TITANIUM –

Reliable Threads for a Material of the Future

Concept Study | AMB 2026 | Schumacher Precision Tools, Remscheid
Development Status: September 2026 · Target Date: Q1/2027

Background

Titanium is one of the materials that most clearly reflects technological progress. Where maximum mechanical strength must be combined with low weight, corrosion resistance, and long-term reliability, titanium is often a key material today. This is particularly true for two industries where the demands could hardly be higher:

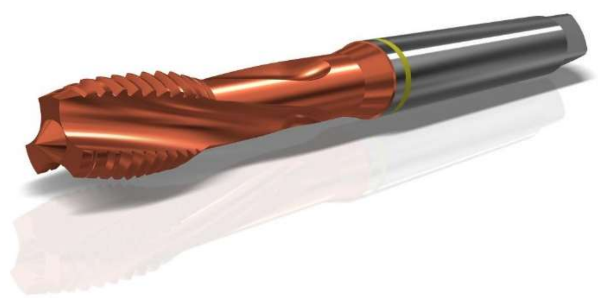
Aviation and medical technology.

This is precisely where Schumacher Precision Tools' development project comes in. The goal is to create a machine tap that makes the production of internal threads in demanding titanium alloys more economically manageable and, above all, more process-reliable. The project's internal objectives deliberately target the "S1 Titanium" machining class, using Grade 5 titanium as the current test material and envisioning a range of applications from Grade 2 pure titanium to medical and aerospace-specific titanium alloys.

A Material at the Intersection of Lightweight Construction, High Performance, and the Human Body

Titanium's unique role stems from an unusual combination of properties. Commercially pure Grade 2 titanium offers high corrosion resistance, good ductility, and formability. Ti-6Al-4V – Grade 5 titanium – combines these characteristics with significantly higher strength and is considered one of the most versatile titanium alloys available. Material manufacturers list Ti-6Al-4V, for example, for aircraft structures, engine and rocket components, and prosthetic implants, among other applications; the particularly pure ELI variant, ASTM Grade 23, is used for applications where fracture resistance is critical.

The aviation industry demonstrates particularly impressively just how innovative this world of materials is. Airbus now relies on additive manufacturing for titanium components in the A350: A 3D-printed door locking shaft, for example, replaces ten previously separate components and, according to Airbus, is about 45 percent lighter than the conventional version.



In 2026, Airbus will go one step further and also integrate large titanium structural parts, such as those in the A350 cargo door. This technology opens up the possibility of additive manufacturing for structural parts with very large dimensions.

In medical technology, the connection between materials and high-tech is direct. In some spinal systems, for example, implant bodies made of commercially pure Grade 2 titanium are combined with screws made of Ti-6Al-4V. Novel hip implants take personalized high-tech medicine even further: one-piece solutions made of Ti-6Al-4V, whose geometry is derived from the patient's individual anatomy.

Titanium is thus far more than just a lightweight metal. The material enables lighter aircraft, high-strength structural components, and customized implants. Yet it is precisely the properties that make titanium so valuable in the final product that pose significant challenges for manufacturing.

When the High-Tech Material Becomes a Test of Strength for the Tool

Titanium alloys are difficult to machine – and the production of precise internal threads, as with many other applications, is considered the ultimate challenge. Of particular note here is the material's low thermal conductivity,

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which causes heat to concentrate heavily in the cutting zone, as well as a pronounced tendency toward adhesion and cold welding. Material buildup, increased friction and tool wear are possible consequences.

For the development team at Schumacher Precision Tools, it was precisely this extreme scenario that served as the starting point for a new tool design. Building on the existing 32800 geometry, the goal is to create a machine tap that not only performs well in specific applications but also achieves significantly higher process reliability across a broader range of applications. To this end, the existing in-house geometry was first compared with selected market benchmarks. External metallurgical and materials science studies helped to better understand novel titanium alloys and their applications. These findings led to the development of several tool variants for the test and development environment.

The development work does not focus on a single variable. The flute and chamfer geometry are designed to better control chip formation and chip evacuation; at the same time, process forces and, above all, friction during reversal are intended to be reduced. In addition, Schumacher is investigating a multi-stage combined surface treatment that, together with geometry and operating parameters, is specifically tailored to Grade 5 titanium. The specific implementation remains, by design, part of the company's proprietary development know-how.

The measurement data determine the next development step

The state of development as of September 2026 already clearly indicates where the technical challenge lies. The current tool geometries were repeatedly tested on a CNC machining center using Grade 5 titanium throughout the year. Test parameters included M8–6H, a 6.9-millimeter core hole diameter, a usable thread depth of 2 × D, Soft-Synchro clamping, emulsion cooling, and cutting speeds ranging from 4 to 8 m/min. A ProMicron tool monitoring system records torques and forces during the machining process throughout the entire development series, which lasted several months. A test conducted in the spring of 2026 showed that during the initial cut, the torque decreased from approximately 19 to 15 Nm as the test progressed. The reversing process, however, was initially problematic. While the torque during chip shearing initially remained at approximately -7 Nm, the load increased progressively during the reversal phase. The measurements confirmed that thread cutting works in principle, but that the increasing friction during reversal still needed to be optimized. Thanks to automated tool design using the ToolSimulation module (via the rapid prototyping process) and blank-based manufacturing, optimized tool variants could always be returned to the test loop within a few weeks – using various titanium alloys – and the reverse cutting issue was also resolved through a combination of the cutting angle on the back edge and surface treatment.

AMB 2026: A Look Inside the Development Lab Instead of an Early Product Launch

The AMB, taking place September 15–19, 2026, in Stuttgart, is one of the most important international gatherings in the metalworking industry, bringing together machine tools, precision tools, measurement technology, and digitalization in one place. For Schumacher, this offers the opportunity to present the titanium development not as a finished production product, but as an engineering preview: an authentic look at a tool being developed for one of the most demanding materials in modern high-tech applications, set to hit the market in early 2027. Further rounds of optimization have, in particular, reduced friction during reversal, further refined the geometry, and validated the combined surface treatment. The solution is currently undergoing final validation under near-production conditions with regard to process reliability, tool life, and thread quality. A tool for titanium must meet the same standards as the material itself: maximum performance where conventional solutions reach their limits.

Schumacher Precision Tools – Engineering the thread for TITANIUM.