# DAMPING GOES THE DISTANCE IN GOLF



## ORIGINATING TECHNOLOGY/ NASA CONTRIBUTION

In the late 1980s, Dr. Benjamin Dolgin of NASA's Jet Propulsion Laboratory developed a concept for a high-damping graphite/viscoelastic material for the Strategic Defense Initiative (popularly referred to as "Star Wars"), as part of a space-based laser anti-missile program called "Asterix." Dolgin drummed up this concept with the intention of stabilizing weapons launch platforms in space, where there is no solid ground to firmly support these structures. Without the inclusion of high-damping material, the orbital platforms were said to vibrate for 20 minutes after force was applied—a rate deemed "unacceptable" by leaders of the Strategic Defense Initiative.

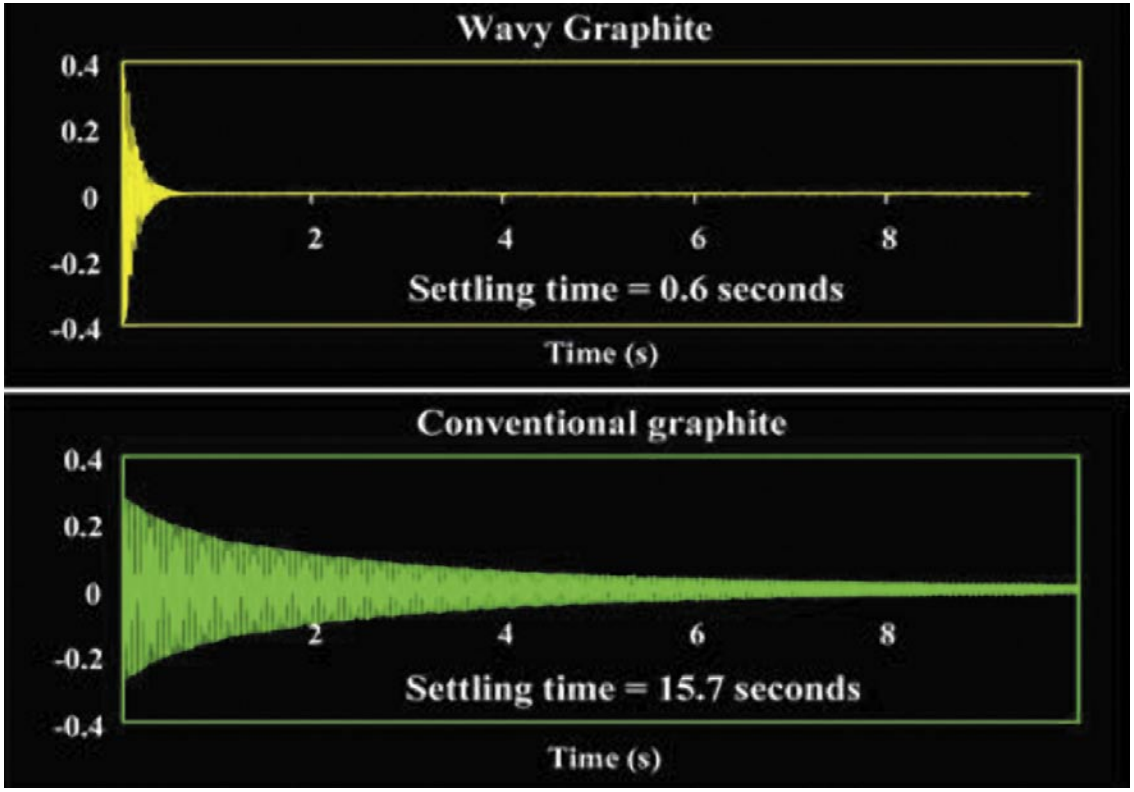
## PARTNERSHIP

Dolgin's proposal for a high-damping graphite/viscoelastic material actually lay dormant for nearly 5 years after he conceived it, until it became the topic of doctoral studies for Dr. William Pratt, a Brigham Young University scholar who would later head up Patterned Fiber Composites, Inc. Pratt took the concept to the next level and discovered a practical method for manufacturing "wavy" graphite composite technology to dampen, or restrain, structural vibration. In 1998, the U.S. Air Force awarded Pratt and his Pleasant Grove, Utah-based company a 3-year **Small Business Innovation Research (SBIR)** contract to further develop this research and come up with an improved means for dampening space structures. In addition, Pratt received an exclusive license to use the NASA concept invented by Dolgin for commercial manufacturing of graphite composite products.

## PRODUCT OUTCOME

By combining his research with Dolgin's concept and using a machine he built for the U.S. Air Force, Pratt has created a progressive golf shaft that is helping golfers to hit the "long ball" even longer. The "Wave Shaft" golf shaft employs a viscoelastic layer sandwiched in between two opposing wavy-patterned graphite layers to create unparalleled stiffness and damping. The structure of the Star Wars-influenced shaft is as stiff as steel, but with thousands of times the damping, which results in less shock and vibration during a swing and ultimately cuts down on the stinging pain and discomfort typically incurred by avid golfers as a consequence of vibration.

When the shaft is placed under load, opposing waves from its wavy fiber composite layers cause a significant amount of shear stress in the viscoelastic adhesive sandwiched between these layers. This greatly enhanced shearing of the




The wavy composite used in the construction of the Wave Shaft contains damping that is thousands of times greater than conventional golf club shafts. When a conventional graphite shaft and the Wave Shaft are deflected the same amount, the vibrations in the Wave Shaft die out in only 0.6 seconds, while it takes at least 15.7 seconds for the vibrations in the conventional graphite shaft to die out.

viscoelastic is what causes high damping in the structure. The shearing action causes stretching of the long chain polymers in the viscoelastic to not only create the high-damping effect, but to generate heat and dissipate energy for longer drives off of the tee.

The Wave Shaft—the first of several golf products developed by Pratt under the NASA license—is currently available from New Revolution Golf, a spinoff company of Patterned Fiber Composites. When ball contact is made with a golf club featuring a Wave Shaft, it takes just 0.6 seconds for any vibrations to die out, compared with at least 15.7 seconds for the vibrations in conventional graphite shafts; steel shafts have even less damping and take at least twice as long as graphite shafts to stop vibrating. New Revolution Golf's Wave Shaft offers extraordinary damping in two directions: twist (torsion) and flex (bending). By the time a club breaks the horizontal on the downswing, the Wave Shaft's high damping has eliminated all the erratic twisting and bending, further preventing fluttering or wobbling in the club's head. This "self-adjusting stiffness" phenomenon allows for consistent, controlled contact between the club and the ball. The Wave Shaft still flexes and "whips" as one would expect, but at impact it stiffens as much as 17 percent to impart greater energy to the ball. The stiffness also prevents head lag during the impact, as well as any lag-induced backspin, and gives a driver more loft.

New Revolution Golf is also producing optimal-performance driver and wood heads that compliment its Wave Shaft. The company's drier heads are packed with 320 cubic centimeters (cc) of aircraft grade titanium, and feature a well-balanced perimeter design to match the dynamics of the Wave Shaft. The wood heads house 150cc and 140cc (3 wood and 5 wood, respectively) of stainless steel, and possess many of the same characteristics of the driver heads.

New Revolution Golf clubs are shaving strokes off of many golfers' games, including an editor for Golf Today magazine who recently tested two models and immediately found a "new love" for his golf bag. According to the editor, who experienced his longest drive ever when using New Revolution Golf's driver: "For the first time in my life, I felt the harder I would swing, the more 'kick' the shaft would create with no noticeable torque at all, even when I purposely hit the ball way out on the toe of the club head. It felt as though the club head accelerated past my hands at impact." While many golfers are recognizing the technology for its distance, others are touting it for its control, like a Professional Golfers' Association (PGA) head golf professional from Arizona, who claims that the ball flight after impact with a Wave Shaft-equipped club is the straightest he had ever seen, not only for himself, but others.


New Revolution Golf drivers and woods are designed to provide maximum distance, forgiveness, and accuracy, along with the unmatched feel of self-adjusting stiffness.

There are many other areas where the wavy composite material developed by NASA and Pratt could be successfully applied. Patterned Fiber Composites has proposed using the damping technology to eliminate resonance problems in helicopter drive shafts and in fan drive shafts for the F-35 Joint Strike Fighter. Pratt also has unfinished business in extending the technology to everyday consumers, as he is hard at work on a line of skis and a "quiet" hard disk drive for personal computers.