New CrN Tool Coatings

Keep Going and Going and Going...

Phygen PVD-applied chromium-nitride coatings on deep-draw tools, form tools and cutting-tool edges last longer than other coatings, and they go on with minimal heating of the tool, preventing distortion and other unsavory side effects of hotter coating processes. Here are two testimonials.

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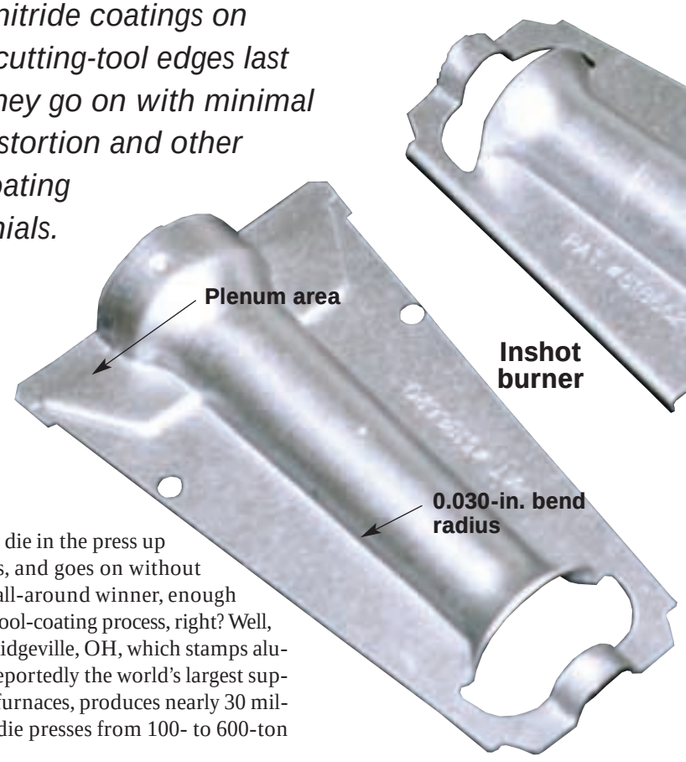


Beckett Gas stamps millions of these gas-burner parts, relying more and more on Phygen CrN tool coatings to maximize hits between sharpenings. Forms on the inshot burners, 2.5 to 3 in. wide, are critical, including the plenum area and the form edge, with a tight 0.030-in. radius.

Let's see: A tool coating that allows you to keep a die in the press up to 50 percent longer between tool sharpenings, and goes on without using distortion-causing heat. Sounds like an all-around winner, enough to convince you to convert all of your dies to a new tool-coating process, right? Well, that's what's happened at Beckett Gas Inc., North Ridgeville, OH, which stamps aluminized-steel sheet to make gas burners. Beckett, reportedly the world's largest supplier of gas-burner products for water heaters and furnaces, produces nearly 30 million stamped parts per year on seven progressive-die presses from 100- to 600-ton capacity, and 30 single-station presses.

Some progressive dies make four million stampings per year, so maximizing hits between tool sharpenings shows immediate return for this 15-year-old company. Its roots were firmly planted in 1925 when founder R.W. Beckett designed and built the Commodore oil burner for C.W. Olsen Co., which is today York International and still a major Beckett Gas customer.

"Our engineering team constantly presents us with design challenges," says Rick Roth, tool and die foreman overseeing the pressroom of the 140,000-sq.-ft. plant, "which has caused us to continue fine-tuning our stamping operations. Forming aluminized cold-rolled sheet, much of which is 0.035 in. thick, to standard tolerances on burr height (10 percent of material thickness) and with increasingly tight form radii (as tight as 0.030-in. radius) has led us to investigate our choice of tool steels and tool coatings. Aluminized coating makes for a very abrasive material and can really tear up a die."

Historically, Beckett ran dies tooled with D2, which on parts for its most popular burner, inshot burners for furnaces, would yield only 60,000 to 80,000 hits between sharpenings, dictated by burrs exceeding the 10-percent limit. Next the firm switched to powdered-metal (PM) tool steels, originally ASP 23 (now Vanadis—Beckett uses Vanadis 4 and 6 alloys) from Bohler-Uddeholm. The switch to PM steels doubled tool life between sharpenings. A TiCN multiple-layer coating, applied using the physical-vapor-deposition (PVD) process, on the PM tools added another 50 percent to tool life, getting the dies to last 200,000 to 220,000 hits between sharpenings.

"We used TiCN-coated PM for four years, very successfully," says Roth. "Then we learned of a new coating, a chromium-nitride PVD coating called ST.3 SuperTough (from Phygen, Inc., Minneapolis, MN) and decided to try it on our most critical tools, the form and cutting tools on the inshot dies. The result was another 25-percent increase in hits between sharpenings."

In addition to more hits, the Phygen coating also causes no tool distortion, an unfortunate byproduct of the previously used hot-process coating technique. "We'd get form tools back from the coater," recalls Roth, "and in some cases form rings would shrink by as much 0.007 in. due to the hot coating process. We'd have to send the tool back and have it fixed, further delaying production. The Phygen process goes on at only 925 F and therefore does not cause any distortion to our tools."

In another instance, on a newly developed form tool for drawing inshot halves (see photo), the die has to draw 0.035-in.-thick aluminized steel to a ¾-in. depth and roll a tight corner of a mere 0.030-in. radius.

"Stuffing the material quick and hard into that tight form in one hit," says Roth, "was beating up our tools. Using a hot thermal-diffusion coating process on those form tools took us to 400,000 hits before the abrasive aluminized sheet would wipe out the corners of the tools. Now we get 600,000 hits using the CrN coating."

Summarizing his experience with Phygen CrN coatings, Roth says, "We started with one set of forms for an inshot die, back in the fall of 2002, then decided to send all of the form and cutting tools for that die to Phygen for coating. Now that we've converted one complete die, we'll continue to send tools there as they need recoating, about one tool a month, until we convert nearly every coated tool over."

Galling Rocker-Arm Stampings

Toledo Technologies, Perrysburg, OH, makes roller followers, roller rocker arms and rocker-arm stampings. In April 2003, the firm faced a prototype runoff for a new rocker arm, of 1008 cold-rolled steel 0.118 to 0.121 in. thick, and found that it couldn't produce even 100 parts before galling and cracked stampings had the firm pulling tools for repolishing and coating, using TiN and TiCN coatings.

"Running the prototype parts on a set of single-hit line dies," says Brian Towns, the firm's sales manager for North American automotive, "called for 24,000 stampings, 12,000 each of two arms, intake and exhaust. Then

we entered first-year production in May, using the single-hit line dies. For second- and third-year production, we'll build a transfer die and use a portion of the single-hit tooling, so we had to solve the galling problem. Phygen did that for us."

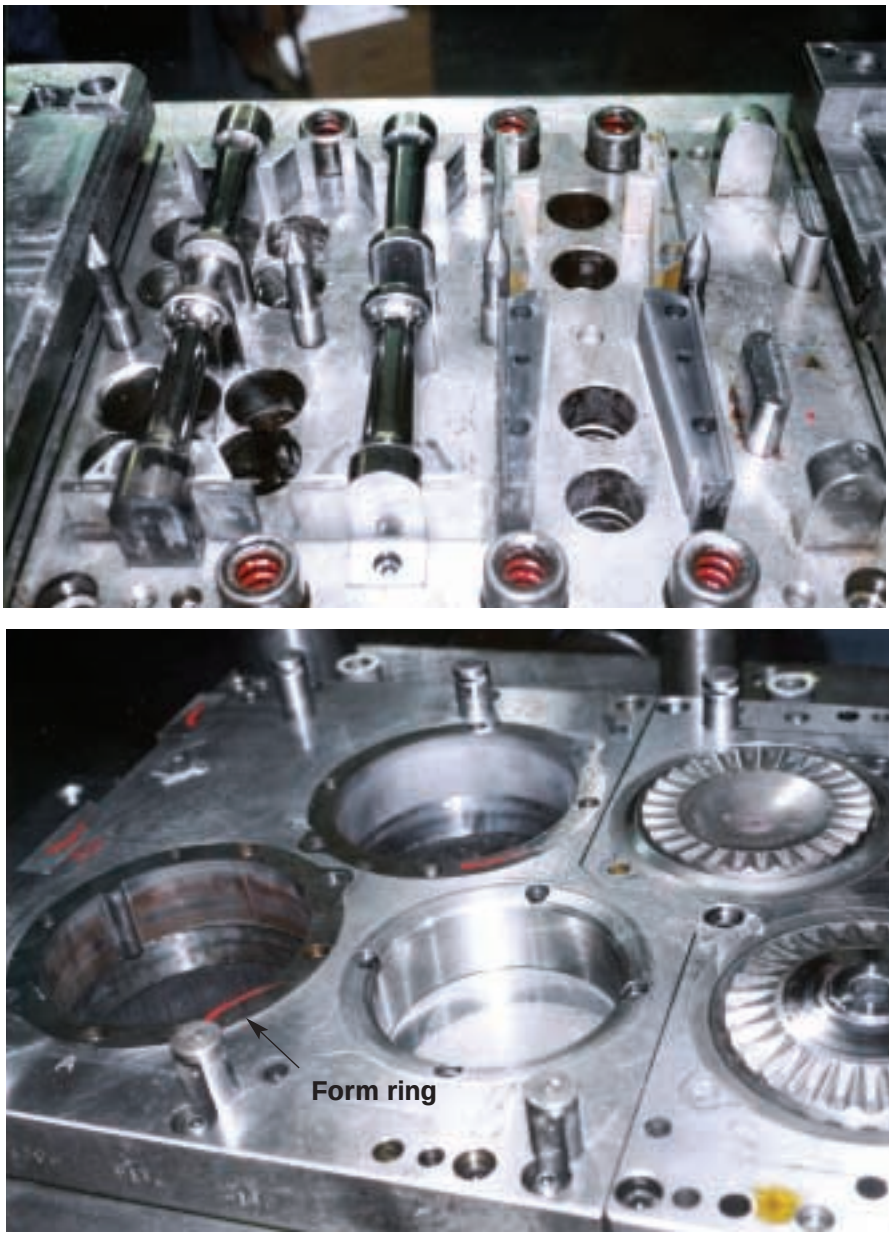
Toledo eventually ran the prototype contract in five weeks, using the Phygen CrN coating on the rocker-arm die's six forming tools (lower-die steels) and on three upper forming punches. To prepare tools for Phygen, the firm wire-EDMs worn tools, taking care to obtain "an above-average surface finish using EDM," says Larry Webb, production manager and former tool and die maker, then hand-polishes. Tools average 3 in. thick, 3 in. wide by 6 in. long. Punches average 5 in. tall, 1 in. wide by 3 in. long. All are of D2 steel.

An unexpected byproduct of the switch to Phygen CrN coatings: Toledo Technologies found it could run the rocker arms using 25 percent less die lubrication. "On the last 2500 prototype stampings, knowing how smoothly the process would run, we decided to experiment with lubrication," says Scott Smith, manager of stamping design. "We reduced lubricant supply by 25 percent and saw no difference in part quality or tool wear."

The newest of the firm's rocker-arm jobs is not the firm's first experience with the Phygen coating. Late in 2002 Toledo Technologies decided to try the new coating on another rocker-arm project, using DC53 tool steel as a replacement for carbide tools, as the firm struggled to get carbide shipped in as needed.

"We tried the DC53 uncoated, which worked pretty good for us," recalls Dan Mills, manager of product development, "particularly because we heat-treated the DC53 to Rc 63-64, as hard as we could get it. DC53 is a cold-work die steel popular in Japan and we've found it to be very resistant to galling and to distortion from wire-EDM.

"When we coated the DC53 punches with Phygen CrN, we wound up with punches comparable to or better than carbide punches, at half the cost," Mills continues. "We use the coated DC53 punch at the most critical station, the one that forms the socket for the rocker arm, where surface finish of the part is critical. Using Phygen on DC53, we've run as many as 215,000 parts before we lose the required surface finish, while running a double-coated (TiN and TiCN) carbide tool maxed out at 135,000 parts." **MF**



An inshot die, top, reveals an array of tool coatings, as Beckett looks to eventually coat nearly all of its form and cutting tools with Phygen ST.3 SuperTough. Not only does the coating maximize hits between sharpenings, but it goes on colder than other coating processes, says Beckett's Roth, avoiding distortion of components such as the form rings used in water-heater-burner flame-spreader tools, bottom.