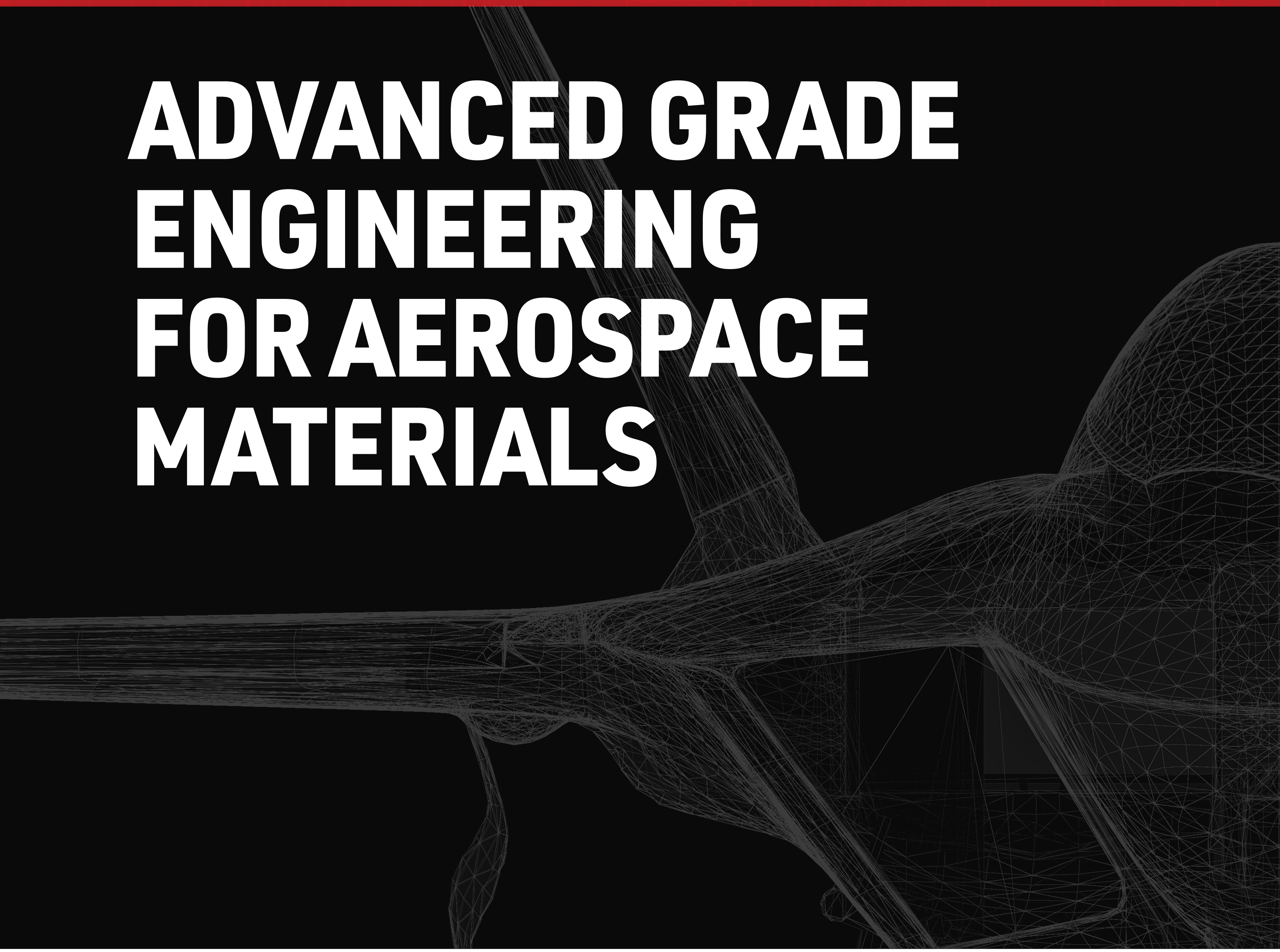
ADVANCED GRADE ENGINEERING FOR AEROSPACE MATERIALS



H.B. Carbide

Addressing the challenges of machining aerospace materials places critical importance on cutting tool design and composition. At the core is grade selection, which not only affects tool life, but also the ability to consistently machine components that are high value and often complex.

1. CUTTING TOOLS ARE BUILT FROM THE GRADE UP

Carbide grades are the basis of many of today's most advanced cutting tools. They are engineered to provide strength and wear resistance for high performance and predictable tool life. As consumables, they wear, but ideally at an acceptable rate while achieving performance until they are indexed or replaced. Proper grade selection is the start to successful machining. The main aspects of any grade are cobalt content and grain size, with performance also influenced by geometry and coating. In tungsten carbide grades, the hard, brittle carbide grains are cemented together by soft but tough cobalt through sintering. More cobalt equates to softness and is more difficult to break, referred to as toughness or impact resistance. Smaller concentrated grains give the substrate better wear resistance for longer tool life, but less impact resistance. By varying grain size and cobalt percentage, cutting tool manufacturers make carbide grades either tougher or harder.

2. MATERIAL DIFFERENCES

Standard ISO material groupings have been around for hundreds of years – Steel (P), Stainless Steel (M), and Cast Iron (K) and have a wide range of machinability. The evolution of industries, like aerospace, has seen the emergence of newer materials such as Superalloys and even stacked materials where carbon fiber is sandwiched with titanium and aluminum. Airframe, landing gear, and engine components fall within the newer S" category, which includes nickel-based materials such as Hastelloy, Waspaloy, and Inconel 718. These groups maintain mechanical strength and structural integrity even in extreme heat and are ideal for aerospace. The metallurgical properties that enable this also makes them difficult to machine. Higher cutting forces are required, which generates higher heat and limits cutting speed and, consequently, productivity. Among the more obvious machinability challenges is abrasiveness. Bottom line, superalloys consume carbide.

3. ENGINEERING GRADES FOR THE JOB

This creates the need to optimize machining through skillful selection of cutting tool grades, coatings and geometries – as well as the process – to effectively machine aerospace components.

Substrates for aerospace machining are engineered for higher cutting forces, offer high temperature resistance and superior cutting-edge integrity to prevent corner and micro chipping. To get there, cutting tool manufacturers create solutions with optimal blends of sub-micron carbide grains and a slightly higher (than normal) use of cobalt binder, and even other materials such as chromium carbide that prevent particles from growing during the sintering process. This results in both toughness and wear-resistance. Typically, a cobalt content of 6 -12% works, offering high hardness and abrasion-resistance. Grades with these characteristics, such as H.B Carbide's high performance grade HB-710, which has been tested in several aerospace applications and has shown tool life increases in high temperature alloy, Inconel materials of 20% to 30%.

4. QUALITY

Long tool life is obviously a desirable feature. It makes economical use of the tool, eases the process for operators, and keeps production running. But the biggest advantage of longer tool life is predictable quality imparted to the component. This is especially true with aerospace given the cost of material and the number of processes performed along the journey to becoming a finished part. Scrapping workpieces is an expensive proposition, and anything sub-par will not pass QC. Thus, long tool life only matters if operations stay within tolerance as the carbide wears. This has been accomplished with HB-710. It starts with materials consistency, which is U.S. sourced, moves into exact percentages of cobalt binder and carbide grain sizes, and ends with a process that is consistent and repeatable.

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H.B. CARBIDE ADVANTAGE

CAN DO FOR YOU

- **Responsible corporate citizen -** social, cultural and environmental responsibilities
- **Reliable partner** for global supply & support
- **Sustainability –** Environmentally focused, including recycling of carbide scraps
- **Focus on customer experience –** Service Supply & Technical Support
- **Material innovation –** Optimized application specific grade selection
- **Advanced production controls** and techniques ensuring quality and consistency

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