

Firestone

**World's Number 1
Air Spring.**



FIRESTONE INDUSTRIAL PRODUCTS COMPANY

Coil-Rite Design

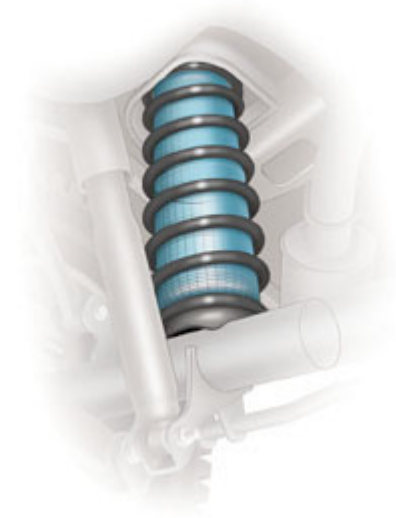
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1. Background

The Coil-Rite product is used as an air helper spring for certain vehicles equipped with coil spring suspensions. Most applications are for the rear suspension such as for vehicles hauling or towing heavy loads, but some are for the front suspension like trucks with snow plows or RV's.

Applications like those mentioned above can include a wide range of environments. The extremes of hot and cold combined with highway and off-road uses can provide a design challenge.



2. Firestone Design

In order to meet the design requirements of the applications, a tough material is essential. Firestone has selected a highly durable thermoplastic elastomer that not only is flexible enough to expand and contract with the coil spring, but is also resilient to tearing and abrasion.

Another area of design that is critical is that of the air connection. A Coil-Rite must be able to be inflated and maintain a certain amount of air pressure throughout the service life of the part. This involves routing an air line that is connected to the Coil-Rite on one end and a valve on the other. In order to make installation of the air line into the Coil-Rite easier, Firestone uses a push-to-connect air fitting in the Coil-Rite. The air line is first cut off square and then simply pressed fully into the push-to-connect fitting of the Coil-Rite.

In order to further extend the service life of the part, Firestone has now incorporated a revolutionary design feature that further enhances the robustness of the push-to-connect fitting. When a Coil-Rite is inflated, the material stretches and conforms to the coil spring. Further stretching of the part occurs as the suspension moves when it encounters bumps and potholes.

The new design surrounds the push-to-connect fitting with adequate material to ensure that an air-tight seal is formed. A groove is molded around the fitting area to isolate it from the stresses caused by material stretching as mentioned above. As the material stretches, the stress-relief groove can expand while protecting the seal around the air fitting. This also allows the fitting area to flex during extreme suspension travel. An additional ring of material is formed around the groove to prevent it from expanding too much. US and international patents have been filed to protect this innovative design.



3. Firestone Engineering Development

The new design was first created in cyberspace using a computational tool called finite element analysis (FEA) that simulates the inflation and movement of a Coil-Rite inside a coil spring. The stresses, (represented by various colors) could then be predicted and various designs were created and analyzed using this method.

Once the design was optimized, prototype tooling was made to produce it. Prototype Coil-Rites manufactured to the new design were subjected to several fatigue life tests where they endured over a million cycles. Tests were also performed at hot and cold temperatures to ensure acceptable performance in a variety of climates.

