

Arrow Gear: Spiral Bevel Specialist

Joseph L. Hazelton

James J. Cervinka and Frank E. Pielsticker must've known the future when they named their new business Arrow Gear Co. in 1947. They started out to manufacture gears for hand tools and machine tools, but their business has taken off since then.

"Arrow" suggests flight, speed and weaponry. Today, Arrow Gear of Downers Grove, IL, is a leading manufacturer of gears for aerospace. The company specializes in high-tech, high-quality spiral bevel gears, and its products fly in commercial aircraft, military aircraft, helicopters, rockets and cruise missiles. About 70 percent of Arrow's sales are to aerospace customers.

Arrow's other gears transmit power in ground applications—in robotics, printing presses and off-road equipment, as examples. But, even on the ground, some Arrow gears are used for "flying"—like the ones they made for an Indy race car.

Arrow's course, though, started with a teenager and a summer job. Cervinka has had gears in his blood since high school, when he worked for Chicago gear manufacturer D.O. James Corp. "I'm a hands-on mechanic," he says.

Cervinka also studied engineering in college, but his education was first used in service to his country. During World War II, he served as an engineering officer in the Pacific Ocean, aboard the heavy cruiser U.S.S. Bremerton.



James J. Cervinka, Arrow's chairman and CEO, worked for a gear manufacturer in high school and served in the U.S. Navy in World War II. Both experiences were vital to starting Arrow.

After the war, Cervinka went home to Riverside, IL, just west of Chicago. He was thinking about getting a master's degree, but he had to wait before he could get back into college. So the engineer took a job with American Gear in Clearing, IL, just outside Chicago.

Cervinka expected to be with American about six months, just 'til it was time to go back to college. On the job, he met fellow engineer Pielsticker, who was involved in calculations for spiral bevel gears for American.

Besides a master's degree, Cervinka was thinking about something his father encouraged him to do: Start your own business. "My father had a business before The Depression."

He and Pielsticker got along well, and they had complementing talents: Pielsticker was good at business administration and gear calculations,



Joseph Arvin joined Arrow in 1972 as manufacturing manager. Four promotions later, he became Arrow's president in 1987. After 31 years, his professional enthusiasm remains: "It's exciting to me to work with gears."

Arrow Gear Co.

Established: 1947

No. of Employees: 175

Size of Factory: More than 145,000 sq. feet

Industries Served: Aerospace, Robotics, Printing, Off-Road Equipment

Major Products: Spiral bevel gears, Straight bevel gears, Spur gears, Helical gears, Gear drives

Quality Registrations: ANSI-RAB QMS, AS9100, ISO9001-2000, and NADCAP

Industry Affiliations: AGMA, ASM International, ASME International

Website: www.arrowgear.com



Arrow Gear Co. occupies more than 145,000 square feet in Downers Grove, a western suburb of Chicago, IL.

Cervinka at maintaining machinery and manufacturing gears. If they combined their talents, they could even run a business—so they did.

And they decided that business would manufacture spiral bevel gears. Cervinka explains that those gears were highly technical and: "We wanted to get paid for our brain work."

To equip Arrow, Cervinka and Pielsticker used a valuable currency—Cervinka's veteran status.

During World War II, the U.S. government used a lot of manufacturing machinery. Afterward, it no longer needed the machines, so it started to sell them.

Cervinka's veteran status meant great advantages: veterans were treated as first in line for the machines, which they could buy at very low prices, with just a down payment. They had five years to pay the balance, but they also could each receive a 10-year loan of \$25,000.

Thus, Arrow acquired several Gleason Works machines and opened shop in a small industrial building in Worth, just southwest of Chicago.

Arrow then faced the problem of new businesses—finding customers.

"We knew where they were," Cervinka says candidly, "they

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when quality
counts . . .



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Spiral Bevel Contact Patterns—Right the First Time

What's the key piece of Arrow's highly accurate, closed-loop system for making spiral bevel gears?

"All the software," gear engineer Tom Mifflin says. "All that software is what makes everything work."

Mifflin should know; he manufactures spiral bevel gear teeth using the system, which can create aerospace-quality spiral bevel gears with contact patterns that are right the first time.

A 31-year employee, Mifflin is in charge of gear-tooth manufacturing and contact pattern design for Arrow.

The system itself consists of two Gleason Corp. machines, a Phoenix[®] gear cutter and a Phoenix gear grinder, and a Zeiss/Höfler coordinate measuring system. These blue and gray machines are scattered throughout the factory, sitting among green gear generators and gear checkers.

Also, the system uses Gleason's CAGE, T-900 finite element analysis (FEA), and G-AGE inspection analysis software.

The software brings the scattered machines together off the factory's cement floor, to computer screens in Mifflin's carpeted office.

Arrow bought the system's pieces over about 10 years. The last piece, the FEA software, was bought in 2001. Before then, the system had been operational for years, using loaded tooth contact analysis (TCA) software to design contact patterns.

Even without the FEA software, though, Arrow twice manufactured spiral bevel gears with first-time, right-on contact patterns for a jet engine project in the late 1990s.

The project started in 1998. Arrow had to manufacture two spiral bevel gear sets for the commercial aircraft jet engine. One set was for the tower shaft, the other for the accessory gearbox.

"The bevel gears manufactured by Arrow Gear performed excellently," Roger Levine says. "The contact pattern was excellent, right where it was supposed to be."

During the project, Levine was a staff engineer on mechanical systems at Pratt & Whitney Aircraft in East Hartford, CT. He was also leader of the team for the project's tower shaft and main gearbox and was mainly involved in designing the spiral bevel gears.

Levine says the contact pattern was "right on the money with the first set of gears." He adds that getting the pattern right the first time isn't a normal thing in his experience. Levine has helped design and build five spiral bevel gear sets for aircraft jet engine projects during his 30-year career.

Arrow also manufactured the spiral bevel gears for the accessory gearbox. That gearbox was being provided by Sundstrand Corp.



From his office computers, gear engineer Tom Mifflin manufactures spiral bevel gear teeth using Arrow's closed-loop system for manufacturing spiral bevel gears. Mifflin sees the software as the key to the system: "All that software is what makes everything work."

Mike Blewett, then a Sundstrand design engineer, was on the team that designed the accessory gearbox.

"We found that the patterns were pretty much exactly where Arrow predicted they would be," he says. "We never had to adjust the contact pattern ever since the first unit was shipped." ⚙️

COMPANY PROFILE

just weren't going to put their eggs in our basket."

At that point, Cervinka went looking for a gear order—at D.O. James. The company remembered him and was willing to take a chance on his new business.

Arrow started making spiral bevel gears for D.O. James' speed reducers. Cervinka recalls he and Pielsticker could provide their gears on-time and at a reasonable price—and they were better than what D.O. James had been getting.

The company stayed with Arrow for more than nine years. And Cervinka admits its gear orders really helped Arrow during its first years, giving it time to grow—"When you start, anything is blessed."

Today, Arrow occupies a building with more than 145,000 square feet, in Downers Grove, one of Chicago's western suburbs. A medium-sized gear manufacturer, Arrow employs 175 people; is equipped to design, manufacture, heat treat and inspect gears and to manufacture gearboxes; and has more than 500 customers.

At 56 years old, Arrow remains a Cervinka/Pielsticker business. Pielsticker died in 1987, but Cervinka, now 83, continues as Arrow's CEO and chairman of its board of directors.

Pielsticker's sons, James and Frank J., work at Arrow as executive vice president and materials director, respectively. Likewise, Cervinka has two sons, Mike and John, at Arrow. Mike is director of facilities and human resources, and John is assigned to special projects.

Arrow's president, however, is Joseph Arvin. Nearly 6 feet 3 inches tall, Arvin has the friendly reserve of a country gentleman. Raised in Indianapolis, IN, the industrial engineer has been with Arrow since 1972 and has been its president since 1987. He still retains the barest trace of a Southern accent—"You get that in Indianapolis," he says. "It was a lot worse before I came up here."

Today, Arrow is home to a highly accurate closed-loop system for manufacturing spiral bevel gears. The system can create aerospace-quality spiral bevel gears with contact patterns that are right the first time, saving development time for Arrow and its customers.

Also, the system has been on a streak. It's manufactured a spiral bevel gear set for five different projects: four aerospace and one automotive racing—the Indy car. In these consecutive projects, each of Arrow's gear sets had the right contact pattern the first time.

"That's what we're striving for," Cervinka says. ⚙️

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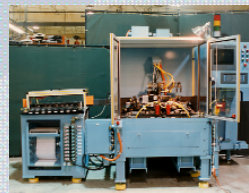
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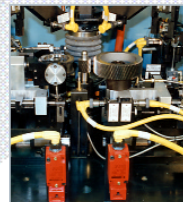
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