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FIRESTONE INDUSTRIAL PRODUCTS UTILIZES HIGH-FREQUENCY TESTING TO DETERMINE LEVEL AND EFFECT OF HARSHNESS ON SUSPENSION COMPONENTS

Leading-edge technology allows for development of customized OEM applications

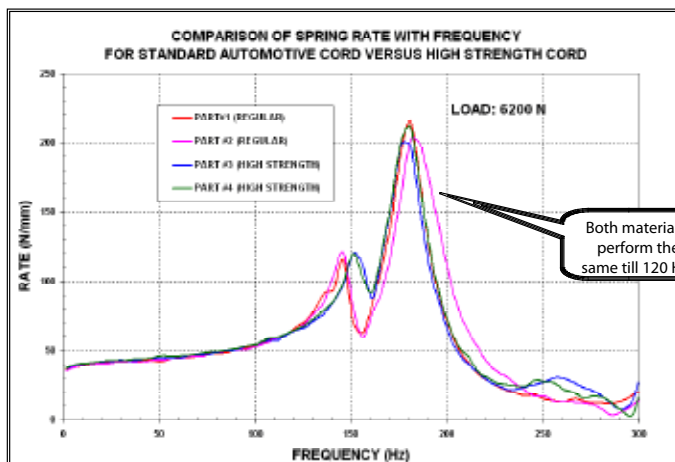
INDIANAPOLIS, Ind. — Firestone Industrial Products Company, LLC (FSIP) is utilizing a high frequency test machine in the development process of its high-performance air springs, which are customized to OEM specifications for minimized and reduced ride harshness.

“Our high-frequency testing, which can provide extremely accurate vibration measurements of up to 500hz, is one of the tools that allow Firestone to understand how variables affect the performance, durability and reliability of an air spring, said Brad Hayes, automotive engineering manager, FSIP. “With this realization, Firestone has the proven, accurate FEA tools to meet tight OEM timelines from concept to market. Data collected from that testing is then used to fine-tune the compounds and components that distinguish our product’s performance in controlling harshness.”

One of the major determinants of a vehicle’s ride quality, harshness is the high frequency (25 Hz and above) vibration of the suspension system that is perceived tactilely and audibly. On an air spring-equipped suspension, these small stroke high frequency inputs can have a significant impact on harshness. The ability to test and predict the harshness effects of air spring construction in conjunction with application requirements is the basis of the equipment.

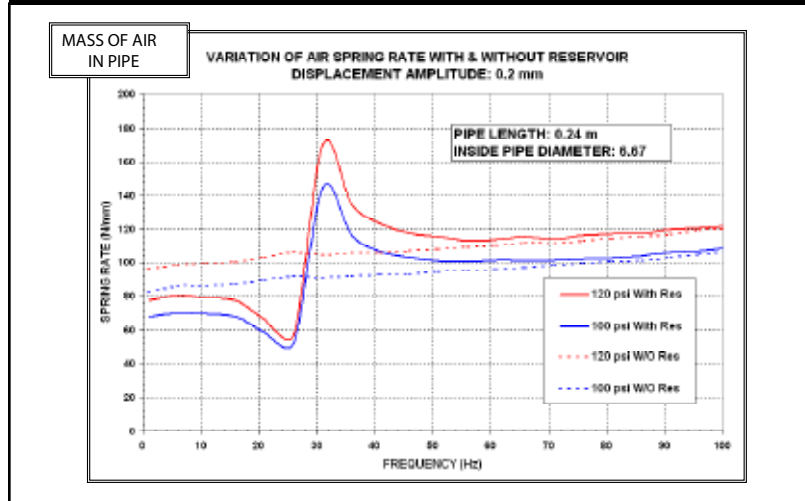
“FSIP strives to continually utilize the latest technology to ensure we deliver a product that meets and exceeds our customer’s harshness acceptability standards,” said Hayes. “We use a broad range of testing methods to specifically determine how changes in compounds, design and construction of our air springs will affect ride harshness. We measure this harshness with state-of-the-art equipment examining the effect pressure, air spring fabric, sleeve thickness, rubber compounding and other variables have on the transmissibility of any vibration a vehicle may encounter.” An overview of the results of this testing and variable construction/applications is shown below.

Transmissibility Effects of Aramid vs Nylon Cord



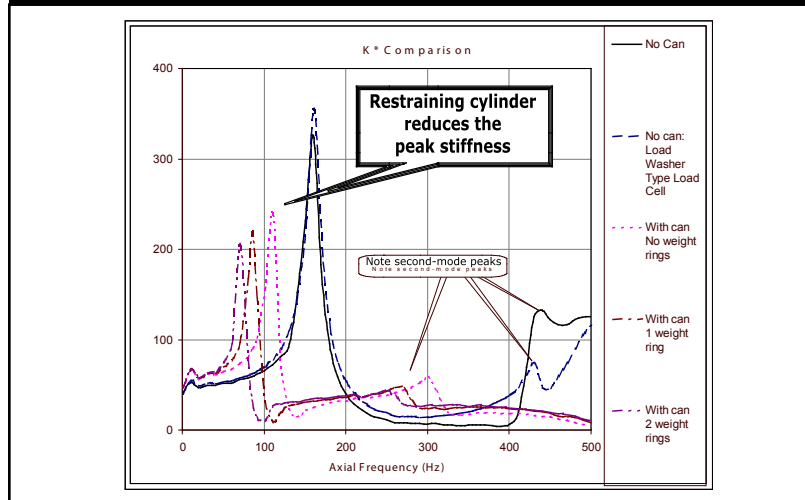
Theoretical FEA and proven empirical data shows insignificant effects on harshness between nylon and aramid fabric in an air spring under certain operating pressures. While there are true benefits in the burst pressure of aramid fabric due to its high tensile strength, little credence can be given to an improvement in ride characteristics under all conditions.

Reservoir Effect On Rate/Transmissibility (Measured)



An air reservoir does not always decrease the spring rate in an air suspension. The mass of air in the pipe will affect the air spring rate at a certain frequency. This effect is important to be aware of and understand in order to optimize the ride.

Rate vs Frequency for Restraining & Non-restraining Parts



Restraining the inflated diameter of the air spring can have a significant positive effect on harshness. The bellows are forced to travel in a vertical path even under extreme high frequency, low amplitude conditions.

To continue developing air springs that improve ride quality, FSIP performs computer simulations from data recorded during live product testing, replicating in an extremely precise manner the conditions experienced in those trials. This information is then used in modeling experiments, which allow engineers to substitute, via a computer model, different compounds, thickness levels and fabrics leading to combinations that result in the lowest possible harshness characteristics for each specific air spring design.

Using technology in this manner also provides a time- and cost-savings benefit to automotive manufacturers, who are able to replicate real-world usage conditions while testing a wide array of product construction variables and specifications.

“As manufacturers in this industry continually search for products to reduce the effects of harshness and improve ride quality, FSIP can assist by creating customized air springs that match their exacting specifications,” explained Hayes.

FSIP’s customized harshness testing and associated air spring development can begin at the early stages of a vehicle design, during a new model year redesign, or even with an existing system that is in need of improvement. It is the company’s total understanding of specific customer requirements that facilitates the use of its products and services.

"We know every customer is different and no single formula can be used in every suspension situation that will provide equally successful ride quality results," Hayes added. "From initial modeling to testing to reviewing competitive products and understanding the very precise needs of the application, FSIP pulls together a large breadth of knowledge, resources and experience in delivering the best possible product."

Like all of FSIP's developmental services, harshness testing and air spring development for new applications is complimentary to Firestone customers.

"Working with Firestone Industrial Product's engineers and development staff gives manufacturers the advantage of integrated resources. Our company has stayed on the forefront of technological development and maintained its dedication to customers for more than 68 years and our industry-leading air spring products are proof of that commitment," said Hayes.

About Firestone Industrial Products Company, LLC:

Firestone Industrial Products Company, LLC, (FSIP) a subsidiary of Bridgestone Firestone Diversified Products (BFDP), specializes in air spring manufacturing and technology with a history of more than 60 years of research and development of technologically advanced air springs. With headquarters in Indianapolis, Indiana, and six manufacturing plants located on four different continents, the company produces suspension products enhancing the driving experience for drivers of heavy truck/trailer, buses, rail vehicles, passenger cars, sport utility vehicles, light trucks, minivans, vans, and motor homes.