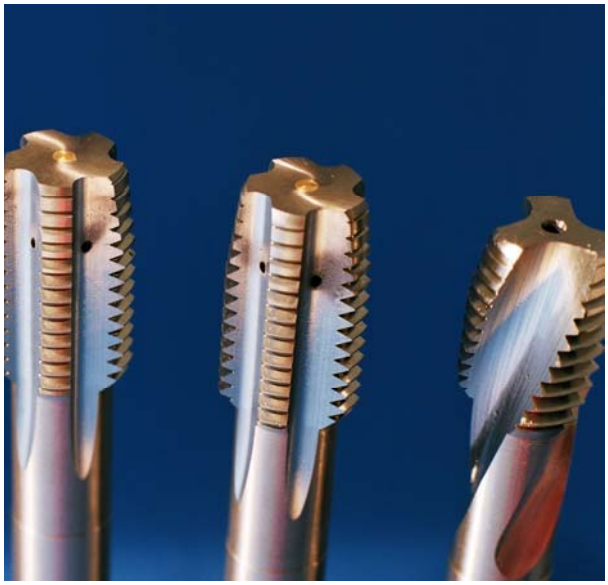
R&D Report:

NEW TECHNOLOGIES FOR SOLID CARBIDE TAPS AND HSS-E/PM FORMING TAPS

For employment in the automotive industry

The Enterprise

Schumacher Precision Tools – founded in 1918 – is an internationally renowned producer of cutting edge precision tools and logistic services.



Schumacher's activities include the development and production of special thread cutting tools (taps and forming taps) for the sectors engine construction, automotive supply, the aviation industry and general machine construction.

Shareholder and Managing Director: Dr.-Ing. Bernd Schniering.

Schumacher has established close research cooperation with Aachen University of Technology (RWTH) over the last two decades with the objective of continuously improving our customer-oriented products and services. The realization of numerous research projects in the sectors production methods, management tools and logistics for SMEs have strengthened our company's competitiveness and ensure a top level position vis-à-vis our competitors.

The Challenge

Due to a substantial increase in worldwide competition, all major automobile cooperations implement ambitious programs to reduce costs and increase productivity. The active involvement of suppliers into the planning processes has become a common instrument to decrease average cost per unit while maintaining a high quality level. This procedure represents a challenge to many small- and medium-sized suppliers.

Schumacher provides a variety of more than 10,000 different tool specifications – individually adapted to the respective case of application – through a carefully-developed network that comprises all relevant steps from tool design and production to after-sales support by our service engineers. Standardized processes enable our experts to refrain to technical know-how from innumerous applications in tooling and enable precisely-tailored service solutions for the automotive industry. Especially within the so-called ramp-up phase, these characteristics can be of deciding influence for a supplier's competitiveness – for instance when it comes to render possible the design, production and delivery of special thread cutting tools within five days (for further information, please see Schumacher's ***5 days Service*** at www.schumachertool.com).

New Developments Solid Carbide Taps and Forming Taps

In cooperation with partners from the automotive industry, carbide producers and hard-coating experts, Schumacher has developed a solid carbide taps series and an HSS-E/PM forming taps series for employment in the sector engine construction. Both of these series meet the latest requirements in terms of process security and cost objectives.

These new threading tools have been employed successfully with the following components in both blind and through holes:

Application A

HSS-E/PM Thread Forming Taps for tooling ADI- Crank Shafts (Austempered Ductile Iron – ADI 800)

When developing an appropriate geometry for forming taps, the particular characteristics of the alloy ADI 800 in terms of high resistance, ductile yield as well as high endurance and resistance to wear had to be borne in mind.

Moreover it was necessary to prove that moulding this material had a cost advantage over cutting and additionally contributed to the customer's process security.

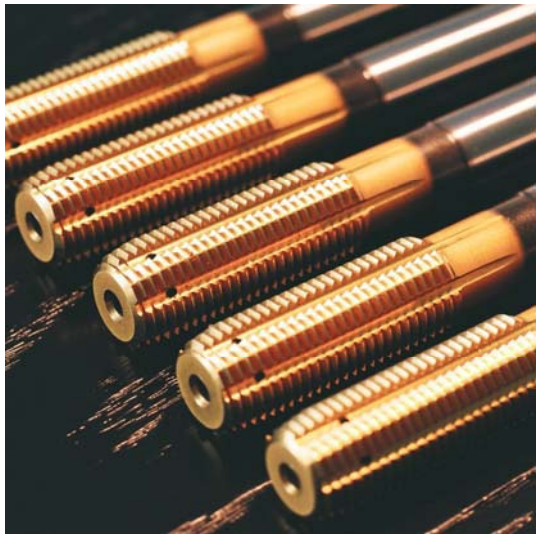
During this project, the parameters

- Polygon geometry,
- Basic substrate (various powder metallurgic steel qualities - HSS-E/PM) as well as
- Surface treatment and coating systems

were modified for the test series. In addition, the respective coolant was added through a broad range of supply techniques in search for the best constellation.
The result was a series of forming taps with individually-adapted geometries, an optimally-balanced TiN-PVD layer and a highly-efficient supply of central coolant with radial outlets.

The R&D Environment

Crank Shaft



Material and Application

Austempered Ductile Iron – ADI 800	
Blind hole	2,5xD
Machine	BAZ Kondia HM2010
Coolant Supply	20 bar via spindle
Coolant	8,5 % emulsion

The Tools

Substrate	HSS-E/PM
Lengths	DIN 374
Layer system	TiN
Dimension	Ø 18-24 mm
Type of Thread	Metric Fine
Chamfer	5 pitches
Geometry	6 Polygons
Flutes	6 Oil grooves
Cooling System	central coolant, radial outlets

The Results

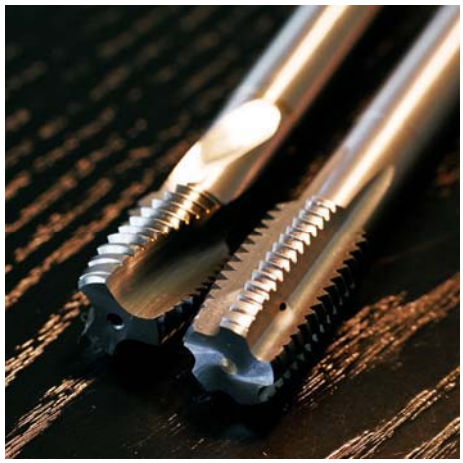
Substantially improved production of formed threads in ADI 800
Improvement of tool life compared to thread cutting: 3 times

Application B
Solid Carbide Taps for Engine Construction in the Automotive Industry

Based on the Schumacher technology data network, a partnership project with engine producers enabled us to significantly increase cutting speeds, raise tool life and improve the thread's overall quality through the employment of newly-developed solid carbide taps. In close cooperation with the substrate producers, the precision tools were specifically adapted to the broad variety of engine constructors' production techniques.
These new solid carbide taps are meanwhile employed under various clamping situations and both in CNC-machines as well as in transfer streets with automatic chucking machines.
Hence, this solid carbide technology was able to successfully replace previous High Speed Steel taps.

The R&D Environment

Cylinder Head
Engine Block
Crank Shaft Case



Material and Application

GG26
GGG60
C70
AlSi9Cu3

Blind and through holes	<=2,5 x D
Machines	CNC-Machines and Transfer Streets
Coolant Supply	40 bar via spindle
Coolant	9 % emulsion

The Tools

Substrate	Micro grain carbide
Lengths	DIN 371 / DIN 376 / DIN 374
Layer system	bright and TiN
Dimension	Ø 6-18 mm
Type of Thread	Metric, Metric Fine
Chamfer	Form C, Form B, Form E
Flutes	straight and 15°/25° RH spiral flutes for blind holes
Cooling System	central coolant

The Result

Cutting Speed	Vc 50-80 m/min
Improvement of tool life compared to HSS/E:	3.5 to 4 times

Executive Summary

The continuous development of tool geometries, substrates, tool and material clamping and significantly improved machine kinematics will most certainly provide further fields of employment for solid carbide threading tools. By considering the industry's most urgent requirements regarding production costs, time frame, process security and technology innovation, this R&D project proved that critical applications in the tooling sector can be improved significantly through systematic analysis and a strict and coherent development strategy.

A fundamental requirement for the realization of any such project proved to be an innovative management of the respective product's data bank information collected throughout innumerous previous applications. Refraining to the entire parameter spectrum of this data bank during the development phase contributed to the expert knowledge of the development team and facilitated their work, thereby substantially decreasing the time frame needed for the development process. In addition, the continuous data bank-based evaluation of the test series' results contributed to the on-time completion of the development goals by accelerating the iterative process.

A long-term development perspective and the constructive cooperation with all involved partners (customers, tool producers, substrate producers and hard coating experts) have enabled Schumacher to develop innovative solutions to critical problems, broadening the range of both applications and future markets for the respective products.

Dipl.-Ing. V. Nötzel, General Manager and Head of Unit Production/Development
Dr.-Ing. B. Schniering Shareholder and Managing Director (CEO)
Prof. Dr.-Ing. P. Burgwinkel RWTH Aachen, University of Technology

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