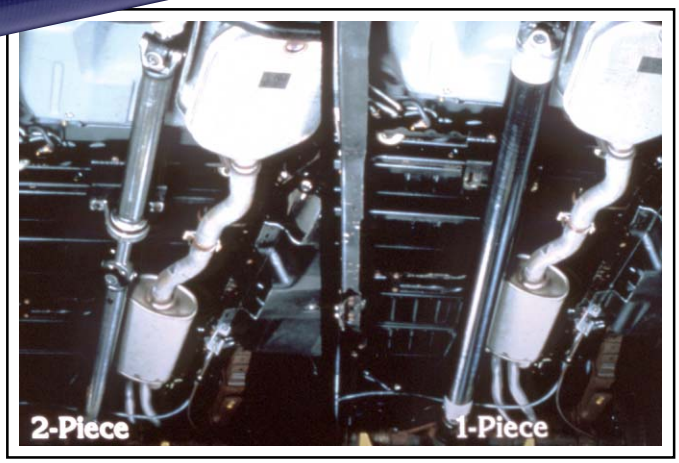
STRONGWELL

APPLICATION PROFILE

GRAPHITE DRIVESHAFT PUTS AEROSPACE TECHNOLOGY ON THE ROAD



A lightweight driveshaft of fiberglass/graphite pultruded over an aluminum tube by Strongwell is the first high volume auto industry application of aerospace technology to a one-piece production driveshaft. The Spicer Graph Lite™ driveshaft made its market debut on General Motors 1988 model GMT-400 pickup trucks. (Production began in October, 1986.)

The graphite/fiberglass/aluminum driveshaft tube, pultruded for Spicer Universal Joint Division of Dana Corporation, is a direct response to industry demand for greater performance and efficiency in light trucks, vans and high performance automobiles. Replacing conventional two-piece steel driveshafts, the Graph Lite™ composite driveshaft offers the following benefits:

- It is 60% lighter than a two-piece steel driveshaft, with an average 20-pound weight saving per vehicle, offering fuel economy and better mileage.
- It eliminates a multi-piece driveline, thus reducing assembly time, inventory costs, maintenance and part number complexity.
- It eliminates warranty associated with center bearings.
- The transfer of powertrain noise and vibration to the passenger compartment is decreased due to inherent dampening characteristics of composite material and less rotating mass.
- Composite driveshaft material protects against driveline deterioration from corrosion leading to longer life.
- And most significantly, it permits custom design of driveshaft performance based upon vehicle use and powertrain systems.

R & D for the development of a composite driveshaft has actually been underway by Spicer Universal Joint Division of Dana Corporation since 1962, but the project was dropped in the mid ‘60’s because of lack of technology throughout the industry. Research was resumed in 1975 and in 1983, Spicer Universal Joint Division of Dana developed the graphite/aluminum tube design and brought the project to Strongwell. Strongwell developed new pultrusion equipment and technology to produce the Spicer Graph Lite™ design. A composite of fiberglass, graphite and a special resin is pultruded directly onto the seamless aluminum tube. This composite reinforces the tube, eliminating the need for center bearings. The composite is engineered with an isolation barrier between the aluminum tube and the graphite to eliminate electrolytic galvanic corrosion.

The product, once it was developed, went through two years of testing, simulating 20 years of vehicle life, before it ever reached the market. Test engineers concluded that the Spicer Graph Lite™ will outperform conventional two-piece driveshafts in strength, weight saving benefits and longevity.

TECHNICAL DATA

Product:	Graphite/Fiberglass/Aluminum Driveshaft
Process:	Pultrusion
Materials:	Graphite fiber, proprietary resin, fiberglass, aluminum tube
Sizes:	Various lengths: 62" to 69" long - 4" dia. Wall Thickness: Aluminum .083 Graphite/fiberglass .065
Weight:	8.93 lbs. per ft.
For:	Spicer Universal Joint Division, Dana Corporation
User:	General Motors

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