MYTHS vs. Facts:

The Realities of Grinding Aerospace Components

By **Heather Tunstall**, Associate Editor

The aerospace industry has been changing rapidly over the decades, and so has grinding technology. The perception of grinding from 15 years ago is no longer accurate as the process has evolved into an evermore highly-advanced set of technologies. So, how does an operator know the truth amidst out-dated knowledge? Let's examine the myths and facts of grinding applications.

MYTH: Grinding is the most expensive, highest cost-per-part operation.
FACT: This is no longer necessarily true. To consider the cost of the operation, one must take into account not only the process, but also the contemporary equipment and all of the benefits that go along with the new technological advances.

"Quite often, once customers look into the total manufacturing cost of a product, taking into consideration the modern equipment as well as the modern consumables such as grinding wheels and dressing tools, they may find out that the manufacturing cost-per-part is not nearly as expensive as following the traditional processes," says Chris Stine, Vice President – Profile, United Grinding Technologies, Inc.

New technology includes some machines that can do multiple processes in one setup, such as turning and grinding.

Together, these new technologies – and others – enable reduced costs of tools, setup time, space, and operation times. All of these add up to potential savings in certain processes as opposed to alternative methods.

MYTH: Grinding is the slowest, least productive process.
FACT: This misconception is actually baseless nowadays. Often, precision machining draws a perception of lower productivity or speed, but today's grinding metal removal rates would far exceed many users' expectations, according to Stine. "In the case of aerospace and super-alloys that cannot be machined with conventional milling or turning processes, the application of grinding is far and away the most productive and cost-effective method for precision machining," he says. "With results yielding exceptional surface finishes, complex feature shapes and tolerances within the 0.0001" range, grinding is the process of choice."

MYTH: If it ain't broke, don't fix it
FACT: Some manufacturers have the mentality that if their process has worked in the past, they shouldn't change it. This may be a counterproductive mindset.

Operators must continuously educate

themselves on the newest technologies in order to get the full benefit of modern machines. With the new materials being ground in aerospace applications, there are new requirements on the machines. Machines must be highly flexible and rigid to effectively grind the parts without changing the structure of the surface or without chipping a coated material. It is important that the operator be aware of the new challenges and the technologies to deal with them.

"Newer wheels and technologies in the superabrasives area require different dressing and tooling technology," states Hans Ueltschi, Vice President – Cylindrical, United Grinding Technologies, Inc. "The newer generations of machines have features to deal with that, which are sensors, and ways to monitor the process from the dressing side or from the grinding side, or from the deterioration of the wheel, so that the process can be maintained automatically."

Adding the new technology and changing the process to comply with the updated equipment allows for significant increase in productivity.

"Making a one-for-one exchange on a machine is how the market operated in the past rather than looking at the whole value stream of how to make the part," Stine says. "It's very seldom that there are one or two specific variables that you modify." The biggest benefit comes from looking at consolidating processes and using the new machines and technology to its full potential.

MYTH: CNC machines are not efficient for low-volume parts manufacturing.
FACT: In the past, it was cumbersome to change over and set up CNC machines. Now, with the new generation grinding machines, programming can be done offline in a simplified manner.

"Now, we can virtually set up a machine offline first on a PC and look for interferences, and set up the tools in a matrix of where the tools or the workpieces are going to sit, and where the clampings are going to be and so forth, and this way, you reduce the time it takes to go from one part to the next," Ueltschi explains. "In general, that has dramatically changed over the last few years, because the software is much more powerful."

Grinding software has also become much more intelligent. The basic concepts are now in the control, so that feeds and speeds can be calculated and a new part can be ground very quickly – a stark contrast to where the industry was 10 or 15 years ago with the old programming technology.

MYTH: Grinding is a 'Black Art' that requires highly specialized and skilled operators that have been in the industry for many years.
FACT: New controls and new software technologies reduce the need for these highly-skilled, experienced operators. Companies can bring new grinders up to speed extremely quickly through tutorials and external resources, such as abrasive suppliers, coolant suppliers, or even Grinding.com.

The expertise is typically built into the controls and software of the machines themselves. The software looks at part geometry, material, and tolerance requirements for the best grinding parameters, reducing or eliminating the need for operators to develop the highly-specialized ability to detect a perfectly-ground part.

MYTH: Grinding is strictly a finishing process
FACT: While grinding is known for its well-deserved reputation of extreme accuracies in surface finish, it is also useful in some applications as a metal removal process. Often, it is economical to complete the part on one machine, removing the metal and finishing the part all with the same grinder. This also ensures optimal quality, because each step is an improvement over the last step.

Turbine blades, fuel injector needles and turbo charger shafts are examples of aerospace parts that go directly from an investment casting to a finished product with grinding as the only operation. With difficult workholding setups, multiple machining processes would jeopardize the extremely high quality necessary for the parts.

"[With multiple clampings], you would have to get the part concentric, or the dimensions have to be balanced to each other," Ueltschi says. "You'd have additional processes to get it to that status, so you may as well start that way."

New superabrasive wheel technology is now able to handle such metal removal rates. The wheels now has longer lifecycles and are more consistent than in the past, making grinding an efficient done-in-one operation.

"There are some examples where locating the part on its datum surfaces is very challenging, and if you did that numerous times, it would be nearly impossible to maintain the relationships that you need to, so being able to hold onto it one time and finish it becomes extremely important due to quality standards," Stine explains.

COMBINE THE FACTS

Grinding provides manufacturers with a means to create extremely accurate parts with ideal surface finishes. Now, metal removal rates are becoming an added advantage as new materials become more difficult to machine with traditional methods. Machines with added features such as advanced software, wear-resistant abrasives, and multiple spindles enable companies to complete parts faster and better than ever before.

Manufacturers who educate themselves on all of the benefits that grinding has to offer and who transfer that knowledge to their employees and coworkers will reap the rewards – both in terms of productivity, and financially. The best way to gain knowledge is to research via resource websites, ask suppliers, and attend conferences and workshops. In the end, grinding will prove to be an evolving, innovative industry that continuously changes to meet the needs of aerospace manufacturers. **A**

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