

Outsourcing Creep-Feeding Grinding

Abrasive-Form believes many companies fail to consider the complete picture

by Dave Bode

Outsource creep-feed grinding process used in high-volume turbine part production, among other things -or keep it in-house? When contemplating outsourced manufacturing versus in-house capability, many companies fail to consider the complete picture as they try to determine whether outsourcing their creep-feed grinding requirements is preferable to keeping the operation in-house. In order to make a more informed analysis and decision, a number of factors must be examined, including cost, delivery, quality, flexibility and risk reduction.

Explained John Harig, president of Abrasive-Form, Inc., one of North America's largest creep-feed grinding outsources, "In the current economic environment, we see a growing interest among top level manufacturing executives and managers to revisit existing processes and look for new ways to trim production costs. But often, however, we find that many of the real costs of inhouse creep-feed grinding are overlooked, such as the overhead associated with direct labor costs, costs of purchasing and maintaining inventories of consumables, training costs, and management of ancillary operations like deburring or heat treating, among others.

"Many of the most profitable manufacturing operations outsource creep feed grinding so they can better concentrate on their core competencies. In fact, what we do best is take a project from the drawing to full implementation. Abrasive-Form has the most extensive track record with creep-feed



View of various sized turbine air foil components made by Abrasive-Form suggests the company's range of capabilities for various industries and a wide range of geometric requirements. AF machines parts as small as 2.5 mm and as large as 838 mm long.

Grinding in North America and has been a partner to such companies for more than a quarter of a century"

Headquartered in Bloomingdale, Illinois, U.S.A., Abrasive-Form, Inc. (AF) was founded in 1976 by CEO Ken Kummer to specialize in close tolerance linear form grinding. Back then, linear form grinding, as well as creep-feed (CF) grinding, were relatively new processes in the U.S., Kummer noted little was known about their true economic value to manufacturing and the ability to eliminate processes by grinding forms from the heat-treated solid, as well as CF grinding's use in difficult-to-machine aerospace materials.

In the 1980s, the company converted itself into a production shop and purchased its first CNC creep-feed grinder, which enabled it to pursue a new tier of repetitive-run production parts. Also in the 1980s, AF began machining turbine

components, which ultimately led to its recognition today as a leader in high volume turbine part production.

In the 1990s, Abrasive-Form dramatically increased its capacity through the addition of machines, capable machine operators and support staff. In 2000, the company merged with Roselle Tool, Inc., giving it an expanded capability to engineer and rapidly fabricate tooling for new projects. Also in 2000, AF moved into a modern 5760 m² facility to accommodate its growth and currently has 38 machines and some 80 employees serving customers worldwide in industries as diverse as gas turbines, diesel engines, hydraulic pumps, hand tools, medical equipment and clipper blades.

Creep-feed grinding is a highly accurate, efficient method of machining intricate forms and slots into a wide variety of materials. In contrast to conven

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Engine Components



Creep-feed grinding's ability to remove a large amount of material in one pass, as shown by the depth of cut in the partially machined gas turbine blade dovetail section at right, helps make the process very cost effective. Completed part after all cuts have been made is shown at left. AF engineers the machining routine needed for each completed part.

tional grinding, where the grinding wheel is gradually lowered as it reciprocates over the workpiece, the CF grinding machine plunges a formed grinding wheel deep into a workpiece and then economically moves the piece under the wheel, yielding a finished part in only one pass. The grinding wheel's form is automatically maintained by frequent dressing.

Further, unlike milling where multiple operations might require multiple setups with different tooling, AF can design innovative fixtures to process multiple operations or even multiple parts simultaneously, rather than be constrained to sequential operations or batch processing. This, of course, makes the operation more efficient and shortens cycle times.

Surface finishes achieved with CF grinding are normally much better than those obtained with conventional grinding, and the process typically does not leave troublesome burrs, Harig noted. Indeed, the process is described as a manufacturing technique combining rapid stock removal rates, complex part geometry and superior surface finish.

Other CF grinding benefits include: improved part quality due to the CF process' ability to hold extremely tight tolerances; elimination of part distortion during heat treating because parts are ground after hardening; improved fatigue resistance because the process interjects such mild residual compressive stresses; shorter lead times and lower inventories due to fewer manufacturing steps and reduced need for work

in process and finished goods inventory; and applicability to almost any material including all steels, alloys carbide and ceramics.

Tremendously high forces are generated during CF grinding, requiring machines specially designed for rigidity and power. "The negative point about creep-feed grinding .if it can be considered a negative point .is that the equipment to do it economically is very expensive," explained AF Product Manager Neil Fehr. "The average machine with adequate support features costs around US\$500 000, and machines can cost as much as US \$1 million. The machines are also costly to maintain and are best run by experienced specialists. There are few, if any, user-friendly books on the process, which has dozens of variable parameters happening all at once."

Most of Abrasive-Form's CF grinders, which range from 4 kW to 78 kW, are Magerle and Blohm CNC units with Siemens, GE Fanuc or Allen Bradley

controls. Also included are Edgetek, Jones & Shipman and Bridgeport Harig machines.

Currently, according to Fehr, AF has had its greatest successes in industries like turbine component manufacturing and aerospace where parts contain high nickel alloys .because tools to mill or broach them are very expensive and cannot consistently hold CF grinding's tight tolerances of as small as two microns.

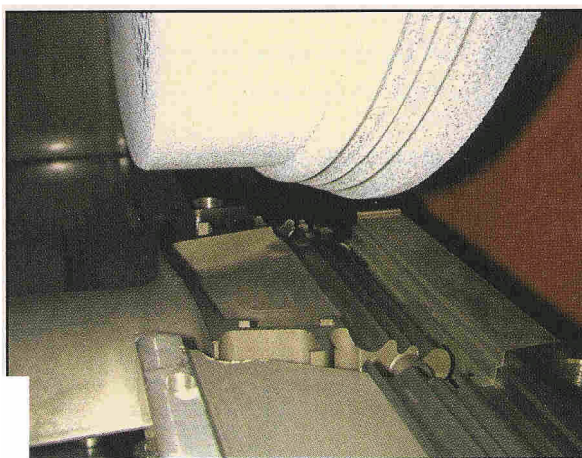
As a leading subcontractor to the gas turbine industry, AF .which is ISO 9002/ AS9000 certified .said that since

1988 it has machined over 500,000 turbine blades, buckets, vanes, nozzles and shrouds. Customers include GE Power Systems, Rolls-Royce Energy Systems, Siemens Westinghouse and GE Aircraft Engines.

AF offers a wide range of grinding-related services to suit its customers' requirements. It can, for example, simply grind a customer's blanks or supply him with completed parts. The company, which is well-known for its inhouse tooling design and production, can also design and build tooling to meet the customer's specific manufacturing objectives.

"In contrast to our customers, Creep-feed grinding is Abrasive-Form's core competency," said Kummer. "From the cost standpoint, we can often bring our years of experience, our highly capable people and our up-to-date machines to bear on our customers' precision linear form grinding requirements more cost-effectively than they could do it themselves."

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The formed CF grinding wheel is lowered into place to grind the gas turbine blade dovetail form on the rough casting. This view shows the wheel raised above a just-finished part. Abrasive-Form uses proprietary tooling design concepts to optimally secure tooling.