

CASE STUDY



INTRODUCTION

In Early 2005, the Technical University in Freiburg, Germany, IMTEK, decided to evaluate the use of the Micro EDM Milling method to manufacture insert cavities for prototyping micro-fluidic chips. The aim of this evaluation was to assess the quality and economic feasibility that could be achieved through micro-erosion technology.

REQUIREMENTS

Microfluidic chips are used for blood treatment and analysis purposes. They integrate very small micro-channels with an average height of 100 μm and width of 10 μm . Four main requirements regarding for the mould inserts were formulated.

- Material to be hardened steel
- Average geometry accuracy within 1 μm
- Surface roughness <80 Nanometers
- Burr free machining

APPROACH / SOLUTION

One of the most critical issues was the particularly high surface finish quality required on all sides of the channels. Another key issue was maintaining geometry consistency of the channels within 1 μm . SARIX accepted the challenge to carry this machining to demonstrate and confirm its Micro EDM Milling capabilities. SARIX applied various technologies for identifying the best suitable machining conditions to meet IMTEK requirements.

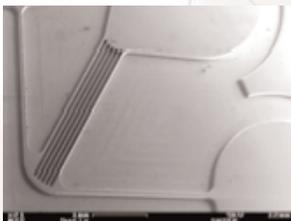
EDM-AN ATTRACTIVE WAY

IMTEK conducted a thorough evaluation of the various alternative methods such as mechanical milling, laser structuring, electrochemical milling and UV-LIGA, in order to determine feasibility and costs. The Sarix μEDM milling results demonstrated to IMTEK that Micro erosion milling was an attractive way to manufacture the insert cavities. IMTEK's work showed that SARIX μEDM provided the means of manufacturing high precision micro-shapes while overcoming the problems of burrs and material modifications at the same time, achieving superior surface finishes with-out any additional machining operations.

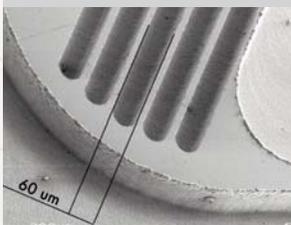
CONCLUSION

μEDM milling has evolved into a micro machining solution that overcomes many problems associated with conventional and other alternative technologies.

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Disposable chip made by injection moulding with a Micro EDM milled tool steel insert



INDUSTRY-RELATED RESEARCH



SARIX is continuously involved in current industry-related research and projects with Universities and Laboratories specialising in machine tools and Production Engineering in the field of micromachining.

SARIX is an active affiliate member of the "4M Network of Excellence in Multi-Material Micro Manufacture". SARIX's machines with full 3D Micro EDM Milling options have been installed WORLDWIDE in many research institutes.

In 2005, no less than 6 technical Universities have purchased SARIX equipment taking the benefit of an evolutive solution: Uni DTU-Uni (Denmark), KU-Leuven (Belgium), Atilim University (Turkey) University of Strathclyde (Scotland) and Memorial University of Newfoundland (Canada).

All these projects combining with our consolidate experience and know-how constitute an excellent tool to develop the newest technologies and realise technological optimisation for converting into the industrial production.

ABOUT SARIX SA

SARIX designs, manufactures and markets highly efficient Micro-EDM equipment typically used in many industries such as: die-making, micro-electronics, medical, watchmaking, automotive, and aerospace as well as research centres and universities. The SARIX SX-100 and SX-200 product line is designed for use in various Micro EDM Machining modes offering users the highest level of flexibility including Micro-Drilling, Micro-Milling and Micro-Sinking.



If you need this MICRO EDM MACHINING high performance

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SARIX newsletter

SUMMARY OF CURRENT ISSUE

Overview and Technology applications

Automation Wear Compensation concept

SX-CAM for fast programming

Generator family for maximum flexibility 4 Generators "in one"

Case study IMTEK Uni-Freiburg (D)

OVERVIEW OF μEDM MACHINING

Dear Readers,
SARIX as a leading manufacturer of MICRO EDM equipment is committed to providing our customers with up to date information and materials in order to easily understand application trends and benefits of the micro EDM (μEDM) machining technology.

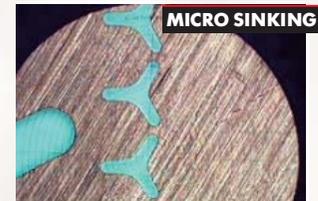
Micro Drilling is the conventional application for μEDM . SARIX has been a pioneer in fine accurate micro hole EDM. The SARIX equipment can be configured for a large variety of machining ways to meet individual requirements. A wide range of options gives the user maximum flexibility while improving at same time improving return of investment.



MICRO DRILLING

Micro Drilling is the conventional application for μEDM .

SARIX has been a pioneer in fine accurate micro hole EDM. The SARIX's capability ranges from few millimetres diameter down to 10 microns (0.010 mm) with a high surface quality finishing down to Ra 0,05 micron and without any material alteration.



MICRO SINKING

Micro Sinking provides additional machining capabilities.

Slots, cavities and all types of shaped features can be machined. By using a "built-in" Wire Dress device, electrodes can be shaped automatically as needed on the machine, allowing users to extend machine capabilities, the surface finishing quality and capabilities with minimum additional investment.



MICRO MILLING

Micro Milling represents an EDM improvement of the Micro Drilling and Micro Sinking processes offering additional capabilities. SARIX first introduced 3D Micro EDM Milling using standard round electrodes. The major barriers which have held back micro-milling technology have been the inability to achieve enough accuracy because of inadequate control of electrode wear and the lack of appropriate EDM CAM software. Taking advantage of its large extensive in Micro Drilling, SARIX has developed a true Micro Milling solution introducing its enhanced Electrode Wear Compensation Concept and integrating its SX- μEDM -CAM software.

WHY MICRO EDM MACHINING?

In recent years, there has been an increasing interest in micro-machining based on μEDM . A couple of major factors are behind this trend:

- its ability to produce a variety of complex shapes with a high degree of accuracy.
- its ability to process hardened materials such as high treated steel alloys and carbide, as well as PCD polycrystalline diamond and conductive ceramics.
- as a non-contact process, μEDM eliminates burrs and any effect of material alteration such as cracking of the work piece.

Many of these factors are of particular advantage when machining micro-parts making μEDM technology an indispensable process in many fields of the micro-machining.

SARIX μEDM is used for very different Micro EDM machining operations such as: Precision micro hole drilling, high speed and deep hole machining, micro sinking and 3D cavity Milling. Since these different machining operations drive different machine requirements the SARIX Micro machining solution has been designed as a highly modular system. The SARIX equipment can be configured for a large variety of machining ways to meet individual requirements. A wide range of options gives the user maximum flexibility while improving at same time improving return of investment.

AUTOMATIC ELECTRODE WEAR COMPENSATION CONCEPT

The phenomenon of electrode wear can be easily compensated for during conventional EDM. However, relatively high wear rates with the very small electrodes used in micromachining make precise control a crucial factor for achieving accuracy within 1 micron.

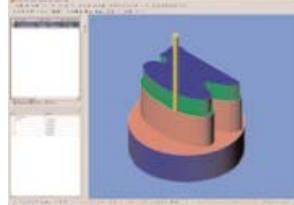
That's why, in addition to the standard rotating electrode technology, SARIX has introduced its new Automatic Electrode Wear Compensation concept on the automatic refeeding spindle, the SX-A344 series.

This concept automatically compensates for electrode wear in Z axis during the milling process.

In addition, an integrated self-learning software including an integrated technology base allows operators to define optimum machining conditions.

The Automatic Electrode Wear Compensation coupled with self-learning software are an efficient and indispensable feature for high performance precision Micro machining.

AUTOMATIC ELECTRODE WEAR COMPENSATION CONCEPT



Modelling and electrode path simulation of a micro stamping tool

KEY MACHINING FEATURES

Geometry accuracy down to 1 µm.

Surface finishing Ra down to 0.05 µm.

SX-CAM FOR FAST PROGRAMMING

SARIX delivers true Micro Milling

capabilities with the **SX-µEDM-CAM** module working under the ESPRIT CAM software. SARIX imports CAD files in the most commonly used formats. Once the 3D model is created, it becomes possible to manipulate the model and create a comprehensive part program within a complete machining environment, including fixtures, tooling, work piece and erosion technology. Tool paths collision checking and machining time are simulated. The output is then a ready-to-run program for the CNC-SARIX EDM machine. The application is not limited only to milling operations. The **SX-µEDM-CAM** is used also to position and drill rows of round and

CUSTOMER SUPPORT

SARIX is committed to providing our customers with efficient technical assistance.

SARIX Online Support offers direct, one-to-one communication for fast, and complete answers to your equipment, configuration, and troubleshooting questions.

fan cooling holes and create slots on

turbine blades for aircraft engine. It constitutes an indispensable tool ensuring the most complex parts to be machined correctly the first time. For maximum flexibility SARIX offers three versions:

2.5D Version: used both for pocketing and contouring of low to medium complexity 3D micro-shapes which fit the production of micro cavities in most applications. 2.5D provides a solid base for the 3-axis conventional µEDM milling.

3D Version: For complex true 3D models and cavities, SARIX offers the 3D version. This version analyses the model and automatically recognizes slots and profiles with different boundaries.

This version enables programming of roughing and finishing in one step, optimizing machining and programming time. Version 3D is particularly efficient for machining complex geometry parts simplifying both programming and providing cost effective machining utilisation.

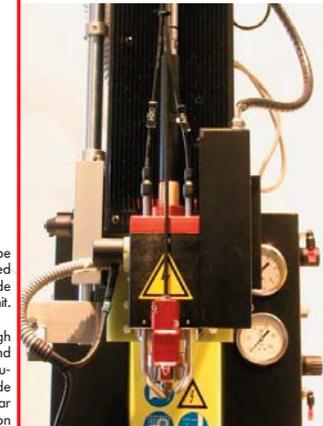
3D Plus Version is an extension of the 3D version and supports 4 axes simultaneously for additional machining capabilities.

The choice of any particular solutions depends on individual requirements which need to be weighed together with costs together with customers to define the most appropriate solution for any given application.



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Micro pulse shape generator integrated inside the EDM head unit.

SX-C-A344 - High precision rotating and C-indexing spindle with Automatic Electrode re-feeding and wear compensation

GENERATOR: CORE OF MICRO EDM 4 Generators "in one"

µEDM is used in a great variety of industrial applications: It can be used to produce items as different as injection nozzles for diesel engines, cooling holes in turbine blades or extrusion holes in textile dies as well as for milling high precision cavities or shapes for the micro mould industry. While drilling of turbine blades require the ability to provide high speed drilling but is typically more tolerant of hole accuracy, injection nozzles require much higher accuracy and geometric consistency.

Mould, die and tooling applications impose the greatest demand of all as they require perfect shape geometry, higher accuracy levels and the ability to generate complex forms.

SARIX generators are integrated into the Z axis head unit, enabling them to control precisely the erosion performances in all situations. Responding to different requirements SARIX offers three generator packages that together make up the full SARIX µEDM solution:

Micro Pulse Shape generator

Built into all SARIX machines, the **SX-MPS** gives operators the basic Micro Pulse technology that efficiently covers a wide range of micromachining operations.

It is designed for operations in Micro Drilling, Micro Sinking as well as Micro Milling, giving great flexibility when planning multiple machining processes.

Micro Fine Pulse Shape generator

The **SX-MFPS** is designed for low layers material removal rates resulting in high surface quality. The MFPS is typically used to produce micro-electrodes down to 5 microns and to achieve high surface finishing down to Ra 0.05 micron.

High Pulse Shape generator

The **SX-HPS** allows relative higher material removal rate. This module is ideal when the amount of material to be removed is important for high speed and for large hole drilling.

Ultra Fine Pulse Shape generator

The **SX-UFPS** bring the performance down to an ultra fine machining for a further extreme ultra fine EDM removal. Its benefit is on matching further down the Micro Drilling and Micro EDM Milling tolerance. The surface finishing of the electrode shaping on the SX-Arienne reduce the micro wave effect on the electrode surface for a higher precision step.



It is possible to combine at any time these four generator on the SARIX machine. This allows machine users to cover a greater range of machining possibilities while ensuring efficient operation depending on specific requirements.

FEATURES & BENEFITS

Cost effective in many applications

Medium & high production production capability

Extremely flexible with great choice of accessories to meet various requirements

Easy operation with SX - µEDM- Milling CAM software

High accuracy and high surface finishing