Super Abrasive tools for grinding advanced materials in the Aerospace Industry

AMIT KOUL
General Manager - Sales & Marketing (Abrasives)
Saint-Gobain Abrasives

Norton Abrasives (part of the Saint Gobain group) provides high-performance abrasives for cutting, shaping and polishing turbine blades used in aerospace engines and gas turbines. Norton continues to innovate, develop and produce a range of products for different grinding applications to meet the growing demand for new materials and the latest production processes in the aerospace industry.

Aerospace Industry is focusing on building innovative engine designs that burn fuel more efficiently. These new lean-burning engines run at temperatures much above the safe operating temperatures of today's nickel-based super alloy engine components. As a result, preference has shifted towards new materials such as Titanium Aluminide (TiAl) which have strong thermal stability and creep properties, lower density corrosion resistance and higher specific strength.

Abrasive Grinding of Titanium Alloys

Titanium alloys are an excellent solution to reduce the weight of an aircraft without compromising the aircraft's structural integrity and are used in aero armor plating, airframes and engine applications.

Titanium is known as the "universal solvent" among metallurgists because it dissolves and reacts practically all metals and ceramics when molten or at high temperatures.

As far as manufacturing of various parts using TiAl is concerned, Abrasive technology plays a vital role in aerospace applications where grinding needs to be precise, faster and cleaner. During abrasive grinding, titanium's reactivity results in the development of wear flats or blunt grains and capping or sticking of titanium aluminide to the abrasive grains. Burning, cracking, subsurface deformation, residual stress, and other surface damages are issues that must be handled appropriately during the grinding of this alloy.

These alloys also have high specific yield strength, high specific stiffness, good oxidation resistance, resistance against titanium fire and improved fatigue properties at high temperatures.

Diamond Superabrasive wheels are proven to consistently draw the lowest power with minimal capping in comparison with other two core abrasives – Silicon carbide (SiC) and Cubic Boron Nitride (cBN). Diamond wheels also have the most stable power curve as a function of stock removed and have the ability to remove 48,000 mm3 of material without damaging components.

Norton Winter Paradigm Diamond wheels offer a superior solution for grinding new aerospace materials, titanium alloys, advanced ceramics and composites. These wheels offer an excellent choice when looking to achieve and maintain a precise profile.

Paradigm Diamond wheels combine metal bond and abrasive technologies, which is ideal for maintaining a precise profile during the grinding of difficult to abrade materials like TiAl. Paradigm wheels have significantly better performance, with double the material removal rate of SiC. The Paradigm wheel's total tooling cost is also lower compared to that of the price of SiC or EP (Electroplated) diamond wheels when grinding TiAl.

Controlling and decreasing heat production during grinding is critical to achieve success in TiAl component manufacturing. Heat is removed from the grinding zone by using the best grinding wheel coolant and application. Proper wheel dressing procedures keep wheels sharp and reduce frictional heat generation. After precision geometry is ground, a final step of deburring and polishing is undertaken to generate the required surface finish. Norton Quickchange discs, NoRax polishing belts and non-woven abrasives are other abrasive products used in deburring and polishing operations which offer high surface finish and endurance to the components.

With the success of Paradigm diamond wheels in grinding TiAl, as well as carbide and ceramic cutting tools, Norton Saint-Gobain Abrasives is evolving along with aerospace customer requirements to address these additional emerging materials. TiAl represents only one such effective change in materials and there are many such upcoming developments in the aerospace industry and Norton is constantly striving to help its customers attain high functionality and more productivity in optimized costs.