



## R&D Report:

### NEW TECHNOLOGIES FOR HSS-E AND SOLID CARBIDE FORMING TAPS

#### The Company

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

The company develops and produces special thread tools (taps and forming taps) for the engine construction and automotive industries, as well as for the aviation sector and the machine tool industry.



Within the R&D sector, Schumacher has established research cooperation projects with several reputable institutes, such as Aachen University of Technology (RWTH).

#### Points of departure for the ‘non-cutting’ production of threads

Crucial advantages of thread forming vis-à-vis thread cutting have led to a significant increase of this non-cutting internal threading technology in the metal working industries. Deciding criteria of thread forming include:

- Higher speeds and therefore reduced working times
- Increased quality and thread resistance of the tool
- Advanced endurance and a subsequent reduction of set up times during production
- Universal and flexible employment of the tool
- Non-cutting working process for smooth production of larger thread depths
- Avoidance of oversized threading, which potentially occurs through spoiling in cutting during the thread cutting process.

These advantages have caused an increased use of forming taps throughout many industry sectors. The share of these tools amongst all thread production implements has passed 20 percent already – and is predicted to increase even further.

Aside from the working material's ductile yield, the forming taps' specific respective represents the deciding criterion for a successful employment of the tool. Tool producers can resort to various process-relevant factors for the modelling procedure. These factors – which have been analysed in numerous quantitative and qualitative test series – help to optimise the transformation process and broaden the range of employment for this procedure. The structure of Schumacher's technology data bank allows for a substantial shortening of the prototyping process through the employment of simulation elements and variant construction.



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This in return provides substantial advantages in competitiveness, most notably for Schumacher's innovative capacity.

### New Developments in solid carbide and HSS-E forming taps

Industry requirements with regard to the tools' abilities focus on a number of specific demands which will have to be met if the share of forming is to increase further:

- increased speeds during tool use
- an optimisation of the friction – through improved coating technologies for instance – and thereby
- a reduction of the otherwise increased torque during thread forming
- an extended tool life
- formability of basic materials with tensile strengths of up to 1400 N/mm<sup>2</sup>
- an optimisation of polygon geometries of the forming taps for synchronised use
- an optimised development of the thread core in the processed work piece



In a team with high-speed steel and solid carbide producers, as well as an expert for PVD coatings, Schumacher has developed a new generation of forming taps which meets the above-stated requirements, broadening the range of employment for this tool category. In principle, the development process of forming taps comprises certain technological features that can result in a variety of different tool performances, depending on their combination in the production process. The employment of a well-structured technology data base is of crucial help to obtain predictable models for the required tools. For the project described in the above passages, the following tool parameters were modified in order to reach the optimal solution for the respective task:

- basic substrate
- length of thread
- polygon geometry and number
- length and angle of the lead
- core diameter of the oil grooves
- coolant holes
- surface treatment (coatings)

In combination with 'external' influences on the test series, most notably

- material groups of the workpieces
- core hole diameter
- cutting speed
- coolant supply



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the development project has resulted in optimized combinations of all parameters for the three substrate groups

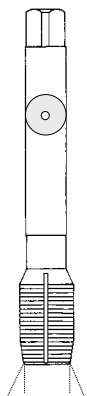
- steels of up to 1.400 N/mm<sup>2</sup>
- chemical resistant steels up to 700 N/mm<sup>2</sup>
- aluminium

The newly developed forming taps have been tested on blind and through holes in the above substrate groups, and significant improvements could be obtained in comparison to 'conventional' thread cutting and previous thread forming tools. These improvements have been incorporated into the standard production accordingly and are thus available off stock in the extended Schumacher catalogue.

### Examples

#### Application 1

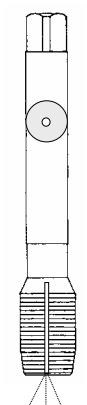
##### Substrate group: Construction Steel



Substrate:	Type: St 37	Tensile Strength: 340-470 N/mm <sup>2</sup>
Type of hole:	Through Hole 3 x D	
Core hole diameter:	9,30 mm	
Tool type:	Art. G06/415360 Forming Tap DIN 371 Solid Carbide with oil grooves, TiAlN-coated	
	5 Polygons / Number of oil grooves	
	„RIK“ Cooling System with outlets in the flutes	
	4,5 mm Lead length	
M 10 – ISO2X/6HX		
Cutting Speed:	<b>Vc 70 m/min</b>	
Cooling medium:	Emulsion 7%	
Tool life improvement:	<b>50%</b>	

#### Application 2

##### Substrate group: Heavy Duty Tool Steel



Substrate:	Type: 1.2379	Tensile Strength: 1300 N/mm <sup>2</sup>
Type of hole:	Blind hole 2,5 x D	
Core hole diameter:	11,10 mm	
Tool type:	Art. G07/5360 Forming Tap DIN 376 Solid Carbide with oil grooves, TiAlN-coated	
	5 Polygons / Number of oil grooves	
	„IK“ Cooling System with internal coolant supply	
	5,3 mm Lead Length	
M 12 – ISO2X/6HX		
Cutting Speed:	<b>Vc 40 m/min</b>	
Cooling medium:	Emulsion 7%	
Tool life improvement:	<b>50%</b>	



## Executive Summary

The computer-based development of innovative precision tools requires a well-structured technology data management. Only standardised data enables the economic incorporation of available know-how into a company's R&D activities. It is particularly the notion of 'limited means' that provides an important perspective for data management tools. The ongoing rationalisation process at many tool companies could benefit from these advances in prototyping. In the absence of such modelling processes, the sheer number of available parameters would complicate the development and production process, and aggravate the accurate reproduction of previous results.

The above-sketched project has successfully broadened the range of employment of forming taps for internal thread production through the development of a new group of forming tools. A key objective in this project, however, was the strengthening of Schumacher's competitiveness. Through the use of standardised methods, the development and production of these tools could be completed in less than half the time it took to realise previous projects of the same size.

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