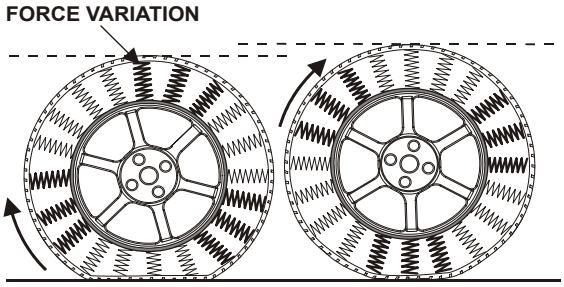
What is GSP9700 Road Force Measurement™?

Loaded Truth on Tire Force and Runout Measurement to Solve Vibrations

GSP9700 Road Force Measurement™ (a roller turning against a tire under high load) accurately locates and quantifies the forces in the wheel/tire that cause non-balance related vibration and radial tire-pull complaints. The combined effects of geometric (eccentricity) and constructional (hidden internal) related issues can be measured only if a load is placed against the tire during measurement. It is the most effective way to quantify the effect of all items in a tire and wheel contributing to non-uniformity of the assembly. Loaded (force) measurement has been the accepted industrial standard used by tire and vehicle manufacturers for over 20 years.

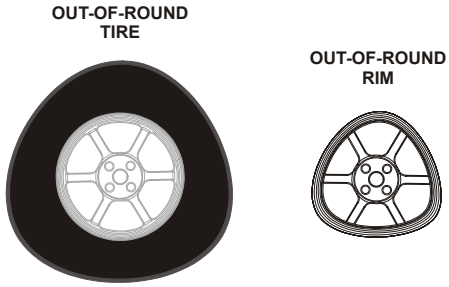


Tire Related Forces Are Revealed Only When Testing Under Load

Road Force Measurement is displayed in pound force (Lbs.), kilogram force (Kg.) or Newton (N). There are two major components analyzed during Road Force Measurement that contribute to the total non-uniformity of a tire and wheel assembly: (1) Loaded Runout Measurement and (2) Tire Stiffness Measurement.

Road Force Measurement uniquely combines loaded runout (eccentricity) measurement of the tire-wheel with the effects of the tire's overall stiffness. Eccentricity, when stated in terms of runout alone, does not quantify the actual force because the force is dependent on the stiffness of the tire being measured. Runout does not necessarily create the same force from tire to tire. For example, two tires with the same runout will differ in their ability to create vibration when a stiff tire sidewall is compared to a similar tire with soft sidewall. The stiffness of the tire will reduce or increase the eccentricity of the assembly when rolling under load.

Runout Measurement is a distance measurement, not a force. Runout is traditionally measured in thousandths of inches (0.000") or hundredths of millimeters (0.00mm). Runout can be measured in an unloaded/free state or loaded "road test" condition. Runout measurement of a tire is a compromise compared to calculating forces and is not as effective when diagnosing vibration problems. Runout measurement in a loaded "road test" condition is faster than unloaded runout measurement, however it is not as effective as calculating the Road Force since the stiffness effect of the tire are not taken into consideration.



Runout (Eccentricity) is Only Part of the Vibration Measurement Needed

Loaded Runout Measurement on a tire is accomplished with a loaded roller placed against the footprint. The load roller performs a 'simulated' road test but differs from Road Force Measurement because tire stiffness is not measured. Loaded runout is the most effective method of runout measurement that samples the entire tire footprint. Measuring the tire footprint with a loaded roller is unlike any form of tread sampling with unloaded runout. The tire under load is tested in a similar manner as it is driven on the road. A loaded runout test is faster than single area sampling and automatically averages the runout of the tire footprint. A tire is compressible and therefore loaded runout measurement is a preferred method over unloaded runout.

Unloaded Runout Measurement is a good choice when measuring a non-compressible object such as a wheel. The best way to measure a wheel is to average the runout of bead seats. Unloaded runout of a tire is the least preferred method to quantify vibration issues. Unloaded runout involves measuring a small area of the tire such as the center rib. Usually the center area of the tire is used because unloaded runout measurement has been proven to be different at various spots across the tread. The problem with center tire measurement is that measuring in the center tread area has the least influence on the actual forces transmitted to the vehicle. It's logical that unloaded runout at the center tread area completely flattens against the road as the tire rolls. This is why unloaded runout is the least preferred method to quantify vibration problems. The wider the aspect ratio the less any runout in this area will be felt...it's the sidewall stiffness variation that transmits to the chassis. Furthermore, tire sidewall variations and hidden constructional issues in the tire are not taken into consideration when unloaded runout is measured. Unloaded runout measurement can not indicate how much force is being created as a result of the runout since the tire stiffness can not be measured. Tire shoulders and other areas not measured may amplify or diminish the runout (and forces) when measured under load.

In Summary:

Force

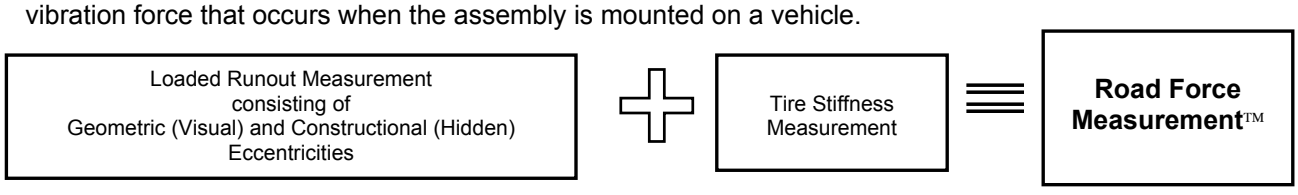
The forces generated by a tire and wheel must be measured by placing a tire under load. Tire stiffness also plays a role in force calculations since this amplifies or diminishes the vibration effects of the runout measured. Road Force Measurement™ uses loaded runout and tire stiffness measurements to calculate the actual force created by the loaded runout alone. For example, two tires with the same runout will differ in their ability to create vibration when a stiff tire sidewall is compared to a similar sized tire with a soft sidewall.

Runout

* Loaded –Eccentricity measurement with a loaded roller measures is a faster and more accurate sampling and representation of the average overall runout of the tire. The shoulder areas and sidewalls of the tire contribute greatly to vibration potential and are also sampled simultaneously. This is superior than non-contact unloaded eccentricity measurement at isolated areas on the tire.
* Unloaded - Tire runout measurement is problematic and limited in use since the tire has spring rate and is compressible. Non-contact runout is limited and not as repeatable since typically small areas of the tire face are measured. In most cases, non-contact, unloaded runout is used on tires for visual related issues and is not the best measurement choice to estimate vibration-causing eccentricities. A wheel is not compressible in the same manner as a tire and therefore unloaded runout is acceptable. The best wheel measurement for vibration-causing eccentricities provides two measurements taken at or near the bead seat area. The two measurements are vector averaged to find the true low-point average of the tire bead seat areas of the rim.

Important:

Runout measurement alone diminishes the ability to solve tire related vibration complaints. Unloaded tire runout ignores (a) constructional forces hidden inside the tire, (b) sidewall stiffness and 'spring rate' contributions and (c) it samples isolated areas of the tire instead of the entire footprint. Locating non-balance related vibration issues might very well diminish to a "game of chance". As a result, the best possible ride quality is diminished and repair time increases in frequency.
The GSP9700 measures loaded runout and tire stiffness simultaneously...so you know the magnitude of the vibration force that occurs when the assembly is mounted on a vehicle.



Now…here's the rub. Some "diagnostic" wheel balancers only measure runout, while others only use unloaded runout. Don't confuse runout measurement with Road Force Measurement. They are not the same. Sure, knowing runout can be handy at times and without better equipment it is better than no information at all… but what you really need to know is, does the runout create an excessive force when loaded? Is the runout sufficient to cause a vibration complaint? Make the right equipment decisions by understanding the benefits of loaded tire measurement.