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TECH TALK

BY JOHN D. MANLEY

Reducing stress on aerospace parts post-9/11

As most readers are acutely aware, the aerospace industry, especially post-Sept. 11, now faces tough regulations. Similarly, manufacturing companies in the aircraft industry must meet stringent requirements.

As outsiders, we often assume that this engine of the economy runs flawlessly, but in reality, it is a challenged industry facing global competitive stresses. More relevant to this article, however, are the stresses encountered by subcontractors' parts in flight, and how these stresses are overcome by processing parts with sophisticated grinders.

Axial, torsional, compressive and thermal stresses all come into play during flight. From the moment a plane takes off, the landing gear struts compress and extend, experiencing phenomenal load factors. The wing flaps and rudder rotate under enormous stresses while their accompanying hydraulic actuators endure incredible pressures. Most significantly though, the turbine's shafts, blades, vanes and the encompassing housing, undergo significant thermal stresses.

So how does the aerospace industry combat these stresses? The number one method is to avoid enhancing the "weakest link", i.e. don't introduce stress in the manufacturing process. Having sharp inside radii on shafts, marred chrome surfaces on cylinders, or recast layers on EDM-generated blade/vane surfaces is troublesome. Grinding, if implemented correctly, offers controlled in-feeds, massive coolant flow and the ability to contour the chosen form while maintaining a fine surface finish.

Numerous aerospace parts are dramatically affected by grinding.

Grinding of turbine shafts, for example, allows chrome plating to be kept to an optimal and consistent depth, unlike turning where finish and stock removal results can fluctuate greatly.

Creep-feed grinding of vane and blade root forms generates complex five-axis forms within 0.0001" form profile, which dimensional stability traditional chipmaking longs to achieve.

Unlike milling or broaching, there is no need to experiment with complex cutting tools and broaches that are often very expensive and lead-time intensive. The life of the broaches, especially in difficult materials such as Inconel 100, with very high nickel content (see http:/www.mmsonline.com/onlinetools/glossary.html then search metals/glossary/Inconel), is so poor that rough grinding of forms is becoming the only viable alternative.

With creep-feed grinding, a conventional abrasive or vitrified CBN can be sculpted to the desired "root form" instantly with a turbine disk dresser, whose form is downloaded and generated under CNC control from a CAD profile. The finished result is a burn-free (no thermal stresses), consistent part.

Lastly, turbine housings, requiring multiple parallel locating surfaces, are well suited for rotary table grinders with universal wheel-head setups that provide tight concentricity. Traditionally ground in multiple setups, these parts are now processed in a single productive chucking.

Probably the greatest change affecting the aerospace industry is the trend towards automotive manufacturing techniques. Large-scale manufacturing, where manufacturers produced 100,000s of similar blades each year, is being replaced with responsive quick-change work cells or even subcontracting to more cost effective subcontractors. This philosophy has become reality, dramatically changing old ways.

Behind closed doors the aerospace industry is far more complex than the public perceives. It is driven by stressful applications, filled with grinding requirements, and continuously pushed towards batch downsizing. It's an exciting, but changing business, with opportunities for those who are willing to invest in the appropriate technologies. CMM

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