

Springing into New Frontiers

Global Spring Company Opens Up to New Markets While Leveraging Pioneering Technologies

By Rebecca Carnes

Being in the spring business since 1857, **Associated Spring**, a business unit of Barnes Group Inc., has built up an impressive and loyal customer base, but its growth into new key markets is a testament to the company's continuing dedication to technology and innovation. The company's cornerstone in the automotive and industrial sectors is being stretched into aerospace, defense, and green energy because of key technologies the company has pioneered and continues to improve upon.

With eight manufacturing plants—five in the United States and three global—Associated Spring is a leader in high performance race and aftermarket springs. Having invented or first adopted and refined for springs many technologies, such as micro-peening, superfinishing, and induction heating, the company is constantly pushing the innovation and technology envelope to reach new performance levels—for example, by replacing dual springs in the racing market with single ones.

“Our customers are telling us they need a ‘lighter’ spring—with a higher natural frequency and higher RPMs—that can endure higher stresses, and we’re finding the optimal combination of materials, spring geometry, cross section, heat treatment, and surface finishing that best suits their needs,” said company president, Tim Haller. And technology advancements that are made in the racing industry, especially, are now being used in applications for new markets that the company is pursuing. Aerospace and defense are strategic markets for Associated Spring, and the AS9100 certified company is leveraging its aerospace accreditation and in-depth knowledge of engineered springs for critical applications. In a recent example, the company custom engineered a spring for a major defense contractor that is building the James Webb Space Telescope (JWST). Considered the scientific successor to the Hubble Space Telescope and the Spitzer Space Telescope, the JWST will feature unique constant force springs that are engineered and manufactured by Associated Spring and will be utilized during deployment of the telescope's sunshield.

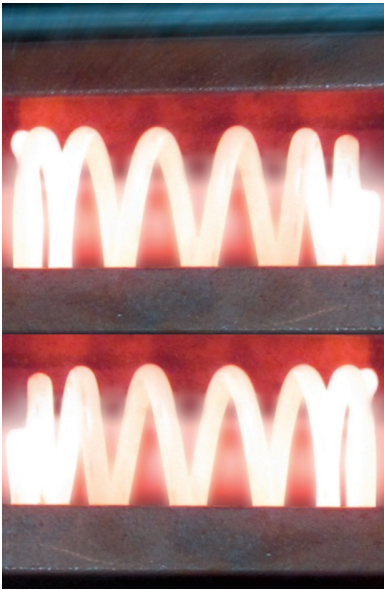
“One important differentiator for Associated Spring is the technical reputation we have with top aerospace and defense companies that trust us with mission-critical engineered springs,” said Haller. “For example, for the Mars Landing application, the luxury of repairing or replacing a spring was not an option. Our Associated Spring team was able to engineer these springs to give peace of mind to the mission control engineering team that had to orchestrate a very complex remote landing, which critically depended on the power springs to lower the rover safely to the surface of Mars.”



Haller also noted that Associated Spring custom engineers and manufactures “a multitude of military precision springs” for the defense industry. These mission-critical components allow for the precise deployment of the ammunition mechanism to ensure it reaches its destination with no room for error, he said.

The medical industry, widely seen as having significant growth potential, is another strategic market for the company. Associated Spring recently collaborated with a prominent U.S. university to resolve concentricity issues with a prototype conical spring for a sensitive medical application that utilizes a spring as an insertion point and anchors a surgical device into the heart. The surgical method is cutting edge technology within the cardiovascular field and has successfully completed the clinical trial phase (aortic valve device). Within six

A sampling of Associated Spring's offerings, including conical springs that enable weight reduction while retaining reliability for high-performance markets, such as drag racing, circle track racing, and aftermarket high performance applications. Photo courtesy of Associated Spring.



Springs are shown glowing during Associated Spring's confidential heat induction process, which improves strength, reliability, durability, and fatigue performance. Photo courtesy of Associated Spring.

weeks, Associated Spring was able to complete the initial custom design and begin manufacturing the first three prototype springs for the application, Haller said.

"We have an exciting and budding collaboration with a customer with whom we are developing a new, innovative green technology engine that could be used in much more efficient numbers than today's competing engine technologies," Haller explained. "Associated Spring leveraged its knowledge of flapper technology from automotive and commercial refrigeration for this unique eco-friendly technology engine, providing a market advantage to our customer as they expand their share in this exciting green energy sector. Associated Spring has a successful track record in collaborating with innovative companies in the early design cycle to bring forth our tremendous spring expertise into their specific design constraints and opportunities, benefiting both customer and supplier and the ultimate user of these products."

Flapper valves are also being refined by Associated Spring's technological advancements to meet increasingly stringent efficiency and environmental standards, noted Dr. Jack Rababeh, global chief engineer for Associated Spring. "With our technologies—for example, our superfinishing—we're able to provide flapper valves that can live longer, with better finish specifications, with improved flow properties, and with superior sealing characteristics, so our customers can achieve reduced compressor sizes and yet improved efficiency and performance," he said.

Superfinishing is a cutting-edge process that Associated Spring has pioneered in the spring industry to achieve perfect surface finish and enable superior performance without spring failures. For example, for the company's high-frequency conical springs that had to be designed to high static stresses, superfinishing reportedly enables the engine valve spring to attain more than 10 million cycles (traditionally termed "infinite life") at a Goodman Stress of 210 ksi. Haller said this constitutes "an astounding level of achievement" that enables lighter springs with superior performance in many applications, such as drag racing, circle track racing, high performance aftermarket, and other demanding applications. The Goodman Stress equation is used for measuring interaction of alternating and mean stresses on a material's fatigue life.

"To our knowledge, nothing that begins with a 2 (Goodman Stress) has ever been reached before. I think that represents a new record in terms of stress level achievable for a performance spring," said Haller. He added that Associated Spring developed

the superfinishing technology for springs because its customers are asking for it. "They're saying, 'My race performance depends on the type of spring I use and its fatigue performance. While I prefer it to last several races, for economical reasons, I expect the spring to give me the edge in my race each time.' Associated Spring therefore partners with our customers to optimize both performance and fatigue/cost factors."

Rababeh went on to explain that the superfinishing technology helps provide a better performance because the surface is honed to the point of nearly a mirror finish and this finely-polished surface is free of imperfections, which could create stress risers and fatigue failures. "They're (superfinished springs) free of the normal pits and marks and peaks and valleys that would normally be present if you look under a microscope on any kind of metallic surface. So when you remove all of those imperfections, you're able to provide superior performance because you've eliminated the areas where fatigue, cracks, and fractures can initiate," Rababeh explained.

Springing into Action

The race car industry is an important niche sector for Associated Spring, and for them, speed is key and the lighter the spring, the better the performance. Associated Spring recently designed conical springs for such high-performance markets as drag racing, circle track racing, and aftermarket high performance applications.

The conical springs enable weight reduction by eliminating components while retaining reliability, Rababeh said. "If you're competing against a nested three-ring module, you can now go down to two smaller conicals, or, if you're at two springs already, by using a conical, you can go from two to one spring. You're saving on weight, which is very important when talking engine valve springs for drag racing. Performance is absolutely number one," he said. "The weight savings equals exceptional performance. If you can save weight, that means active rotating mass inside the valve train of an engine, and that is directly proportional to horse power. Weight equals power in the engine, so if you can save on weight, you can spin the engine faster, go to a higher rpm, and you can make more power and, hopefully, beat the other guys."

Making a lighter product applies to non-racing cars as well, and Haller explained that the automatic transmission business is the company's fastest growing sector due to pressure on OEMs to reach certain CAFE (corporate average fuel economy) standards imposed by Congress. With TS16949 and ISO 14001 certifications and an established, long-standing history with automotive customers, the company is relied upon to help develop products that are more fuel efficient. By using technologies like micropeening and heat induction processes, Associated Spring is scaling up some of its equipment and manufacturing parts in a way that's most efficient and optimized for high volume production.

Micropeening, first developed for the aerospace industry, is one way Associated Spring goes about attaining weight reduction and increased performance for parts in automobiles and other applications. Associated Spring was first to customize micropeening to spring making in high performance applications where a perfect surface finish is key and any imperfections will lead to failure. "In aerospace, they started using these air-driven, nozzle-peening devices, and so in seeing this, we were the first to adapt it to our industry in making precision automotive stampings and coil springs and industrial products and saying, 'We can take this



Components from Associated Spring's Milwaukee division, which specializes in aerospace and defense applications. Photo courtesy of Associated Spring.

idea and, instead of using nozzle peening to modify small holes and bores, we are going to take this and modify it slightly. We're going to use slightly different media which is harder and more durable; it's still very tiny and still in the same range as aerospace was using, except we're going to do it in a batch," Rababeh explained, adding that the nozzle is moved so it sprays over a batch of parts while they're tumbling or spinning and peens them.

With the automotive sector rebounding close to its pre-recession high in terms of sales and production, it's important for Associated Spring to be on the front end of any discussion with an OEM that is seeking to improve engine or transmission performance, Haller said. With automotive growing by a few percentage points each year and with OEMs looking to meet CAFE standards, Associated Spring is getting in early on discussions to improve products. Original equipment manufacturers are striving to meet CAFE standards through the production of hybrid and electric vehicles, but also by making more efficient combustion engine platforms, which is where Associated Spring comes in. There will be a movement to go from 4-5-6-speed transmissions to 8-9-10-speed transmissions and Associated Spring is poised to play a key role in that movement, Haller said.

"If you're on the front end of those engineering and development discussions and you've been a partner and capable, technologically competent supplier, as Associated Spring is, you're generally going to be competitive for the business," Haller said. "We're excited to take part in the technological advances fueling this automatic transmission growth and helping our customers achieve these increasingly stringent regulatory CAFE standards," he added, noting that his company has a long-standing relationship with major automotive manufacturers and that they prefer to work with companies with a long and successful track record.

Heat induction is utilized by the company to strengthen metallic components. In the case of industrial or automotive, heat induction is used to induce heat and harden certain areas or the entire component to improve the strength, reliability, durability, and fatigue performance of that component. "That can be combined with superfinishing and micropeening to yield a synergistic overall effect on the product, thus increasing its market value, penetration, ability to bring it to market, promote it, and improve overall performance," Rababeh said.

Heat induction can be combined with superfinishing and

micropeening to create a lighter spring while driving stress levels and efficiency higher, so that there's a greater volumetric use of the material that is being specified for the component. "So as you use a greater percentage of the material—meaning more of it is under higher stress and less of it is being wasted—you cut out the waste and put more of it into use. So there's a greater volume of the stress at a higher level. You're able to run a higher stress component and you can use less material to achieve that higher stress. And you can still get the same or better performance because you're applying superfinishing to offset the higher stress levels," Rababeh explained.

Powerful Backing, Global Reach

Associated Spring sits under the industrial umbrella of Barnes Group Inc. (www.BGInc.com), a global industrial and aerospace manufacturing and services provider, and benefits from the parent company's strong balance sheet, which is a reassurance to customers, especially during the recent recession, Haller said. A long-standing 156-year history and the powerful backing of Barnes Group gives Associated Spring (www.asbg.com) the ability to continue to grow and innovate. With a keen eye on maintaining expertise, the company focused on investing in, upgrading, and expanding technology across all of its divisions during the recession, Haller said.

"I would say first and foremost, when people talk about Associated Spring, one of the benefits they derive from that is it's not an independent company. It's a company within the Barnes Group and has the strength and financial backing of the Barnes Group's balance sheet," Haller said.

Associated Spring and the Barnes Group have long been intertwined and, in 1933, company president Fuller Barnes was instrumental in starting the Spring Manufacturers Association, which later became known as the Spring Manufacturers Institute (SMI). Associated Spring has been an active member of SMI for the past 80 years and has often given technical presentations to the spring industry, Haller said.

With a background in aerospace within the Barnes Group, Haller took over as president for Associated Spring in 2008 with a vision for setting up centers of excellence within the five domestic divisions. For example, the division that specializes in aerospace and defense is Milwaukee, and the division that specializes in stampings, such as transmission washers and flapper valves, is Bristol, Conn., the company's founding location.

"Instead of [being] generalists in spring making, they (divisions) specialize in different products or processes. So that when the customer is talking to Milwaukee, they know they're talking to the best aerospace spring maker in the country," Haller said.

With three international locations in Mexico City, Brazil, and Singapore, Associated Spring has a vast global presence that especially helps attract continued business from the Big Three auto manufacturers and their primary tiers, Haller said. Major OEMs are now global and are looking for suppliers with global penetration that they can establish long-term partnerships with.

"If they're going to use our springs in Asia, they probably want to buy from me in Asia. So the fact that we have three international divisions puts us on a plateau that differentiates us from at least the majority of spring makers," Haller said. "There's only a handful that are truly global, but when you talk about a U.S.-based, custom engineered spring manufacturer that's global, it's Associated Spring."