



Man with a Mission

In 2002, Fred Young was contacted by a manufacturer with a problem. NASA had contracted the business to make parts for the space agency's two Mars exploratory vehicles. The parts included 12 gears for the vehicles' wheels, but the company couldn't make them to NASA specifications. Could Forest City Gear?

Yes.

But first, NASA had to change the design.

Young and his employees cut gears; they don't design them, but they do check designs before production to make sure they're possible. The wheel

gears were designed with severe crowning on their teeth and were designed for shaping. That was a problem. Forest City would need a special shaper cutter with enough side clearance to create the crowning. Producing the cutter would've been difficult, Young says.

So he talked NASA engineers into slightly adjusting the design so the teeth could be hobbled using a special small diameter hob.

The tweak did the trick. Forest City crown hobbled the gear teeth on the titanium wheels, six for each rover, and shipped them out. In summer '03, NASA launched Spirit and Opportunity on their Mars missions. In January '04, the two rovers landed on the red planet.

Today, a year later, Spirit and Opportunity are still tooling around Mars on their Forest City gears.

Doing a Few Things Very Well
Located in Roscoe, IL, Forest City is a niche manufacturer of loose, custom, fine- to medium-pitch gears. Young and his employees cut gears. They don't design them. They don't heat treat them. They don't turn gear blanks. They don't even cut all types of gears. They limit themselves to spurs, helicals, worms and worm wheels.

They can hob, shape and broach, and they can gear grind, skive, deburr and chamfer. So they can create gears to AGMA Q14 quality. After they're



My Other Gears Are On Mars

Forest City Gear manufactured 12 spur gears for the wheels of two Mars exploratory vehicles. This scale model of one of the rovers commemorates Forest City's contribution to the NASA mission. The model sits atop a display case in Forest City's lobby, along with this aluminum version of the gear itself.



Joseph L. Hazelton, Associate Editor

done, they ship the gears out. They don't put them in gearboxes. Forest City is a *gear* manufacturer, not a *gear-box* manufacturer.

Young focuses Forest City's efforts so his employees become—and stay—gear-cutting specialists. Business consists of almost 40% gear cutting only and 60% complete manufacturing per print. He focuses company efforts even more by gear tooth size: fine- to medium-pitch gears, 200 DP to 3 DP. Young admits 3 DP is “borderline coarse.”

Small Gears, Small Company

Young also limits employees' efforts to gears with outside diameters of no more than 20 inches. “The smaller gears are what I grew up with,” says Young, who worked at Forest City as a schoolboy in the '50s. “We never wanted to deal with gears that we couldn't pick up with two hands.”

Young limits the company's size, too. This year, Forest City is celebrating its 50th anniversary. It has 38 employees.

Young keeps his business small so it's easier to manage. Also, it's hard to find talented people to head production areas, he says. Expanding his company would mean finding a larger number of talented people. A hard task would become harder.

Still, he believes in some expansion. In '01, he added 12,000 square feet to his shop, increasing it to 30,000 square feet, a 66% expansion.



The New Kid on the Block

Young brought this Höfler Helix 400 KK form grinder into his shop in November to investigate its ability to increase the company's capabilities and grinder capacity, especially with small diameter wheels.

“The cost of the expansion was about \$1 million and happened to occur during our worst financial year,” Young says, “but I never let slow business be a reason not to invest for the future.”

Most recently, Forest City has expanded technologically by purchasing gear shaping machinery to cut face gears and grinding machines for gears and threads. This expansion increased the company's shaping capabilities and raised its achievable quality, but Forest City remains a small company that makes small, fine-to medium-pitch gears.

Young, however, turns these limits to Forest City's advantage. A small company can invest in the latest technology *almost* continuously.

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A 21st Century Gear Shop

Barely five years into the new millennium, Forest City is already very much a 21st century gear shop. The company has 33 machines for hobbing, shaping and grinding gears; 13 are 21st century machines, bought in 2001 or later. Forest City's inspection equipment also includes 10 21st century machines.

Young buys the latest technology using 25–40% of gross annual sales. According to Young, gross annual sales have ranged from \$6 million to \$8 million for the past several years. So Forest City has had \$1.5 million to \$3.2 million available to buy new machinery each year.

Young also adds what Forest City makes from selling or trading in old equipment. At 30,000 square feet, Forest City is too small to run new machines and store old ones. What isn't used has to go.

Taught by his Parents

Young's policy of investing in machinery began with Forest City's founders, his parents: Stetler and Evelyn. He recalls they invested their excess profits in the company. After starting the gear shop in '55, they spent that money to buy used gear machines and secondary equipment.

By the late '60s, the investment policy had advanced to buying used gear machines and at least one new gear machine each year. This investment expanded the sizes and types of gears Forest City could make.

By 1980, Young had advanced the policy again, changing it to: Buy the latest technology. That fall, Young bought a Koepfer hobber with attractive capabilities.

One capability was crown hobbing, which Forest City didn't have. Crown hobbing is done on gears and splines to compensate for misalignment and to reduce noise. Another capability was higher quality. Before buying the machine, Forest City's highest quality was AGMA Q11, sometimes Q12. Afterward, the company could consistently achieve Q12 and better.

In summer '81, Young visited Germany to see Koepfer's factory for gears, machines and cutters. He was impressed by the equipment's technology and productivity, so much impressed that he ordered two automated hobbors and a significant amount of tooling.

Young recalls productivity and quality improved by "orders of magnitude" with the new machines. With the two automated hobbors, Forest City could mass produce high accuracy gears as never before. "Koepfer's automation proved to be very flexible and was extremely easy to adapt to a lot of the standard production parts we already had," Young says, "and opened up the possibility for some really high volume and high precision jobs." For example, Forest City was able to start manufacturing for companies that made small motors and power tools.

Schooled in the Shop

Fred Young has been president of Forest City for more than 35 years, but don't look for an engineering degree on his office walls. He was an English Lit major. He minored in math and physics, but they're as close as he got to engineering courses in college.

Instead, Young is a practical engineer, schooled in gear manufacturing on Forest City's shop floor, beginning when he was a boy. Forest City was started by his parents, Stetler and Evelyn Young, when he was 12 years old. His parents started him on easier tasks, removing chips from the gear machines, cleaning out their oil sumps. In time, though, he learned to set up machines and cut gears.

Young graduated from college in 1965, then spent three years as a sailor. In '68, he returned to Forest City. After his return, his parents took a winter vacation in California, leaving Young in charge. It was sink or swim for him; their vacation was a month long. He managed to swim, apparently to his parents' satisfaction. During succeeding years, their winter vacations became longer and longer.

Fred Young



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Capabilities

Main Industries Served

Aerospace	30% of Gears
Motorcycle & Racing	
Transmissions	10%
Medical	15–20%
Defense	10%
Miscellaneous	30–35%

More Specifically: Machines with Forest City Gears

- Aircraft • Military Lasers • Printers • Gun Azimuths • Telescopes
 Artificial Elbow • Power Tools • Tractors • Medical Examining Tables



Functional, Elemental

Forest City can check gears' function via single- and double-flank testing and can perform elemental, or analytical, inspection of them—“A much more rigorous standard,” says Fred Young, company president. Single-flank testing is done by this checker, bought new in '03.

Types of Gears		
Gear Type	Max. O.D.	Diametral Pitch
Spur	20" grinding 16" hobbing 20" gear grinding	3 DP–200 DP
Helical	20" grinding 16" hobbing 20" gear grinding	3 DP–200 DP
Worm Gear	14"	4 DP–200 DP
Worm	5"	6 DP–200 DP
Sprocket ¹	14"	3/4" CP (coarsest)
Spline ²	16" hobbing 20" shaping	4 DP–200 DP (to 32" length)
Internal	20"	4 DP–200 DP (to 5" face width)
Thread Grinding	700 mm thread length, shafts to 1+ meter length	
Gear Form Grinding	20" max. dia.	
Gear Generating Grinding	16" max. O.D.	

¹ Includes roller, block, silent, and ladder chain type sprockets.

² Includes tapered, involute, straight-sided and serration type spline shafts, and jump spline shafts.

Special Services

Skiving (Carbide Rehobbing)

Crown Hobbing

Used on fine-pitch gears to compensate for misalignment and to reduce noise and vibration.

Double Cutting

Reduces hobbing-induced stresses and heat treat distortion.

Gear Inspection

Quality Accreditations

AS9001
ISO 9001: 2000

Quality Controls

The Latest ISO & AGMA
Quality Standards

Process Controls

Statistical process control (SPC)
Computer-scheduled calibration

Suppressing Sticker Shock

After visiting Germany, Young started to look into other, larger gear machines from more companies. The machines were expensive, but he learned not to be deterred by a higher price tag.

Young says some people buy on dollar, so they may hesitate to buy a better machine if it costs \$100,000 more than

a similar one. He takes a longer view of the difference. If the pricier machine is designed to last 20 years, the additional cost averages \$5,000 a year.

"That's nothing," Young says.

Using such logic, he was willing to buy higher priced machines. New equipment expanded the business

and sometimes allowed Forest City to replace the productivity of several older machines with just one new machine. Likewise, Young learned that buying higher quality cutters cost almost nothing extra per part but much improved the gears.

Success through Technology

The higher quality machines and cutters led to higher quality gears, which led to higher quality customers. Young adds the new equipment created a more productive, and more successful, gear shop: "We have been able to increase revenues generally by 10–20% a year without adding people because of the acquisition of new equipment." ■

Forest City: A Mom-and-Pop Outfit

Forest City started in 1955 as a mom-and-pop outfit.

In '55, the mom was Evelyn, the pop was Stetler. Stetler was a tool-and-die man, who started manufacturing gears in Chicago during World War II. He later rose to the presidency of Rynel Gear Corp., located in Sterling, IL. But the company dissolved in '54.

A former customer, though, called Stetler with a gear order worth several thousand dollars. So the Youngs borrowed \$1,000 from relatives, \$3,000 from a neighbor and

opened a gear shop in Rockford. Back then, the Illinois town had so many Dutch Elms it was called "Forest City"—thus, the gear shop's name.

Stetler quoted and set up jobs and talked with customers. Evelyn did secretarial work and ran gear machines. In time, Forest City moved to its current home, Roscoe, an Illinois town north of Rockford.



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