A Spinoff From Mariner

Today only dimly remembered by space enthusiasts and not at all by the general public, the Mariner missions of the 1960s and 1970s constituted one of the most successful of all NASA programs in the early days of U.S. space research.

The Mariners were a family of planetary spacecraft for studies of Venus and Mars. There were nine of them; three failed during or shortly after launch, but the others scored spectacular successes for their day.

A space-derived dry lubricant leads a sampling of technology transfers in industrial productivity and manufacturing technology

Launched in 1962, Mariner 2 passed within 10,000 miles of Venus and became the first successful planetary probe. Mariner 4 (1964), a Mars explorer, was the first spacecraft to return pictures of another planet. Mariner 5 (1967) made the second U.S. flyby of Venus, closer this time at 2,500 miles from the planet's surface. Mariners 6 and 7 (1967-69) flew within 2,000 miles of Mars and provided some 200 pictures. Mariner 9, launched in 1971, went into orbit around Mars, sent thousands of photos of the Red Planet and its moons, and mapped one-third of the Martian surface.

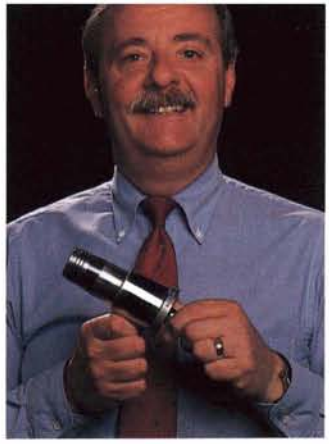
The Mariners were developed in a period of rapidly advancing technology, so each model contained some improvements over its predecessor. The last four, Mariners 6 through 9, represented a second generation of the family, larger, heavier and considerably more sophisticated than the earlier spacecraft.

These latter Mariners incorporated a great deal of what was then considered leading edge technology—a variety of advances in onboard power, scientific instrumentation, communications and imaging/data transmission systems. Among all these improvements was an unsung technology: a dry film lubricant designed to meet the special needs of Mariner missions. Developed for NASA by Dr. Robert D. Nelson of Stanford University, it offered exceptional lubrication quality for reduced friction and extended wearlife of mating parts operating in harsh interplanetary environments where temperatures ranged from well below zero to 500 degrees Fahrenheit.

The technology was subsequently acquired and refined by Micro Surface Corporation, Morris, Illinois, which markets the lubricant as the WS2 modified tungsten disulfide coating. A pressur-

ized refrigerated air application process impinges a dry metallic WS2 coating without heat, curing, binders or adhesives. The lubricant coating binds instantly to any metal or resin substrate with a thickness of 20 millionths of an inch.

In the aftermath of the Mariner missions, the dry film lubricant found its way into industry use, but only by aerospace and defense contractors. In 1984, Micro Surface introduced WS2 to general industry and it has since compiled an excellent performance record in an ever-widening range of applications among the automotive, medical equipment, plastics, tool and die, and robotics industries. It has been used, for example, to coat machine tools, industrial gears and bearings, electric motors, compressors, cryogenic pumps and small firearms.



In the plastics industry, WS2 users have found that in some operations, such as blow molding, injection molding and extrusions, the coating increases production by reducing the drag between tool steel and resin. In automotive applications, it is used to reduce friction and wear by Ford Motor Company, General Motors and Chrysler Corporation in such components as auto bearings, transmissions and engine internal parts. In special applications, it is used by racing hydroplanes cars of the "Indy," NASCAR and Winston Cup types.

In addition to reducing friction and wear, WS2 offers a number of other advantages, depending on the application; generally, it helps improve product quality, extends equipment service life and eliminates or reduces costly maintenance problems. It is finding growing acceptance and Micro Surface's list of WS2 customers reads like a Who's Who of American Industry. In addition to the U.S. automotive Big Three, a random selection includes American Can Corporation, Continental Can Corporation, Kimberly Clark Company, Dow Corning Corporation, Ethyl Corporation, General Electric Company, Phillips Petroleum, Whirlpool Corporation—and, of course, NASA.

In the top photo general manager Ed Fabiszak of Micro Surface Corporation displays a tool for making plastic parts that has been coated with WS2, a dry lubricant originally developed for space use which has found a wide range of practical Earth uses. A few of the many applications: in manufacture of plastic parts such as those shown above, companies coat injection molds to reduce sticking and increase production; automative companies use WS2 to lubricate a variety of parts, such as the pistons shown at lower left, to reduce friction and wear; in the robotics industry, bearings and sleeves (upper left) designed for repetitive movements are coated to extend their useful lives, as are the drill bits and milling tools (near left) used in heavy industry and machining.