

# EUREKA PROJECT E!2924- FGM-MAGTOOL

## 1. General description

<b>Project</b>	E! 2924- FGM-MAGTOOL	<b>Status</b>	Finished- 04-Jan-2007
<b>Title</b>	<b>New Generation Of Shearing And Pressing Tools For High Strength Steels</b>		
<b>Class</b>	Project	<b>Technological area</b>	New Materials
<b>Start date</b>	01-Mar-2003	<b>End date</b>	01-Dec-2006
<b>Duration</b>	45months	<b>Total cost</b>	0.8Meuro
<b>Partner sought</b>	No		
<b>Summary</b>	Development Of Manufacturing Technology For A New Generation Of Tools Coated By Chemical Vapour Deposition System To Increase Their Service Life And Strength.		

## Budget and duration

Phase	Budget(Meuro)	Duration (Months)
Definition phase	0.06	6
Implementation phase	0.74	30
<b>Total</b>	<b>0.8</b>	<b>45</b>

## Member contribution

Member	Contribution	Position	Since
<b>Czech Republic</b>	<b>48.00%</b>	<b>Notified Finished</b>	<b>04-Jan-2007</b>
Sweden	15.00%	Notified Finished	04-Jan-2007
Poland	37.00%	Notified Finished	04-Jan-2007

## Participants

Company	Country	Type	Role
<b>Vuhz A.S. Dobra</b>	<b>Czech Republic</b>	<b>SME</b>	<b>Main</b>
Inop - Metal Forming Institute	Poland	Research Institute	Partner
Vut Brno = Technical University In Brno	Czech Republic	University	Partner
J-Vst Brno S.R.O.	Czech Republic	SME	Partner
Meform Sp. Z.O.O.	Poland	Research Institute	Partner
Mtech Research Center Ab	Sweden	SME	Partner

## 2. Project outline

### Project description

The project aims to develop a new generation of tools (particularly shearing tools and pressing tools for cold bulk forming of high-strength steels), more specifically high-speed tools coated with a Chemical Vapour Deposition (CVD) layer. This coating (TiCN) is applied by high-temperature technology with subsequent quenching and annealing. In order to increase the service life of these tools, a new type of coating will be developed, so-called "multi-coating" with enhanced lubrication properties. The project will also resolve material issues of processed steels so that the increased costs of manufacturing tools are balanced by their higher service life and good formability of machined steels with a final strength of approximately 1600 MPa. In principle it is possible to extend the service life of shearing tools and tools for cold bulk forming in three manners:

- selection of suitable material, which is machined by tool
- geometry of tool
- surface treatment of tool
- reduction of internal stresses of final coated tool.

It is obvious from the above description that service properties of tools are influenced by many variables. Special attention is paid to high-strength materials, i.e. materials with high ultimate strengths. It is possible to minimise the number of tests and to substantially accelerate all experiments by the use of mathematical modelling and numerical experiments. A team composed of researchers, manufacturers and customers ensures the expert quality of the solution.

The project should result in the extension of the service life of tools by approximately 50% compared to the state prior to the project. A final impact will be a reduction of overall costs of consumed tools together with an increase in productivity.

Keywords: forming tool design, development of coating, service life of tools.

### Technological development envisaged

The trend towards manufacturing tools by cold bulk forming of high strength steels (at present the majority of fasteners have a strength class 8.8 and higher) brings increased requirements in terms of quality, particularly to the service life of tools. Issues of service life of tools are closely related to problems of materials, i.e. steels that are machined by the tools.

Solutions therefore deals with two main issues:

- Material issues, i.e. properties of steels, which are machined by tools. These are steels designed for manufacturing of high strength machine components and fasteners. They comprise, apart from steel grades of classes 13-16 according to Czech standard CSN, also stainless steels for selected components (austenitic steels). Material issues comprise optimisation of mechanical properties (yield value, strength, ductility, contraction, notch toughness), structure or texture and character of deformation at pressing (extrusion), such as degree of strengthening and composition of tensile and compressive stresses.

- Issues related to tool development include the manufacturing of tools, including application of coating.

Correct geometry of tool (design of cutting edge, angles), friction factor and surface quality are particularly important. The coating itself, which increases the service life of tool, will be resolved as a so-called "multi-coating", i.e. coating composed of several layers with different chemical composition, lubrication and sliding effects. There are also envisaged tests aimed at reducing internal stress after the application of coating with subsequent thermal treatment. This would result in a final layer of coating with optimal hardness (we expect hardness of 58 - 65 HRC), depending on intended use and roughness.

The harmonisation of requirements for tools and machined materials requires a number of laboratory and industrial scale tests, which is very time-consuming and also very expensive. For this reason we intend to use mathematical modelling and numerical experiments, which reduces the number of technologically indispensable tests.

### Markets application and exploitation

The new generation of shearing tools and tools for cold bulk forming is designed mainly for the broad scope of machinery applications, but also e.g. for industries processing wood, rubber, plastics, etc. In the production of machinery parts and fasteners, thousands of tons of high-strength steels are processed, and shearing and extrusion tools are used to a great extent. A substantial extension of their service life brings

economies in material and power and increases productivity.

Although the price of coated tools is double, it greatly increases service life - by five or even ten times. We expect approximately doubled service lives in comparison with current modern CVD coatings. The greatest effects are seen in mass repeated production, e.g. in the automotive industry. At present the biggest consumer of machinery parts and fasteners is the company SKODA AUTO. The erection of another automotive plant in the CZECH REPUBLIC has recently begun. By the end of the FORMTOOLS project in the year 2006, production will be ready to react to an increased demand for machinery parts and fasteners. At the same time, the Czech market will be better prepared to withstand competition, which is very strong in this field.

It is expected that the turnover of production of coated tools in the year 2006 will be approx. 30 million Czech crowns, of which 30-40% will be exported to E.U. countries.

It is expected that the most important consumers of the results of the project will be the following: HANACKE ZELEZARNY A PEROVNY PROSTEJOV, all screw mills, ZKL BRNO, BRANO HRADEC N/MORAVICI, LUCAS JABLONEC N/NISOU, EDSCHA SEZIMOVO USTI, etc.

As already mentioned, it is presumed that 30-40% of the total volume of production will be exported, mainly to E.U. countries. We will already carry out tests, also at our foreign partner (POLAND - SRUBEX LANCUT). Tools of existing quality have already been exported to SLOVAKIA and GERMANY. This range will also be expanded thanks to the results of this project.

## Project codes

### **BSI**

ALT	product design (industrial design)
M	control and computer technology
T	materials
U	metallurgy
UN/UP	steels
UVO	metalworking
ZKH	production (manufacturing)

### **NACE**

2731	Cold drawing
2733	Cold forming or folding
2840	Forging, pressing, stamping and roll forming of metal; powder metallurgy
3663	Other manufacturing not elsewhere classified

### 3. Main participant

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**Organisation type**        SME  
**Participant role**            Main

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### Contribution to project

Coordination of the whole project and development of a new generation of coated tools with considerably enhanced service life and lubrication properties. Verification of parameters by mathematical modelling and in industrial conditions.

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### Expertise

The company has long-term (more than twenty years) experience in the given topical area. This experience covers not only research, but in particular manufacturing of machinery components, tools and equipment for application of CVD coatings. The results obtained were published in many professional journal articles and presented at numerous conferences.

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### 4. Partner

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**Organisation type** Research Institute  
**Participant role** Partner

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## Contribution to project

- Development of design and tests for forging tools, designing, modelling, cold forging. - Tool exploitation process. - Optimisation of forging tool functional gradient materials. - Structure on the basis of forging technology parameters. - Determination of the FGM Tool durability and its dependence on tribological and other properties of deposited layers and substrates.

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## Expertise

Founded in 1948, the objective and scope of the METAL FORMING INSTITUTE's (INOP) activities are to conduct scientific work and research in the field of applied theory of metal plasticity and to collaborate with industry (development of technologies for products made by metal forming methods). Moreover, INOP experts improve the existing and develop new methods for the manufacturing of machine parts, devices and tools by metal forming and powder metallurgy in order to reduce material and energy consumption and to the improve quality of products. INOP possesses ISO 9001 LLOYD's certificate, certified metal investigation laboratories and an experimental workshop. The staff proposing to participate in the project is comprised of scientific workers and researchers from the Laboratory of Powder Forming. This team has co-ordinated, among others, the EUREKA project "Powder metallurgy high-accuracy rotary die-forming technology and equipment".

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## 4. Partner

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**Organisation type** University  
**Participant role** Partner

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## Contribution to project

The University will solve the following issues: - Stress of shearing, pressing and extrusion tools designed for machining of high strength materials (possibly also of stainless materials); stress from resistance to forming



and stamped pieces in line with technical specifications provided.

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## 4. Partner

**Company** **Meform Sp. Z.O.O.**  
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**Organisation type** Research Institute  
**Participant role** Partner

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## Contribution to project

The company's intention is to play the role of the end-user within the project. Therefore, its main contribution will be related to providing an industrial real-life environment to test the solutions developed during the duration of the project, as well as to share its experience with the project consortium, emphasising the practical aspects. Based on the current production in MEFORM, it will be possible to investigate every step of the tool life cycle, from tool design and tool manufacturing to the production process, and to carry this out for long enough to observe progress of the tool wear. Several tool coatings and different lubricants can be tested. There is also a possibility for common work on improving the design of the tool geometry. MEFORM's engineers will provide all the necessary information to carry out tests, gather experimental data and help to evaluate the results.

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## Expertise

A Polish-American joint venture, MEFORM is a small manufacturing company specialising in hot and cold-formed metal parts, including precision net shaped cold forging. MEFORM has mastered and can apply various methods in modern metal forming, including close to net shape forming and net-shape cold extrusion. Our recent projects cover cold forward extrusion of engine starter pistons and shafts - components of starter clutching units. Shaft's working races and pinion teeth are formed in tight tolerances and require no further machining after forming. The firm was founded by engineers formerly working as R&D personnel in the METAL FORMING INSTITUTE (INOP). MEFORM closely cooperates with INOP and this special partnership gives MEFORM a supplementary technical resource to evaluate and complete jobs in the most effective and timely manner.

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## 4. Partner

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**Organisation type**  
**Participant role**

SME  
Partner

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## Contribution to project

- Selection of tools and proposal of methodics internal stress elimination by using magnetic method in new generation tools. - Manufacturing of tools with internal stress eliminated by a magnetic method. - Testing of coated tools with internal stress eliminated in operational conditions.

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## Expertise

The company is specialised in the manufacturing of tools, design draft and implementing into production. Tests, process simulations and documented evaluations are performed in its own laboratory in close cooperation with clients in order to achieve optimal solutions. MTECH has developed new methods for heat-treating of metals in industrial applications. The largest group of customers are within the mechanical industry with applications such as preheating, hardening, tempering, straightening, etc. Among the clients are ABB, ATLAS COPCO, ELECTROLUX, LKAB, SANDVIK COROMANT, SJ, SKF, TRELLEBORG and VOLVO.