



Cobots That Deburr Their Own Gears

One collaborative robot manufacturer put its own product to work on an in-house production bottleneck and cut scrap from 10 percent to under one percent

Aaron Fagan, Senior Editor

An OB7 cobot picks from a loaded tray of spur gears at Productive Robotics' Santa Barbara factory. Each tray holds 30 to 50 parts, depending on size; the robot's grid function interpolates every pickup position from four taught corner points. (All images: Productive Robotics)

Every machine shop has a job nobody wants. The shop I worked in, you felt like you were being sent to “time out” if you had to go to the deburring station. At Productive Robotics’ Santa Barbara factory, where the company designs and builds its OB7 line of 7-axis collaborative robots, the robots they make do their own gear deburring.

Each OB7 ships with roughly 49 gears across its seven joints. They’re basic spur gears, but precise ones—AGMA Class 12 on average, with motor pinions reaching Class 14.

The material is nitroloy at about 28 Rockwell, which production manager Troy Kirby says behaves like hard stainless under an abrasive wheel. For years, finishing those gears meant operators standing at the bench, pressing parts by hand.

“I’ve spent thousands of hours behind the deburring wheel, unfortunately,” Kirby said during a recent *Gear Technology* webinar. “People just don’t like to deburr.”

Kirby’s gear career goes back to 1984, managing a Santa Barbara machine

shop that built hydraulic undersea manipulators and rack-and-pinion actuators for the U.S. Navy. He earned the Navy’s Reliability, Maintainability, and Quality Assurance Award in 1991 on a NASA project, then ran his own machining and gear manufacturing company until selling it in 2016. He joined Productive Robotics the next year to modernize their internal gear production. Once that was done, he turned to the problem everyone could see: thousands of parts piling up on the deburring bench.



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Where the Line Backed Up

Gear cutting wasn't the issue. The company's shapers and hobbors kept pace with demand. The trouble started after—as OB7 sales grew, so did the backlog of parts waiting for manual finishing.

Manual deburring also carried a brutal scrap rate. Parts flew out of operators' hands, slipped from the tooling, and hit the concrete floor. For precision gears going into robot joints, any floor contact meant scrap. Kirby estimated losses around 10 percent, not from poor

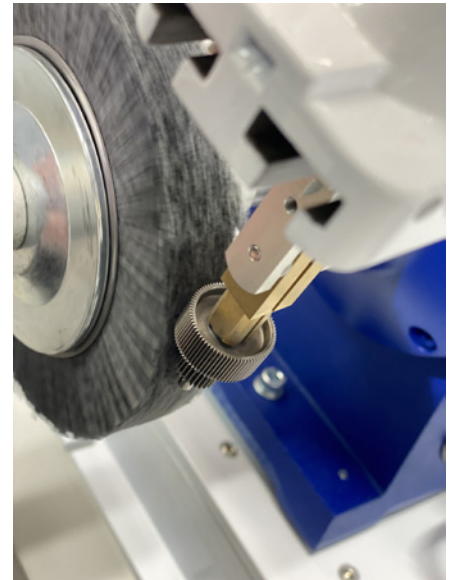
technique but from the basic difficulty of holding small parts against a spinning wheel.

"It would fly out of your hand, fly out of the tooling, onto the ground, on the concrete, under the table," Kirby said. "With our parts, they're just scrap as soon as they touch the floor."

Four Years of Development

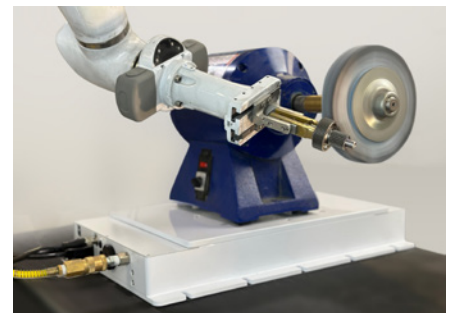
Having the robot hardware was a starting point, not a solution. Getting to a reliable automated deburring process

took about four years of tweaking gripper tooling, part fixturing, media selection, wheel placement, and table layout. The nitroloy at 28 Rockwell called for a specific abrasive: a 320-grit Scotch-Brite embedded nylon wheel, available from several manufacturers. Kirby's team now specs that media for customers running similar jobs.



A cluster gear contacts the 320-grit Scotch-Brite embedded nylon wheel.

The key development was a pneumatically controlled deburring platform. Early attempts ran parts directly against a stationary wheel, but as the abrasive wore down, contact pressure dropped, and results drifted. The platform fixes that with adjustable air pressure and an offset dial—the part meets the wheel with a uniform force regardless of wear.



The pneumatically controlled deburring platform sits beneath the blue motor housing.

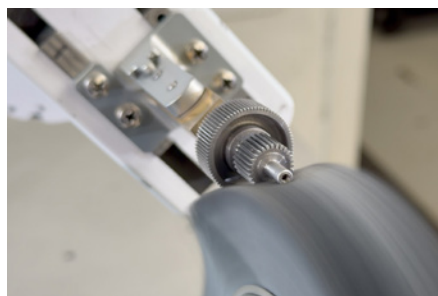
"We developed our deburring platform," said Kevin Meister, the company's application specialist. "It uses air pressure to make sure that the part's

constantly hitting with the same amount of force.” Meister has helped over 100 companies automate processes ranging from welding to finishing.



A pinion shaft held by custom gripper fingers approaches the finishing wheel.

Two wheels sit on either side of the work area. The robot presents one side of the gear’s flanks to the first wheel, moves to the second for the opposite side, and works through the ODs, tooth flanks, tooth ends, gear faces, and bearing journals in one cycle. On the 0.3-module and 0.4-module, 20-degree spur gears demonstrated in the webinar, the process holds an edge radius of about 0.002 to 0.003 inches across tooth tips and flank edges.



A cluster gear at the second Scotch-Brite wheel.

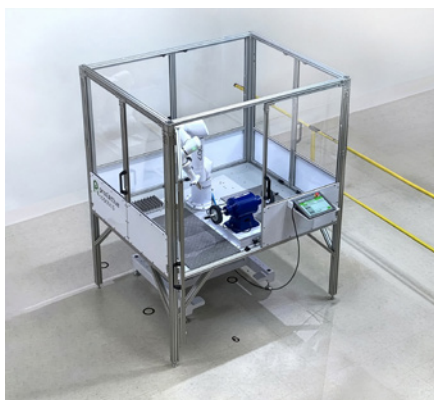
Open Cell and Enclosed Cell

Productive Robotics offers the system in two configurations. The open-cell version puts the robot, deburring platform, and part trays on Productive Robotics’ extra-large machine table. Operators load their existing shop trays—the system was designed around standard fixturing rather than custom holders—and the robot works through the tray while the operator does something else. Kirby said operators typically check back every half hour or so, inspect the last finished part, and adjust the offset if the wheel has worn slightly before reloading.



Inside the enclosed cell, the OB7 holds a part between dual deburring wheels. The offset and pressure adjustment dials are visible on the platform base.

The enclosed cell adds four-sided walls with access doors. Besides containing dust, the enclosure lets the robot run above the 10-inch-per-second collaborative speed limit without needing an external LiDAR scanner for human detection. Productive Robotics runs this version for both pre-heat-treatment deburring and post-heat-treatment finish polishing.



Overhead view of the enclosed deburring cell on the Productive Robotics shop floor. The aluminum-frame enclosure allows the robot to run above collaborative speed limits.

What Changed

Kirby called the throughput improvement a conservative 2×, though he said the real number might be closer to 3×. He attributed most of that gain not to faster cycle times but to the machine staying loaded and running continuously.

Scrap dropped from roughly 10 percent to under one percent. What remains

is almost entirely grip failures, a part not quite seated in the jaw, rather than process errors. And the operators who used to stand at the deburring bench now run other equipment, so the productivity gain extends beyond the single station.

Kirby said his operators treat the output the way they would any CNC process—inspecting a part at the end of a tray run, tweaking the offset if needed, and keeping the machine loaded.

Working the Angles

A good portion of the webinar Q&A focused on parts beyond Productive Robotics’ own spur gears. Meister pointed to the OB7’s seventh axis as the mechanical difference that matters for deburring—the extra joint lets the robot present parts to the wheel at compound angles that a 6-axis arm can’t easily reach.



A cluster gear mid-cycle, seen from below. The OB7’s seventh axis allows compound approach angles that a 6-axis arm can’t reach.

“I can reach around obstacles, or reach around the side of the wheel to present the part in a way that you might not be able to do with another robot,” Meister said.

Kirby said helical gear deburring would look nearly identical to their spur gear process, with the robot following the lead angle. He also mentioned a customer application deburring approximately 32-pitch internal ring gears for aerospace, using a smaller wheel adapted to the motor. That setup was in production within a day.

Meister estimated that a first pass at automating a new part typically gets 50 percent to 80 percent of the deburring done. Further iteration brought many of Productive Robotics’ own parts to the point where no hand finishing was needed. For part families with the same geometry at different sizes, Meister said a taught job can serve as a starting point, with adjustments for each size variant rather than a full re-teach.

Teach by Doing

The OB7 doesn't use traditional programming. An operator guides the arm through waypoints by hand, using buttons on a handle mounted to the robot. During a live demo, Meister taught a pick-and-place cycle in under two minutes, including recovering from a collision by adjusting one waypoint.

For tray work, a grid function handles part locations. The operator teaches four corner pickups and enters the row and column count; the robot interpolates the rest.

But none of this removes the need for process knowledge. The person teaching the deburring job still needs to know the angles, the dwell times, and the pressure. Since the robot repeats exactly what it's shown, a sloppy teaching pass means sloppy parts. Dialing in a new part takes some trial and error.

"It's some experimentation, and it's kind of fun," Kirby said. "My guys really enjoy running the robot to do that."

Loading Machines Too

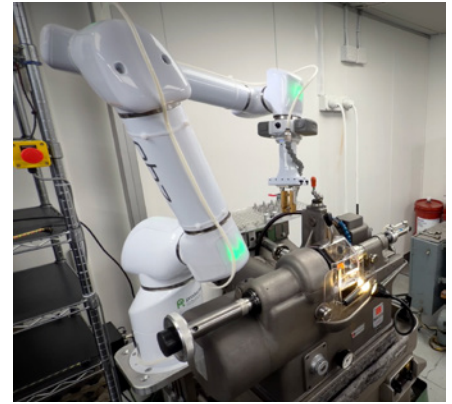
The deburring application wasn't the end of it. During the webinar, Kirby showed

OB7 robots loading and unloading the company's Mikron 132.02 and A33/0 hobbing machines—retrofits done entirely in-house, no integrator involved. The robot picks from standard trays, re-grips for machine-loading orientation, loads the workpiece, closes the door, starts the cycle through an I/O connection, then unloads and blows off the part before placing it back in the tray.



An OB7 Stretch alongside the Mikron A33/0 hobbing machine.

Kirby said they've run thousands of parts this way, cycling four different part numbers of similar configuration through the A33 on one setup.



The OB7 at the Mikron 132.02.

The whole package—deburring platform, compliance system, dual-wheel layout, tray-based fixturing, media specs—came out of four years of running real production volumes on real gears. Whether shops with different parts, materials, and tolerances see similar results is an open question, but Productive Robotics is at least running the proof of concept on its own floor every day.

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