with the alignment of the vehicle).

Since we do not live in a perfect world, all wheels and tires available to the mass market have imperfections that cause an uneven distribution of weight around the perimeter of the wheel and tire.

Conventional lead weight balancing attempts to balance the forces by the placement of a lead weight fastened to the wheel which compensates for a heavy spot on the opposite side (180 degrees) of the wheel and tire. This solves the problem for a while until the wearing of the tire (over the course of

several thousand miles or kilometers) creates another heavy or light spot somewhere else on the perimeter of the tire and necessitates another balancing of the tire-wheel assembly to correct the new imbalance.

How this applies to tires and wheels and to Ride-On is as follows:
When a tire is spinning, centripetal force is created. The centripetal force (the inward force towards the axle) is in balance with the centrifugal force that is going outwards radially away from the spinning axle.

If there is an imbalance in the tire and wheel assembly in the form of a heavy spot on the tire or wheel, it creates an increase in the centripetal force at the heavy spot. Since both the centripetal and the centrifugal forces have to be in balance (Newton's Third Law), the excess centripetal force created by the heavy spot of the tire exerts a directional force on the Ride-On gel inside the tire. Ride-On tire sealants have been specially formulated to be able to move inside the tire and not only seal the liner but also be a force cancelling mass to help reduce vibrations. In this instance, the Ride-On tire sealant attempts to correct the imbalance by sliding internally to the opposite side of the place of static imbalance and counteracting it to balance out the forces. This is called hydrodynamic balancing.

The Ride-On tire sealant is a unique tire sealant gel that is formulated as a pseudoplastic. This means that Ride-On responds to shearing (gravitational) forces created by the spinning tire by reducing viscosity. This reduced viscosity allows Ride-On to move and readjust its position inside the tire in response to the centrifugal and centripetal forces that have been placed upon it. Once the shear forces have been removed (in other words, the tire stops spinning), Ride-On instantaneously regains its viscosity and gel quality. This allows it to stay in place and not drip and drop down to the bottom of the tire.

With Ride-On in your tires, the problem of having to rebalance your tires goes away. As you drive, the sealant is sensing the forces created by the spinning tire and the gel makes adjustments from inside the tire to balance out the centripetal and centrifugal forces.