High pressure coolant aids tough material machining

_HPC makes big impact at aerospace manufacturers_

The role of coolant when machining aerospace parts is undergoing a period of evolution. Machine shops have for many years used coolant by directing tubes into the machining zone. But now, by applying coolant at high pressure precisely at the point of cut between workpiece and cutter, new advantages are available. Broad access to this technology is now possible via CNC machines with higher coolant supply capacity, as well as by adopting new tooling concepts.

**Making a difference**

If coolants are to be effective and make a difference in modern machining they need to be applied in sufficient volume as correctly directed high pressure jets. Simply having a stream of coolant or even flooding the machining zone is no longer sufficient. Qualified application of high pressure coolant (HPC) can make a distinct difference as regards:

- chip formation, control and evacuation
- distribution of heat
- component quality
- surface integrity
- tool life
- productivity

Although HPC is beneficial when machining stainless steel and low carbon steel, it is when machining more demanding materials, such as titanium alloys and heat resistant super alloys (HRSAs) that the practice makes a more dramatic difference. It is of consequence then that a number of recent developments have made HPC even more interesting and more readily available.

**Pioneering the concept**

During the 1980s and 90s, Sandvik Coromant developed the first version of Jetbreak, a high pressure coolant system. Based on research, directed jets of coolant (100-1000 bar) became part of the cutting tool used to machine materials that were demanding in terms of machinability and chip control.

A lot was learnt about the effect of coolant pressure distribution and coolant nozzle size. By varying the jet data, a variable chip-former was achieved and it became possible to guide stringy chips in a desired direction and even improve chip length. Special installations were made on a limited scale to solve problems in the oil, aerospace and bearing industries.

**HPC as standard**

Many modern CNC machines can deliver coolant at pressures of 70-100 bar, which is sufficient to incorporate HPC. An essential basis for HPC machining are modular tools, partly to ensure quick tool changes for minimizing machine stoppages but also to secure coolant connections and channels from the machine to cutting edge. The modular quick-change tooling system Coromant Capto formed the basis for the Jetbreak development and is today the foundation for CoroTurn HP, the new standard high pressure coolant tooling.

Coromant Capto is ideal as a modular platform, designed with internal coolant supply and the ability to supply coolant at high pressure. It is an established ISO standard and option on many CNC machines with stationary and rotating tools.
HPC for turning
CoroTurn HP features nozzles mounted close to the cutting edge, accurately projecting high velocity jets to force the chip off the insert face and cool and break the chips into smaller lengths, helping them to evacuate. The standard nozzle size is 1 mm with 0.6-1.2 mm nozzles available for specific optimization.

Apart from higher security brought about by better chip control, HPC can introduce considerable tool life extensions (up to 50 percent), and the potential to increase cutting speeds by up to 20 percent for ISO S classified materials.

Cutting speed affects temperature, and subsequently tool wear, more than any other factor. Increasing the cutting speed in titanium reduces tool life dramatically, but when the feed is increased on a similar scale, a smaller reduction in tool life is typical. However, high feed is not always an option because of higher cutting forces as well as the effect on chip control.

Internal turning is also an area where HPC can provide an important role to help ensure good chip formation, as well as improving shearing properties in demanding materials such as titanium. When machining relatively large, deep holes with boring bars, such as in landing gear components, modular tooling at the back as well as the front end of the tool can be advantageous.

HPC for milling
HPC can also be advantageous in milling. For example, CoroMill 690 is a long edge milling cutter dedicated to titanium alloys with facilities for HPC machining. With numerous inserts making up each long radial edge, coolant nozzles have been positioned to provide the benefits of high pressure jets for each insert. In cases where the whole axial depth capability of the cutter is not used, plugs can be used instead of nozzles, in that way avoiding wasted coolant pressure through unnecessary jets.

To ensure the right values for coolant flow and pressure, a dedicated calculator is used to best apply HPC for the cutter being used. The calculator arrives at the size of nozzles that will optimize the effect and can reduce flow requirement while maintaining a high pressure flow of coolant through selected holes.

Surface finish
Titanium is chemically reactive and as such is prone to a welding effect between workpiece and the cutting edge during machining. This phenomenon is often a problem as it affects tool life, particularly as it causes the re-cutting of chips and chip-jamming of hardened chips. HPC can often be a solution when machining titanium and other smearing materials.

The application of high pressure machining should not be seen as a means with which to compensate shortcomings caused by other factors, such as unsuitable insert, instability or incorrect cutting data. HPC is an optimizer when operations are established correctly. The concept provides the means for shorter cycle times, improved component quality consistency and higher process security in turning and milling.

The need to optimize various machining operations, especially when chip formation and the effects of demanding materials are prominent makes HPC an attractive option, particularly as it available readily on modern machine tools. Furthermore, the disturbance due to swarf accumulation is critical as these machines are to a rising extent used by machine shops making aerospace components from demanding materials.

About Sandvik Coromant
Sandvik Coromant, a product area within Sandvik Tooling, is a global leading name in cutting tools for turning, milling and drilling as well as modular tooling systems for lathes and machining centres. With some 8,000 employees, Sandvik Coromant is represented by its own sales personnel and specialists in more than 60 countries. In addition there is an established distributor network.
state-of-the-art Productivity Centres located around the world provide customers and Coromant personnel with training in tooling solutions for increased productivity.

For more information visit the website at [www.sandvik.coromant.com](http://www.sandvik.coromant.com).

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**Image 1**  
**Caption:** Sandvik Coromant’s CoroMill 690 with GC2040 insert for Milling

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**Image 2**  
**Caption:** Sandvik Coromant’s CoroMill 690 Long Edge Cutter for Milling

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