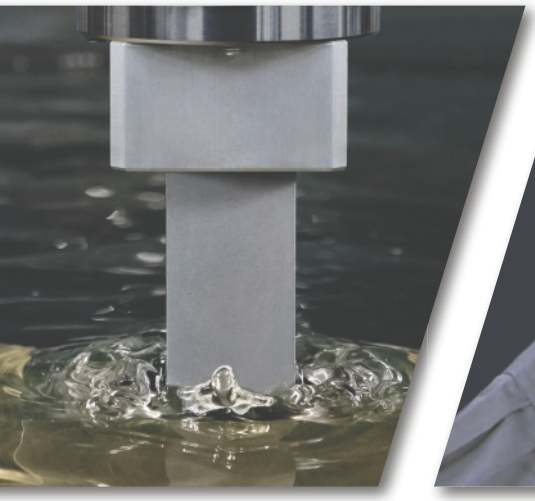
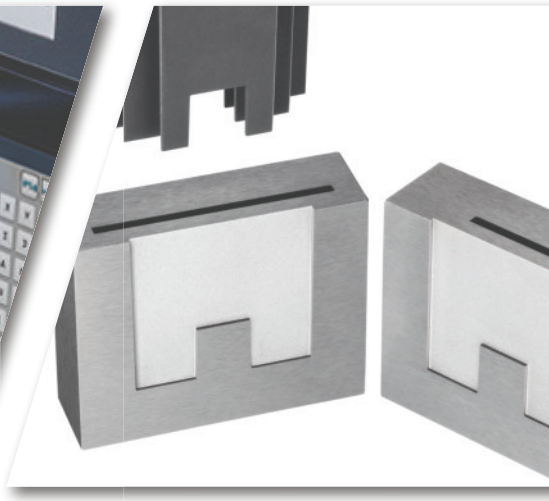
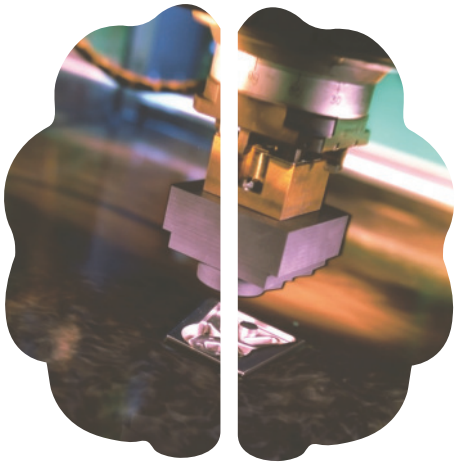
# EDAF SERIES

## High Precision Sinker EDM



MAKINO



# Hyper
TECHNOLOGIES

**Makino's family of Hyper Technologies revolutionize the machining process in both Sinker and Wire EDM, and ensures the ideal mix of Speed, Finish, Reduced Electrode Wear or Reduced Trim Cuts, to achieve the ultimate in productivity!**

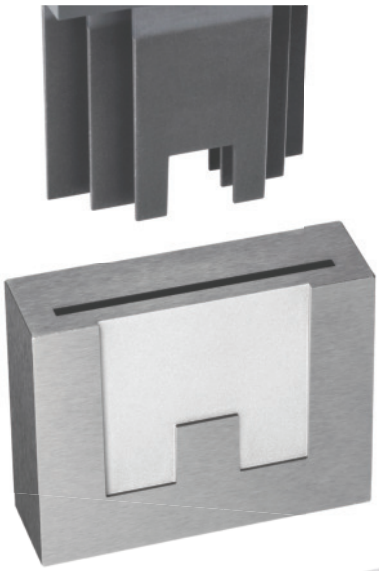
**The unified Hyper control delivers an identical streamlined interface to both Wire and Sinker EDM operations, and provides new levels of capability, efficiency, and user friendliness.**

## Hyper *i*

**New Generation - Touch screen controller available for both Sinker and Wire EDM that makes machining easy as Ready, Set , Go!**


**The Hyper *i* Control improves machine productivity by intelligently streamlining the interface so that all operator skill levels can achieve the most efficient results.**

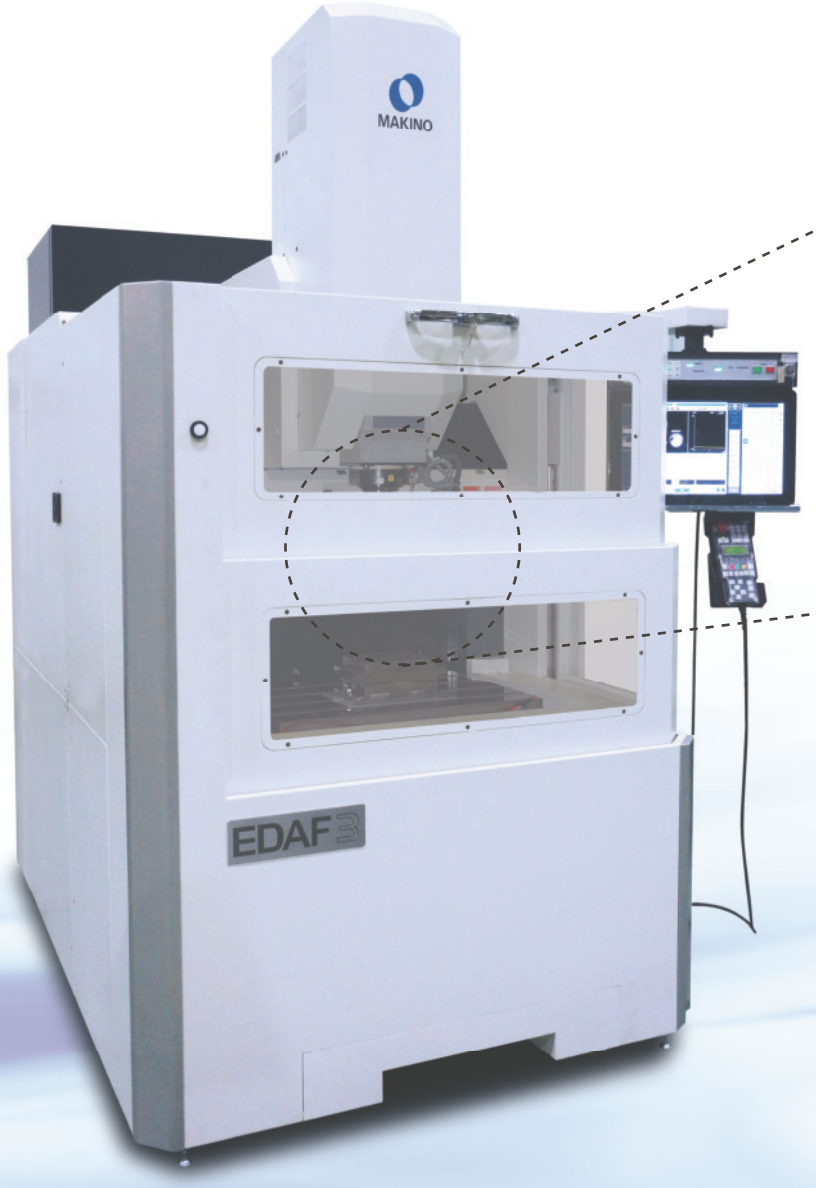
**Texturized Surface achieved by SEDM**

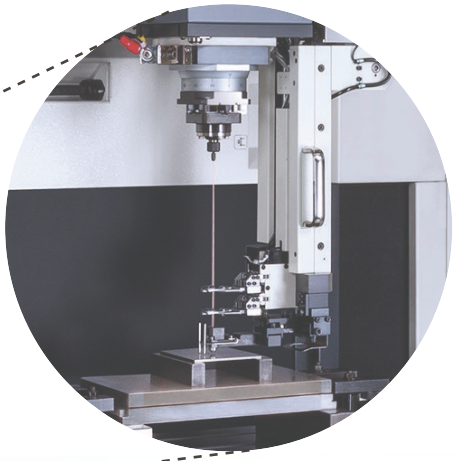


**Multi-rib**

**Super Surface**

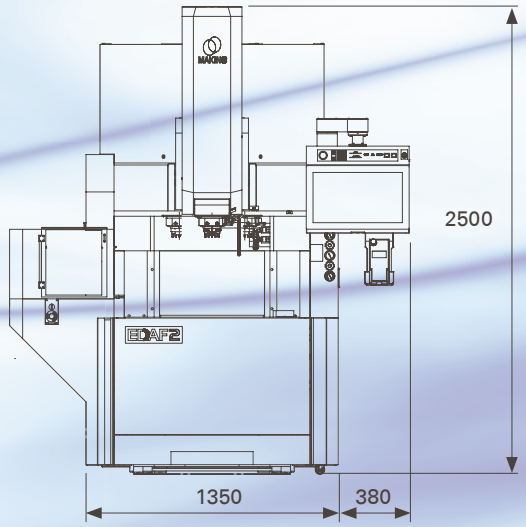
# EDAF2



*Machine
with Fine Hole
Specification

**Compact Design**

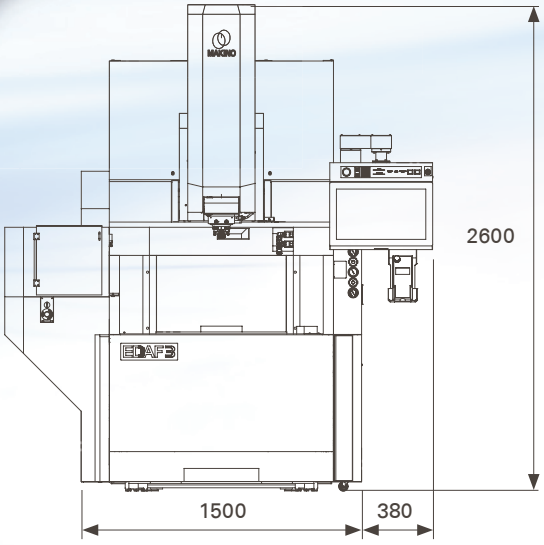



| | |
|---|---|
| Axis travel X x Y x Z | 350 x 250 x 250 mm |
| Work tank size | 550 x 350 mm |
| Maximum electrode weight | 50 Kg |
| Maximum workpiece weight | 500 Kg |

# EDAF3


| | |
|---|---|
| Axis travel X x Y x Z | 450 x 350 x 350 mm |
| Work tank size | 700 x 500 mm |
| Maximum electrode weight | 75 Kg |
| Maximum workpiece weight | 800 Kg |

**Compact Design**




## *i*ntuitive | *i*ntelligent | *i*nteractive

Makino's new **Hyper** *i* control revolutionizes the interface between the operator and the machine. Using the most current interface technologies used by SmartPhones and Tablets, Makino's Hyper i Control makes use of Pinch, Swipe and Spread functions that provide the operator with a simple and natural feel that is comfortable and extremely efficient. The user friendliness of the Hyper i Control is further enhanced with the integration of on-board digital manuals, intelligent help functions, and e-Learning training system.

Any operator with a basic knowledge of machining can learn Makino's Hyper *i* Control. Operators quickly learn and appreciate the technology and power that the Hyper Control provides, and most operators are able to produce sophisticated part details on the first day of installation. Hyper *i* brings a completely new level of user-friendliness, operator comfort, and efficiency to the shop floor.

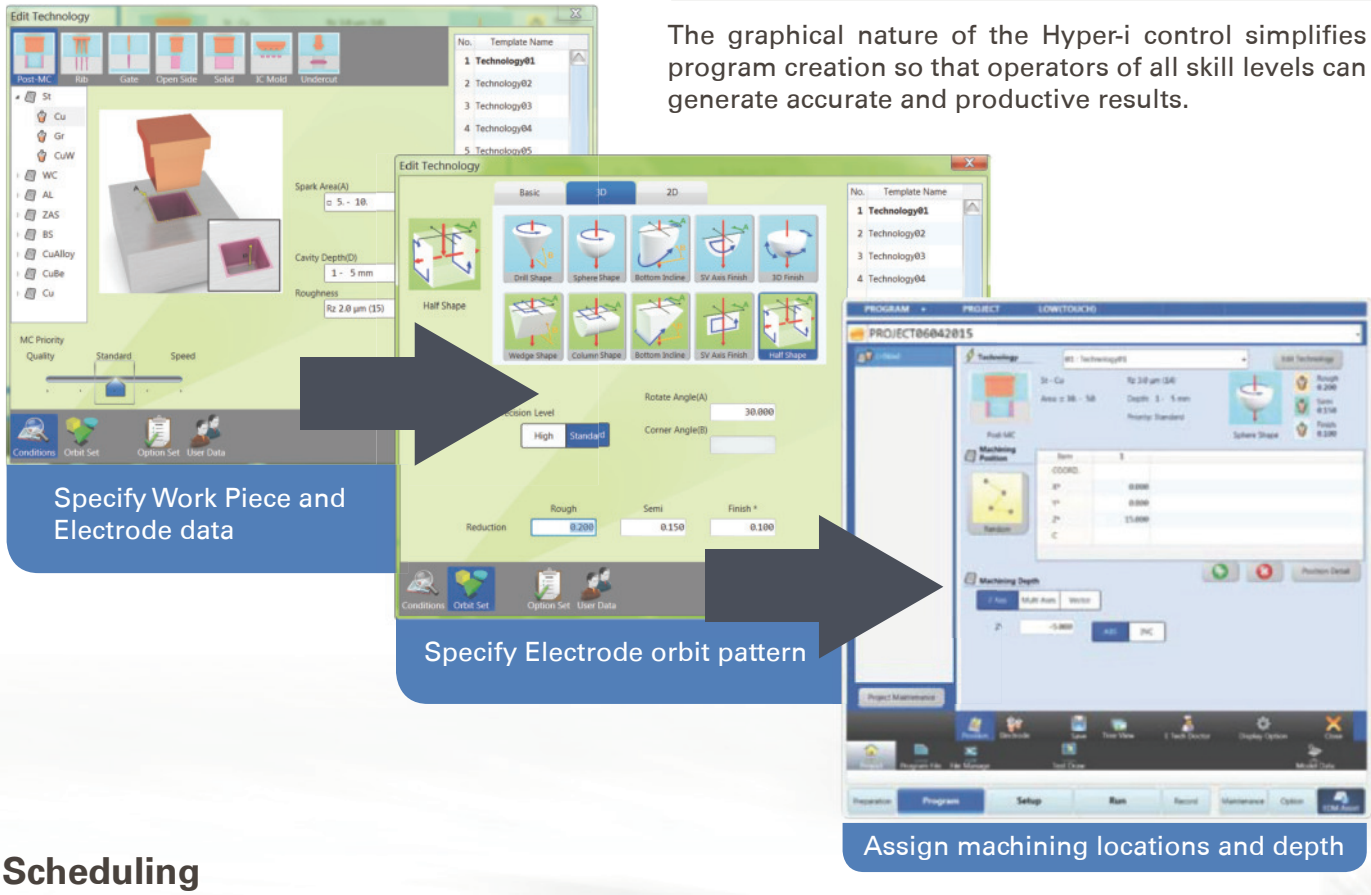
## 1. Program

## 2. Setup

## 3. Run

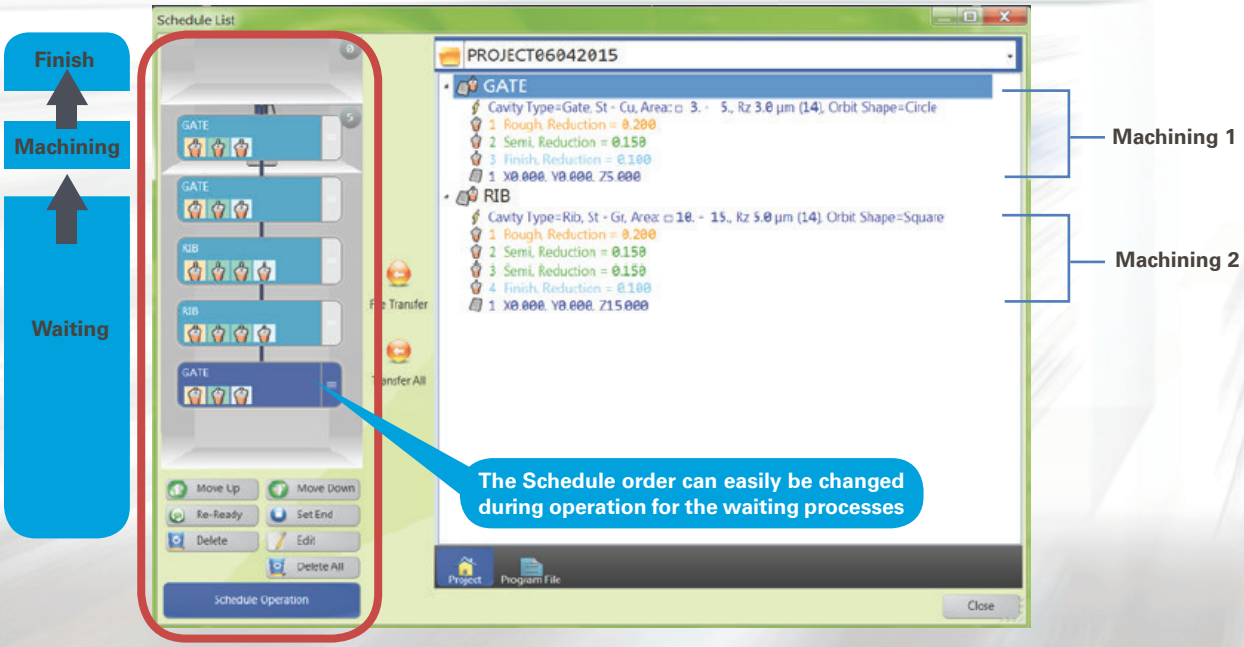
## User Friendly Programming

The graphical nature of the Hyper-i control simplifies program creation so that operators of all skill levels can generate accurate and productive results.



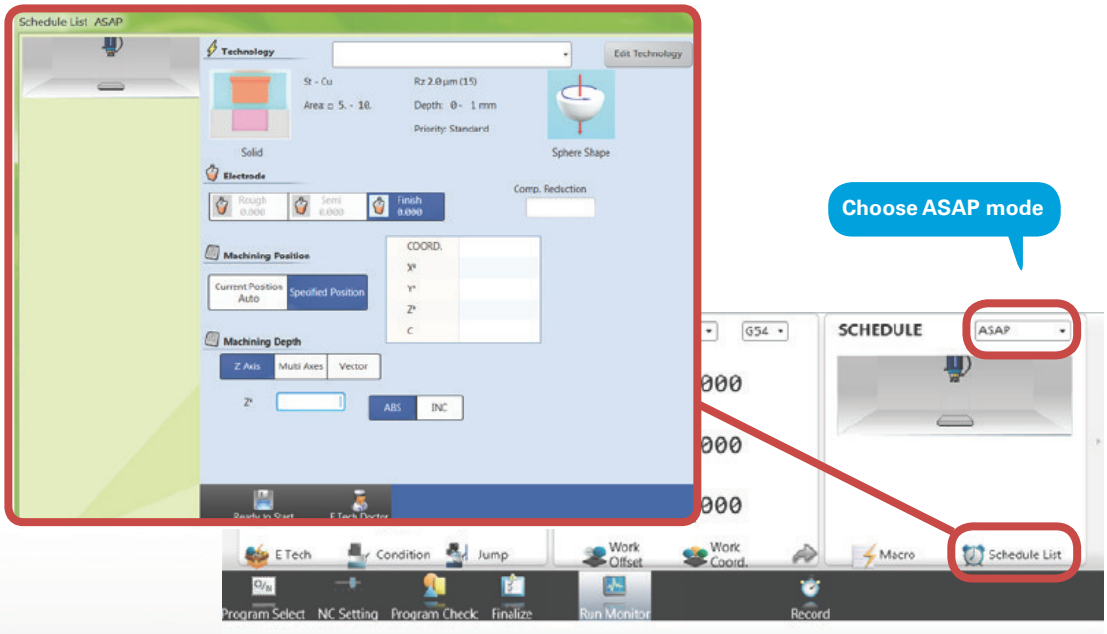

## Scheduling

The Scheduling function provides operational flexibility and simplifies the programming of multiple parts or cavities.



## ASAP function (As Soon As Possible mode)

Provides a fast and convenient method to run simple jobs in the machine without the need for complex programming.




## E-Tech Doctor

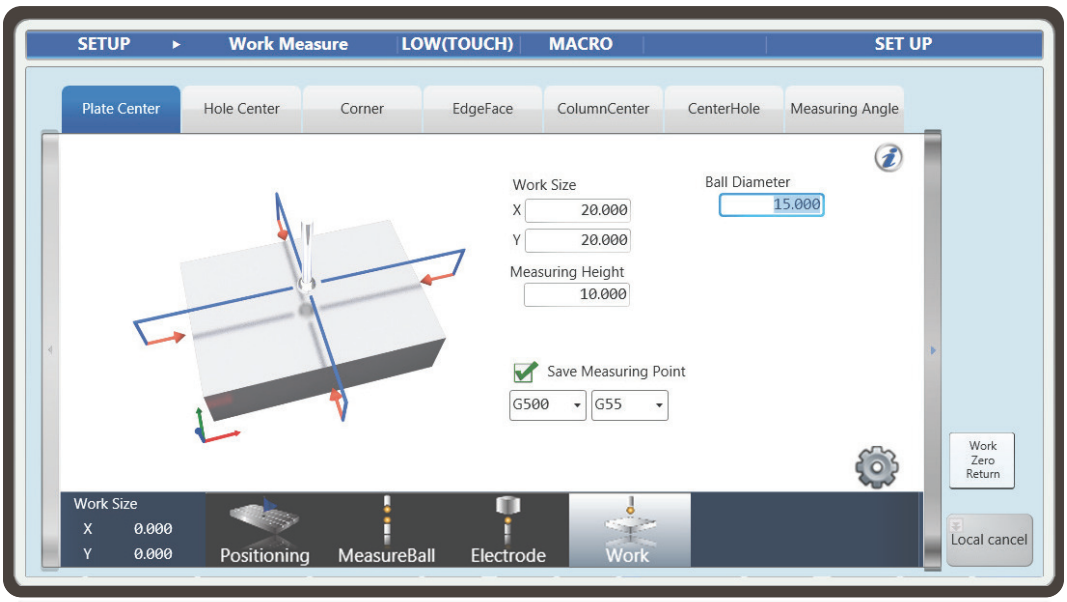
The E-Tech Doctor is an advanced intelligent help function that provides a method of adjusting machining conditions to achieve your perfect part! The revolutionary interface combines the knowledge and experience of an advanced operator into a easy to use graphical menu.

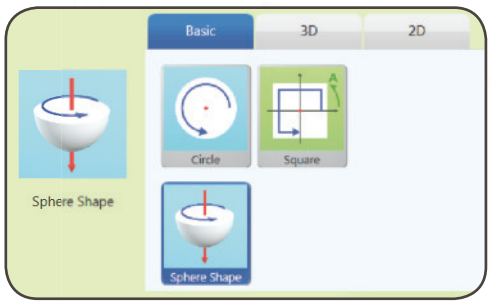

The EZ-cut slider bar provides a quick and easy way for the operator to raise or lower the machining speed and power settings by + or – 25% in 5% increments.


Adjusting to reduce the machining time It is a very useful function to safely cut parts during the night.

## Setup Function

Provides the operator with an easy and streamlined method for aligning the Work Piece and Electrode. There are multiple standard Pick-Up cycles that help reduce setup time.

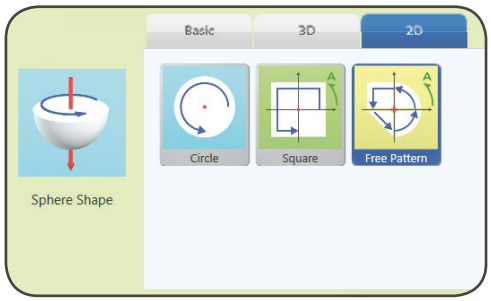


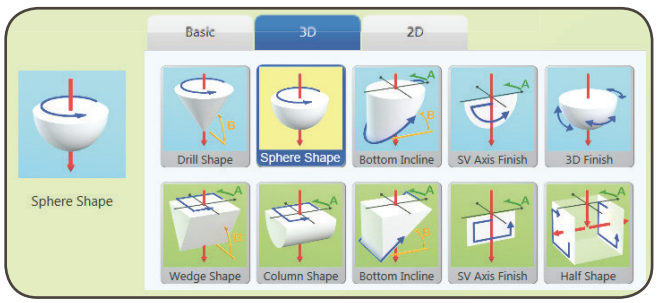




## Advanced Orbit Functions

There are a variety of standard Electrode Orbit motion patterns to choose from that simplify programming while providing the most accurate and efficient result.

The Orbit patterns are organized into 3 Main Shape Categories (Circular, Square, and Spherical), and 2D and 3D Patterns for each shape are provided, making optimized programming easy to achieve under any condition.



# Flexibility

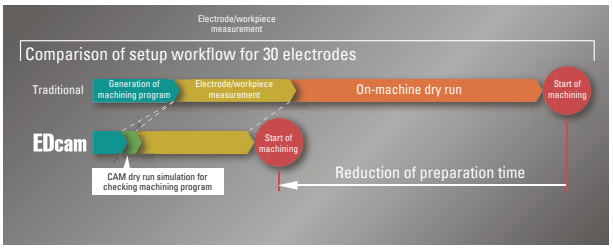
## EDcam

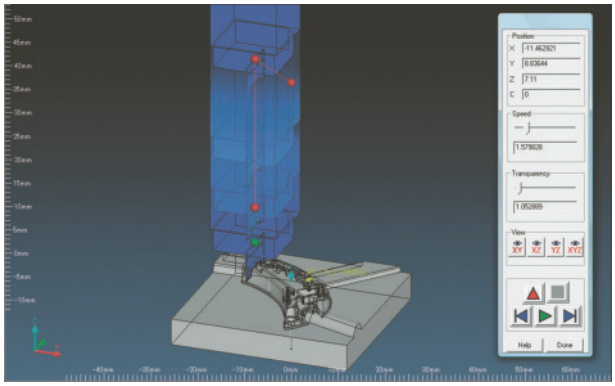
### Cam System for Makino Sinker EDM

EDcam enables machining programs to be generated entirely by PC, and makes use of digital work piece and electrode CAD data information to improve efficiency.

The typical EDM process requires the operator to manually input the EDM positions of each electrode from a printed work instruction sheet. Over 50% of all EDM errors are reportedly caused by incorrect entry of machining position data. To minimize this mistake, most operators will perform a “Dry Run” of the entire program to validate that locations are correct, but this utilizes valuable shop time.

The EDcam system imports machining position data in either CAD or EPX format, and inserts this information directly into the program. This method can eliminate the need for “Dry Run” operations, leading to more efficient and productive machine utilization.



### Elimination of On-Machine Dry Run

#### Dry Run Simulation

In addition to the generation of machining programs without manual input, the machining positions, electrodes, and other details can be checked by the dry run simulation on the PC screen.


Necessary data for creation of NC program can be read from CAD to EDcam without manual input.

- Import 3D model
- Create NC program by EDcam
- Upload program to machine


### EDM Mail (option)

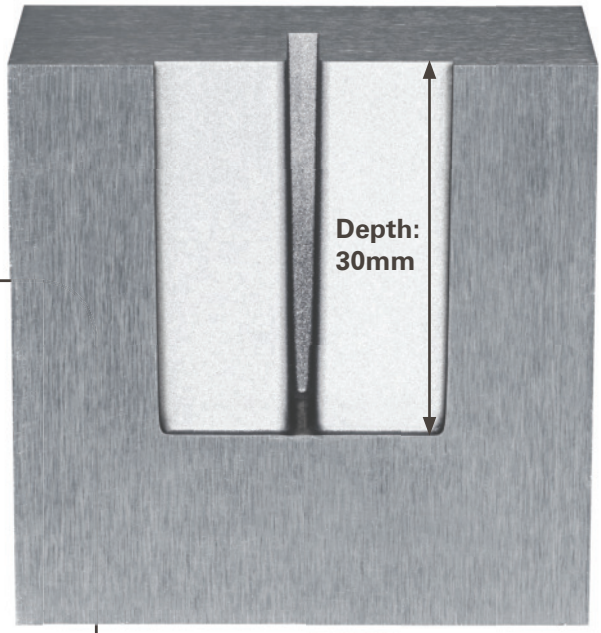
Provides the ability for the machine to send automatic email messages that alert to machining progress or alarm states.

### EDM Viewer (option)

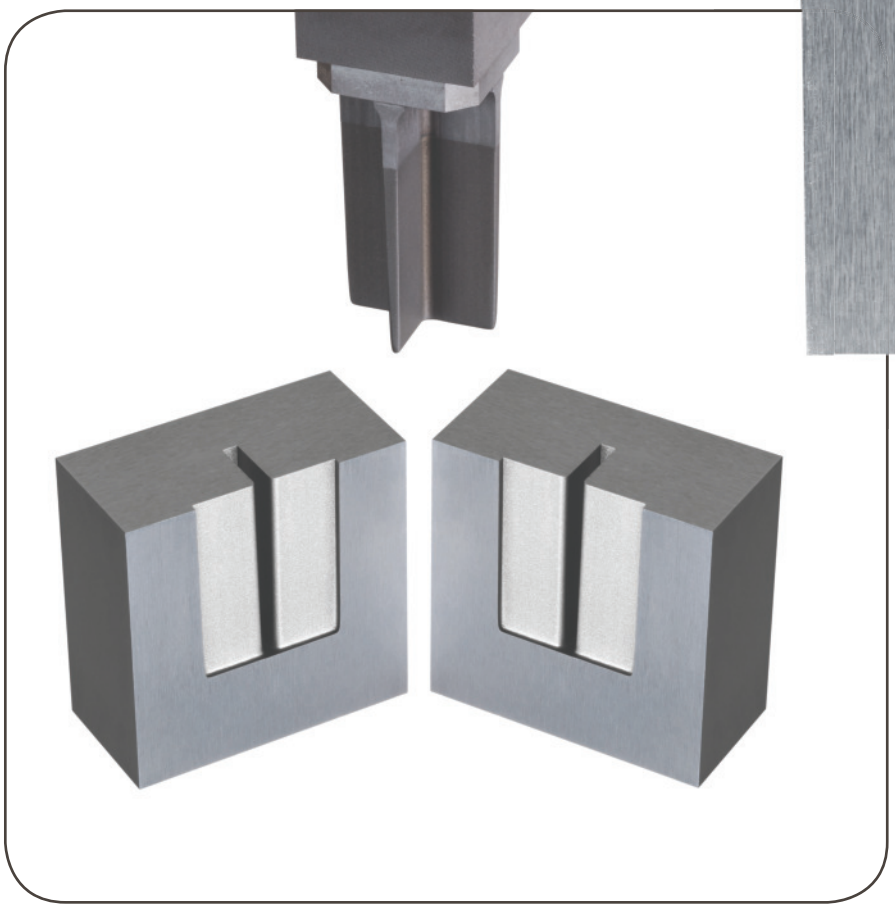
Enables the operator to access the machine control from a remote PC to view machining status, or to verify and create new machine programs.

# HyperCut

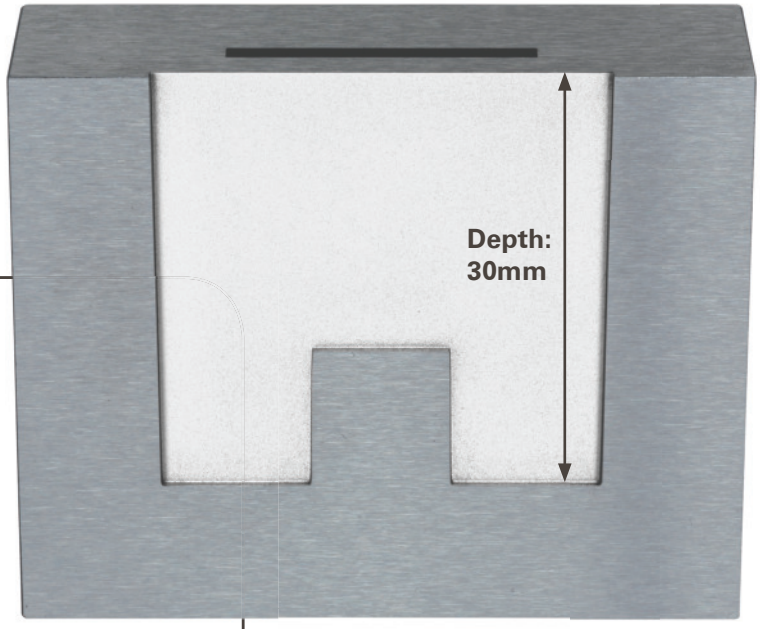
**HyperCut** technology for Sinker EDM are Precision-based settings that utilize a new generator function that allowsincreased power levels without requiring additional reduction on the electrode. Improvements in Roughing speeds by as much as 30% can be realized without affecting work piece accuracy or surface quality.



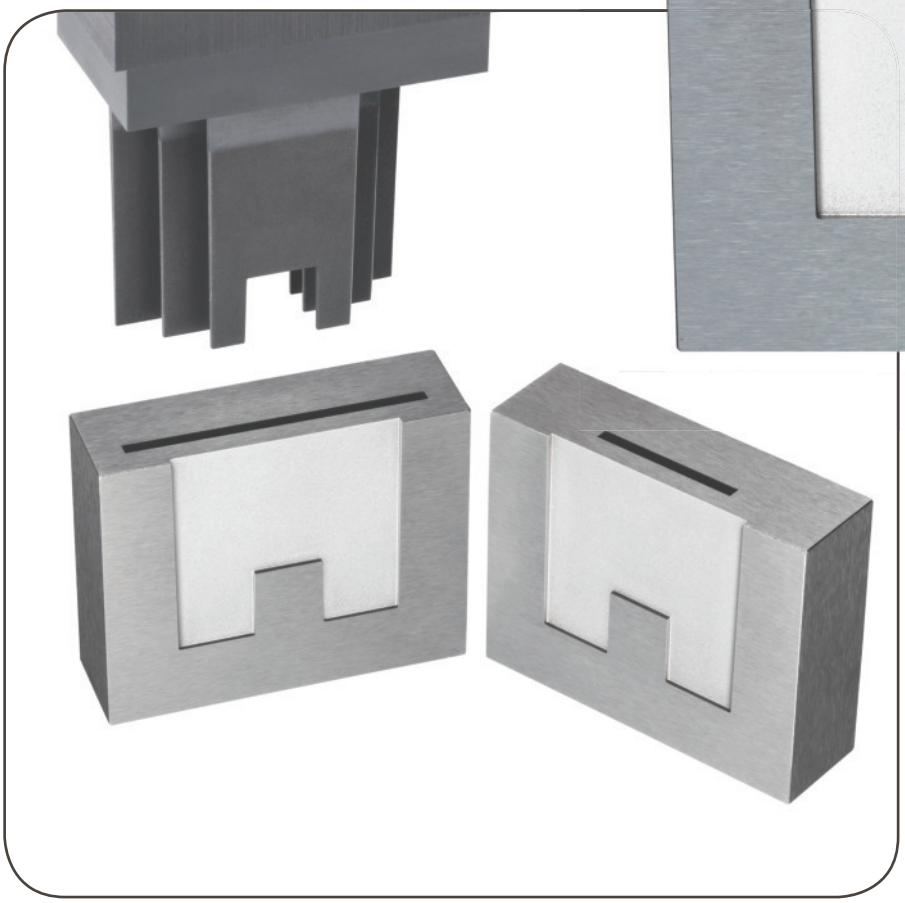

**Cross Rib**

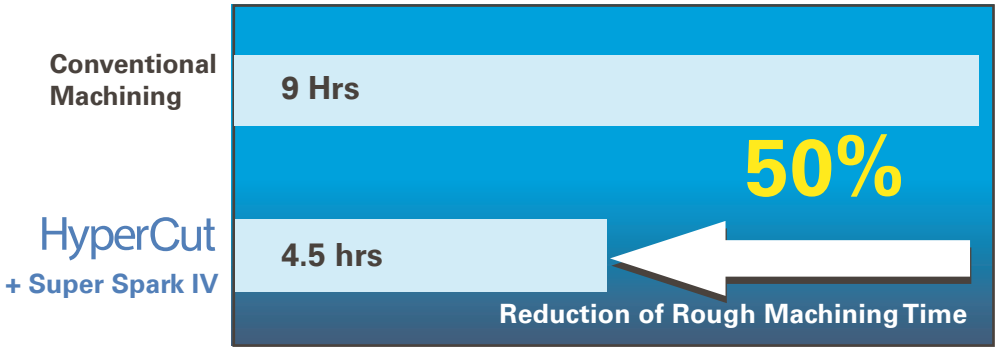


**SuperSpark IV** technology provides advanced adaptive control over machining discharge power and electrode jump motions during roughing and finishing operations. This technology is especially effective on rib or drafted electrodes, and when combined with HyperCut settings, can reduce total machining time by up to 50%.



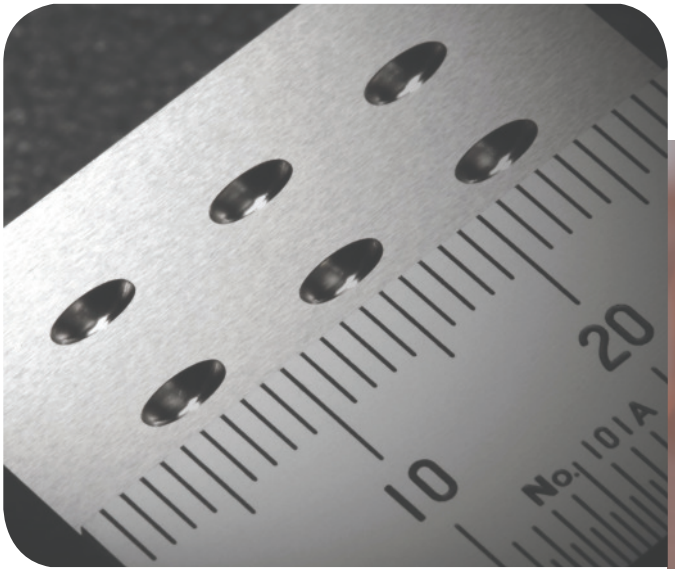

**Multi Rib Machining**



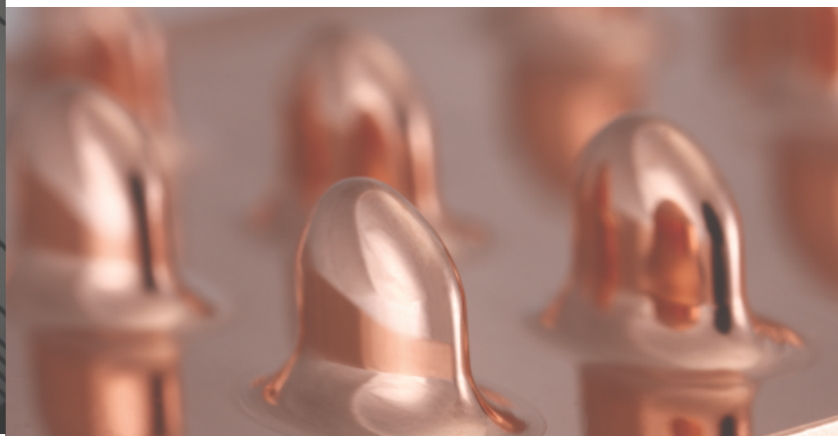


# Surface Finish

## LED MOLD
## Best Glazed Surface Roughness 0.05 μm Ra



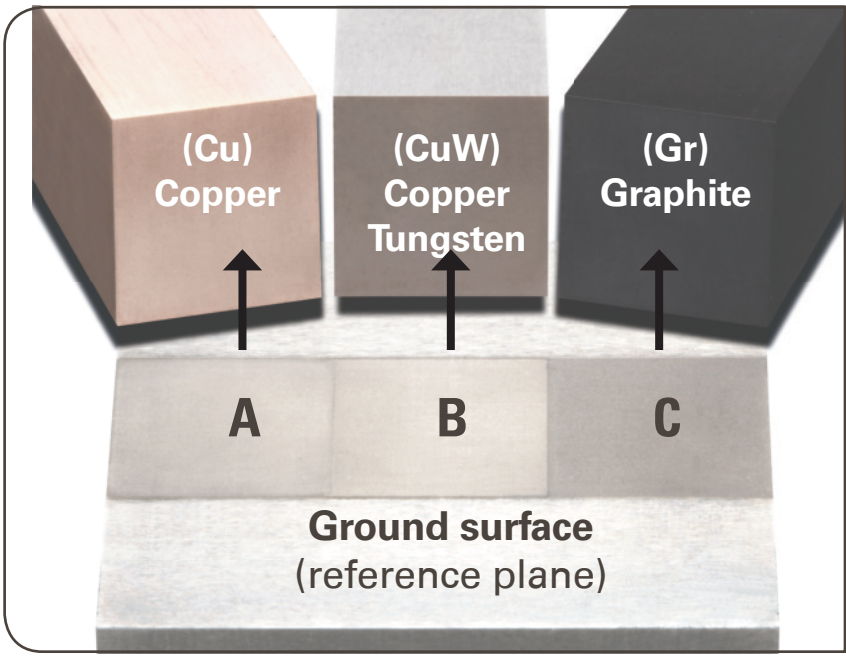

| | |
|---|---|
| Electrode Material | : Copper (Oxygen Free Copper) |
| Work Piece Material | : ELMAX |
| Surface Finish | : 0.32 μm Rz (0.05 μm Ra) |
| Machining Time | : 3h 15min |



## Predictable Results

Attain ±2 μm step difference between ground and EDM surfaces using different electrode materials in unmanned operation as a result of precise construction and thermal stability.

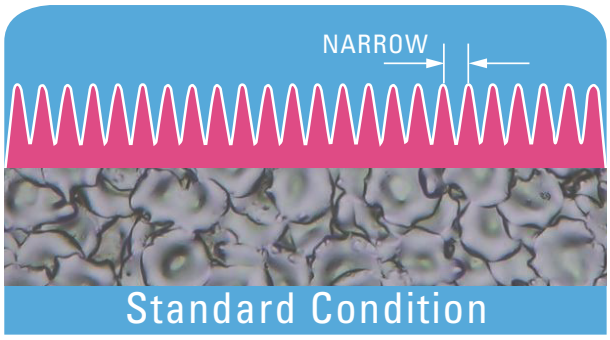
| Conventional process | Process using EDAF |
|---|---|
| Start machining | Start machining |
| Stop machining 5-10 μm before final finish | |
| Clean workpiece | Interface step difference of ±2μm |
| Measure machining depth | |
| Clean electrode | |
| Resume machining | |
| Interface step difference of ±2μm | |



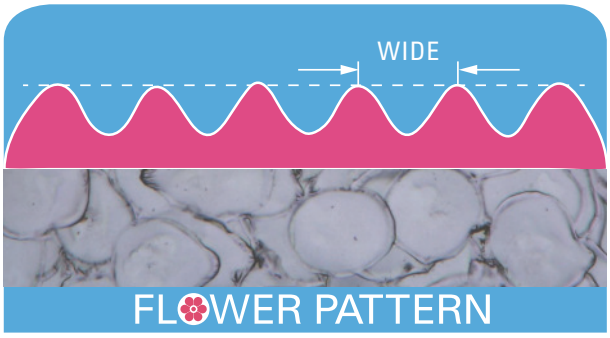

*with Z-axis stabilizer (optional)

## HyperCut +FLOWER PATTERN

Improving the performance of mold tooling requires more than just fine surface finish. Makino's Flower Pattern technology achieves a unique combination of even and consistent surface finish with a large RSm value. The large RSm surface quality provides a more open surface structure that promotes easier release of plastic injection parts, and helps to reduce tool maintenance cleaning intervals.




**Ra 0.4µm RSm 35µm**

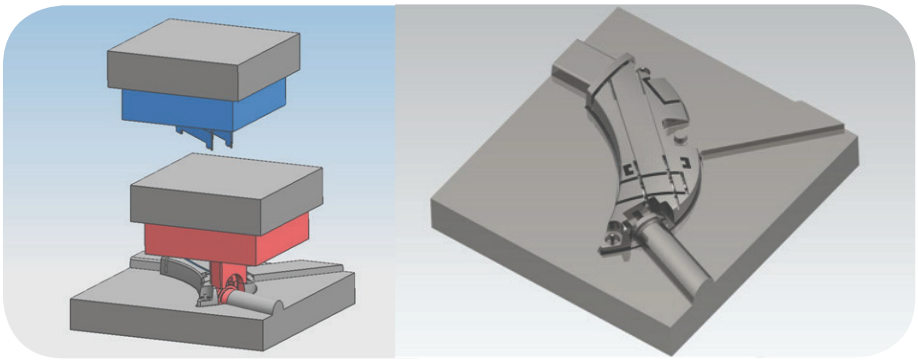



**Ra 0.4µm RSm 132µm**

## +FLOWER PATTERN on rib machining

The flower pattern conditions were developed to obtain a uniform Ra value surface with large RSm value to improve the performance of mold release for plastic injection tools.

- Improve plastic part mold release
- Improve tool life / Reduce interval for cleaning (realize 40~80% improvement)
- Reduce cleaning maintenance time



**Mould of hearing aids**

# Surface Finish

## Texturized Surface by SEDM

**Faithful reproduction of fine detail patterns**

- Special high density graphite electrode allows achieving the most detailed copied surface
- This result would not have been possible with copper electrodes

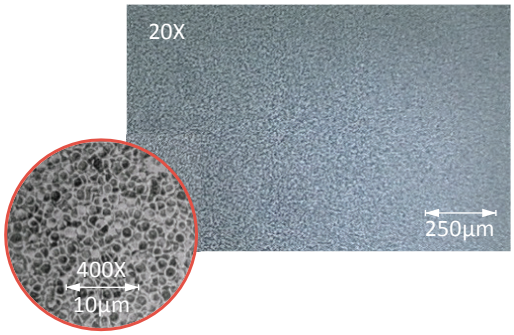

## Super Surface

Provides an exceptionally fine satin finish of uniform quality without pinhole imperfections. Super Surface helps to improve and maintain part detail accuracy by minimizing the need for hand polishing.

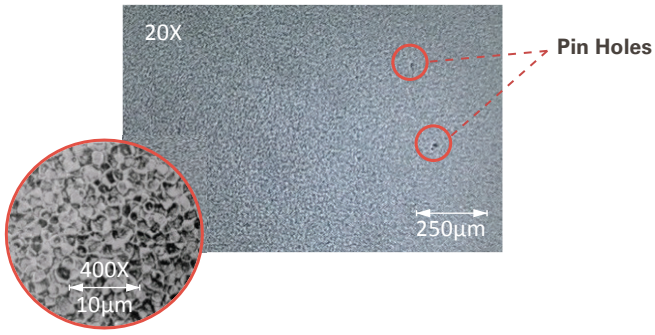
### Watch Bezel Surface roughness up to 0.6 µm Rz (0.2 µm Ra)

Workpiece material: Stavax
Electrode material : Copper (Cu)
Reduction : 0.15mm/ side

**Super Surface Machining**

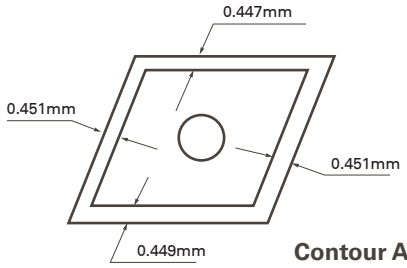



**Traditional Machining**



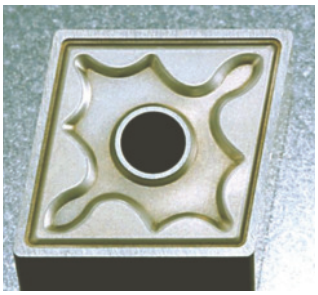

## Carbide Machining Circuit (option)

The Carbide Machining Circuit provides increased machining efficiencies of 50% or more in special hard materials such as carbide and tungsten alloys. This circuit also help achieve optimal surface finish with sharp edge quality and +/-2µm accuracy for the most difficult tungsten carbide tooling applications.




**Contour Accuracy ± 0.2 µm**

**Workpiece**



**Electrode**

Electrode Material : Copper Tungsten (CuW)
Workpiece Material : Carbide (WC)
Depth : 0.5mm
Surface Finish : 0.6 µm Rz (0.2 µm Ra)
Machining Time : 3hrs 10mins

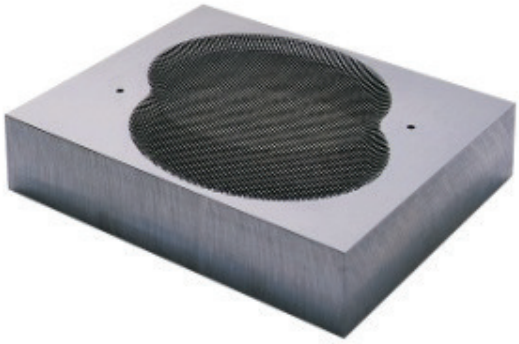
*Option

# High Quality Surface Finish (Option)

The HQSF Technology uses a special powder additive that is suspended in the di-electric oil to provide dramatic improvements to achieved part surface finish while also helping to reduce cycle time. HQSF is effective on both Copper or Graphite electrodes, and can extend tool life while also eliminating the need for manual polishing operations after the EDM process.

## 1 Surface Roughness Reduced by Half

Surface roughness is reduced by half while achieving the same machining time. The same effect is obtained with both graphite and copper electrodes



Electrode Material : Graphite (POCO-EDM3)
Workpiece Material : Stainless Steel (STAVAX) (200 x 200 mm)
Electrode Reduction : 0.15mm / side
Depth of Cut : 7mm
No. of Electrode Used : 3

| | Without HQSF | With HQSF |
|---|---|---|
| Machining Time | 20hr. | 20hr. |
| Surface Finish | 10µm Rz (1.7 µm Ra) | 5µm Rz (0.9 µm Ra) |
| | | 50% Better Finish |

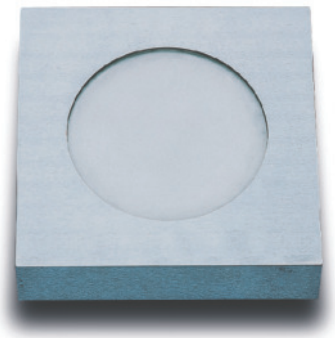
OR

| With HQSF |
|---|
| 18hr. |
| 10µm Rz (1.7 µm Ra) |
| 10% Faster Time |

## 2 Shorter Polishing Time

The HQSF process is effective in improving the surface finish of both glossy and satin machined surface. Polishing time is reduced because of the shallow thermal recast layer.

Glossy Machined Surface



Satin Machine Surface

## 3 Longer Die Life

The HQSF process improves work piece metallurgical quality and reduces the formation of thermal cracks to extend functional life of the component.

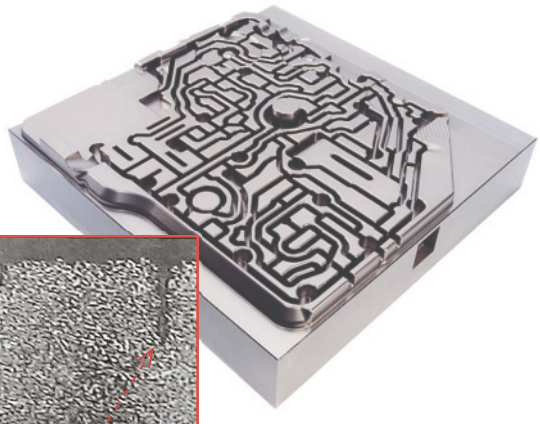
Cross-section views of crack morphology after a 2000-cycle heat crack test (Material: SKD610)

(x25)

HQSF Process

(x25)

Conventional Process (EDM + Polishing)



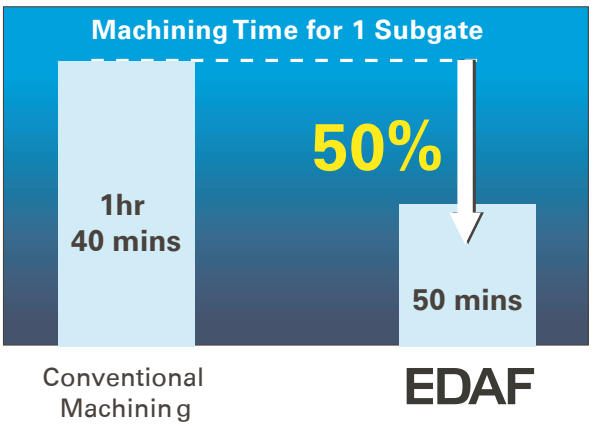
(x100)

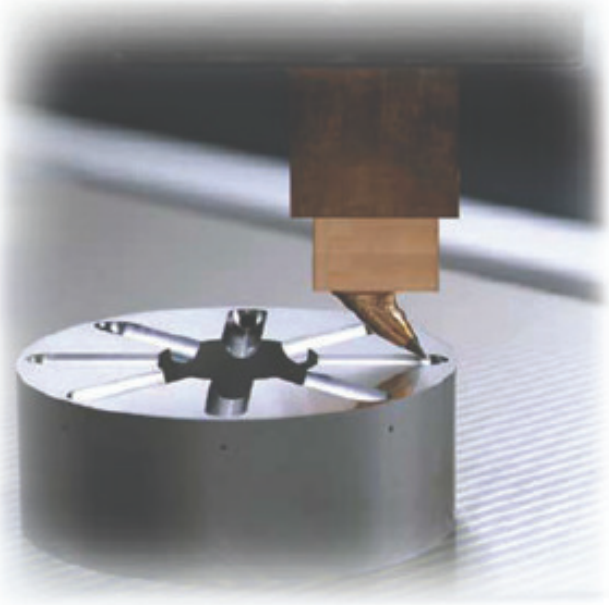
DEEP-CRACK

# Mold Machining

## Pin Gate / Sub-Gate Machining

Challenging Die/Mold applications such as Pin Gates details are programmed and processed with ease on the Hyper i control. Positioning and synchronization of Pin Gate electrodes with the C-Axis is simplified, even when machining with 3-Axis. This dedicated process method ensures the most accurate and productive result.



## High speed jump on side machining

- Reduceed machining time
- Optimized jump speed and acceleration on side axis and 2,3 axis machining
- Suitable for submarine gate and side rib application


0.802 | 0.801 | 0.798mm

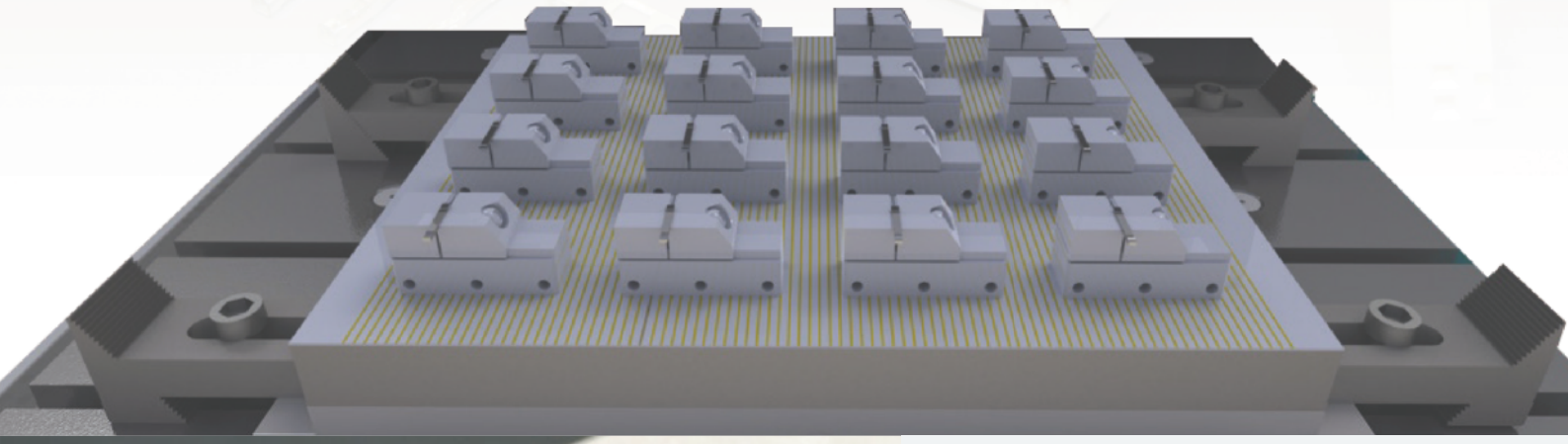
±2µm hole diameter accuracy
(using Z-Axis Stabilizer option)

# Electronics Tooling Applications

As electronic devices continue to become smaller in size, so do the die/mold tools are are used to manufacture these parts. This creates challenging demands for Sink EDM, as the tools require sharper detail with narrower pitch for electrical connectors. The EDAF-Series with Super Edge technology can surpass these requirements and produce an internal radius down to 6µm.

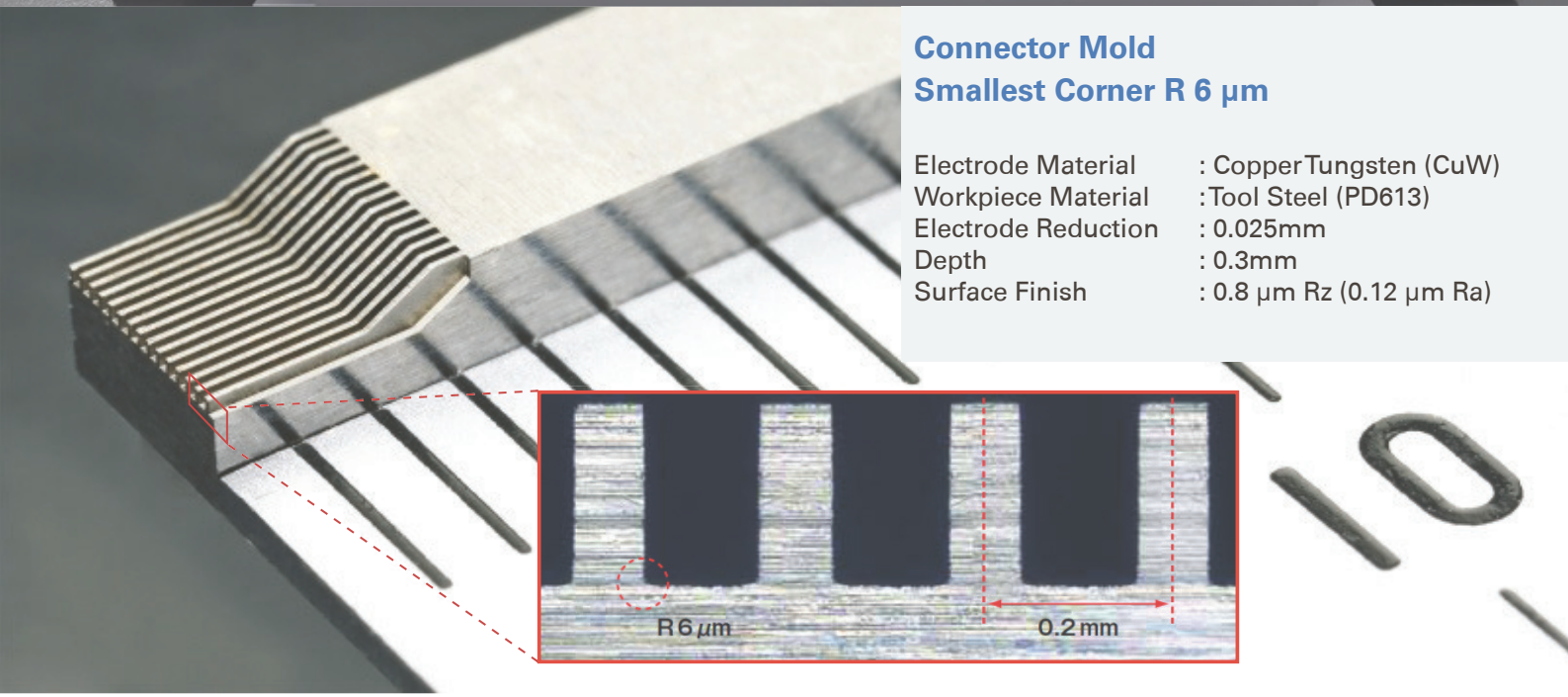
## Connector Multicavity

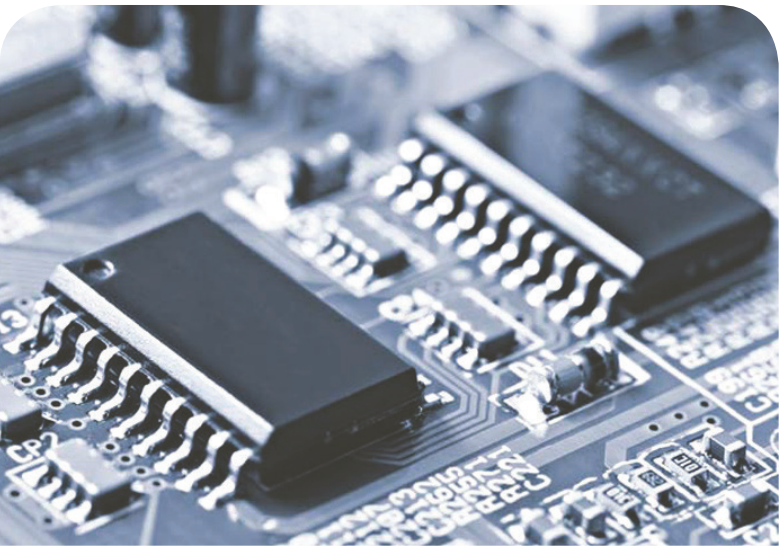
Due to Makino's superior mechanical design and structure, thermal stability is realized. As a result, multiple connectors can be mounted ensuring the same result independent of the machining location.



## Connector Mold
## Smallest Corner R 6 µm

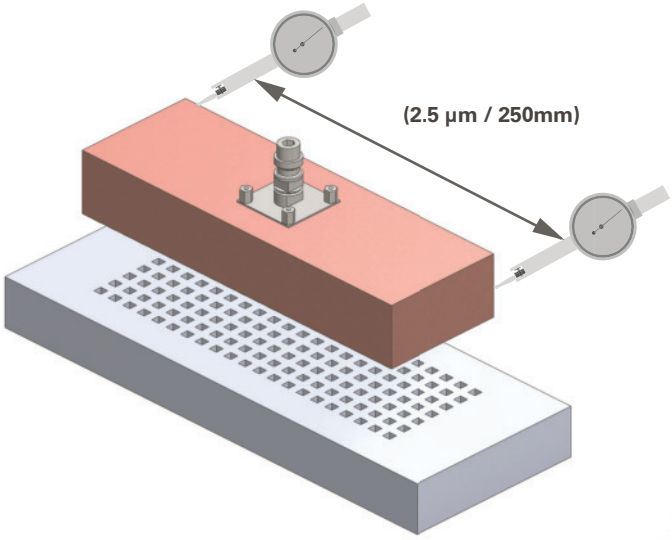
| | |
|---|---|
| Electrode Material | : Copper Tungsten (CuW) |
| Workpiece Material | : Tool Steel (PD613) |
| Electrode Reduction | : 0.025mm |
| Depth | : 0.3mm |
| Surface Finish | : 0.8 µm Rz (0.12 µm Ra) |





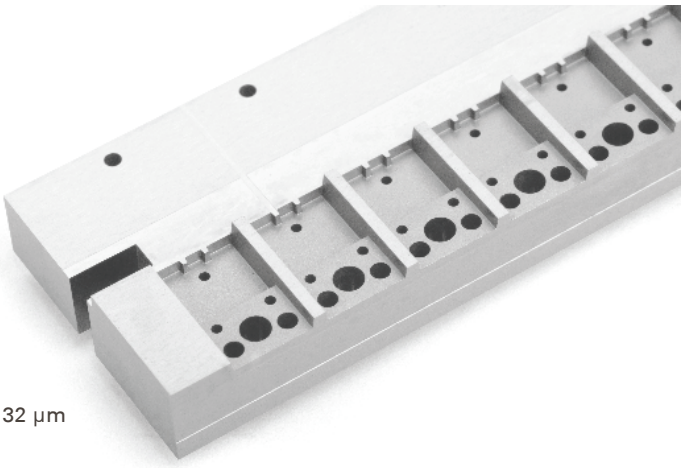
## Semiconductor

Makino has developed the EDAF series to address the ever demanding tooling needs of the electronics industry. Machining performance delivers higher levels of accuracy to shrinking component detail size.




## High Accuracy Specification (Standard)

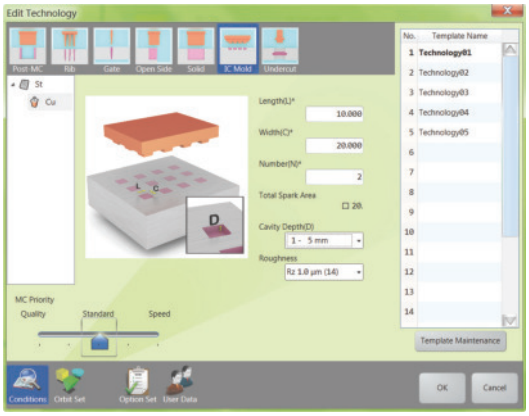
The EDAF machine provides a Semiconductor process package that aids the operator in the setup and preparation of electronics tooling. This function helps to improve and maintain accuracy of straightness and flatness to within 2.5 µm.



| | |
|---|---|
| Electrode Material | :Copper (Cu) |
| Workpiece Material | :High Speed Steel (ASP23) |
| Electrode Reduction | :0.16mm |
| Surface Finish | :3 µm Rz (0.4 µm Ra) RSm = 132 µm |

## Program Creation: Cavity Bar

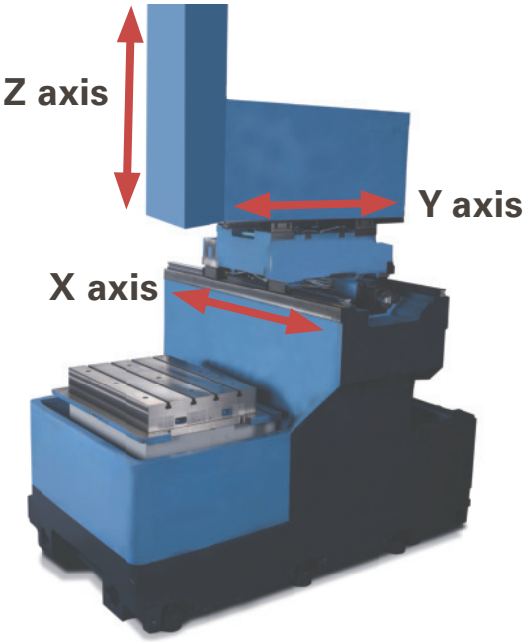
Operators are able to create productive and efficient programs for Cavity Bar tooling without having extensive experience using the Semiconductor package.



# Precision Engineering

## Industry-Leading Construction

Makino designs and builds the EDAF-Series machines for long-term accuracy and reliability. Machine performance is maintained over long periods of operation regardless of work piece size with minimal affects due to environmental temperature change. Great care and craftsmanship is devoted to the assembly process, as the precision is "built-in" to the machine structure through exacting mechanical alignment of all components.




### Rigid Construction
High mass castings provide long-term mechanical and thermal stability

### Stationary Table
Achieve reliable positioning accuracy regardless of work piece size or weight

### Thermal Stability
The Y-Axis and Z-Axis structures utilize an active liquid cooling system to ensure thermal stability and consistent high accuracy results

### Space Savings Design
Integrated reservoir in base casting reduces size and further improves thermal stability

### Dual Anchored Direct Drive Ball Screws
Provides long-term sustained precision

### Quality Craftsmanship & Assembly
Makino spends more time and care to "mechanically" align all components

## C-Axis Configurations

The EDAF Series machines offer (3) different C-Axis configuration options that are designed to provide the greatest level of capability.

| | Indexing accuracy (arc/sec) | Speed (rpm) | Machining Power (Amps) |
|---|---|---|---|
| MR C-Axis | ±15 | 1~10 | 60 |
| MA C-Axis | ±15 | 10~10,000 | 60 |
| MI C-Axis | ±2 | 1~10 | 60 |

# Easy Operation

## Convenient Filter Access

The EDAF-Series machines are designed with an integrated space-savings filtration system. The filters are contained inside a movable track that allows convenient access for filter exchanging.

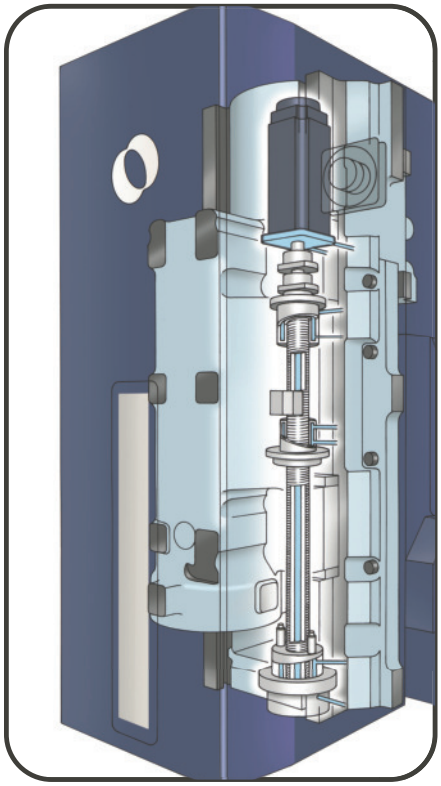
## Full-function Advanced Handbox (Standard)

An advanced remote handbox with LCD display is standard with the machine. This enhanced system provides the operator with more power at their fingertips, as many convenient time savings functions are built-in the handbox, including an additional Emergency Stop button for improved safety.

# Thermal Stability

## Zealous pursuit for stability and consistency

Makino's EDAF series of Sinker EDMs is designed with thermal stability, repeatable accuracy, and user-friendly operation in mind. From the newly designed casting system to built-in control devices, the EDAF series is one of the most advanced Sinker EDM machines available.




## Independent cooling of Z axis for ultra-high depth control accuracy

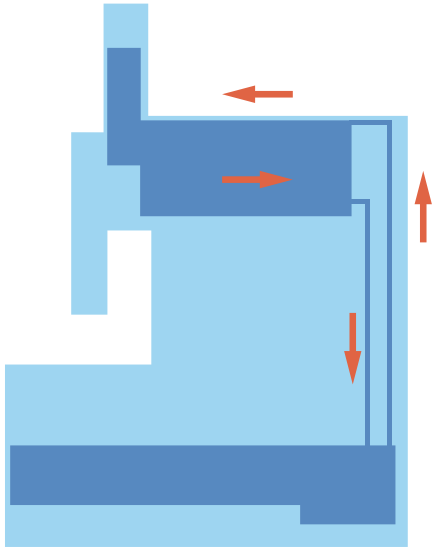
### Core Cooled Z-Axis (option)

The Core Cooled Z-Axis option introduces an independent core cooled ball screw to the Z-Axis structure. This technology further improves thermal stability, and ensures the highest levels of accuracy for burn depths, even when utilizing high speed jump machining.

## Insulation is used between the machine structure and electrical cabinet to minimize heat transfer

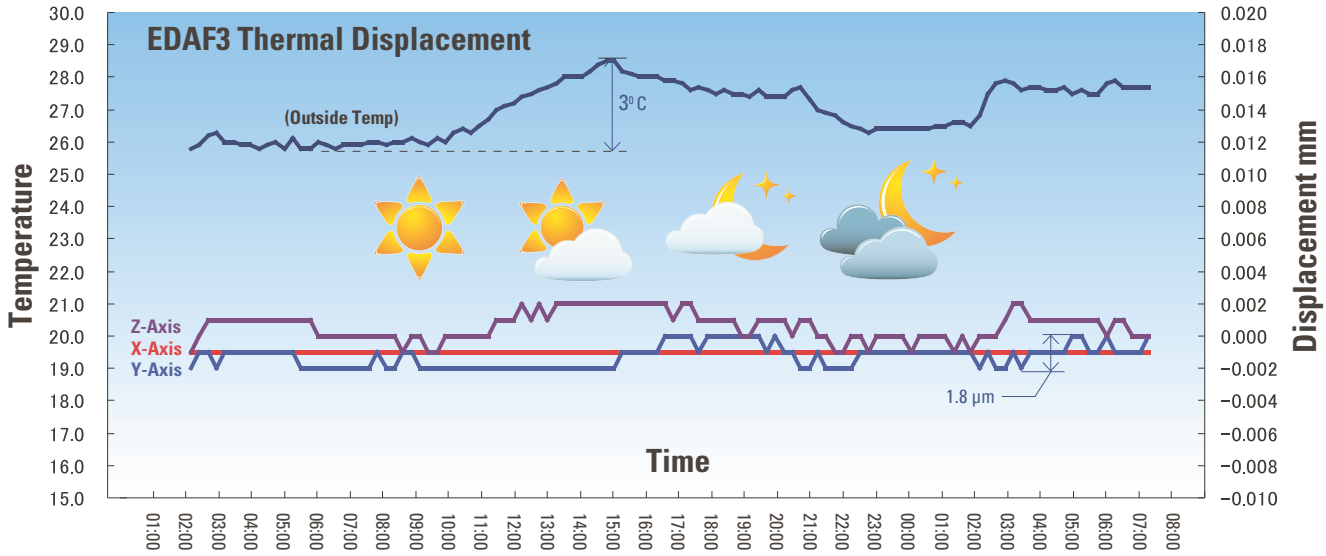

Electrical Cabinet and the Machine structure is separated to avoid heat transfer and achieve thermal stability.

## Active cooling of upper Y and Z structure to provide thermal stability (standard)



Chilled dielectric fluid is circulated through the ram casting and Z-axis motor. The result reduces Y-axis displacement when ambient room temperature fluctuates. This feature is a must have when critical accuracies are needed.

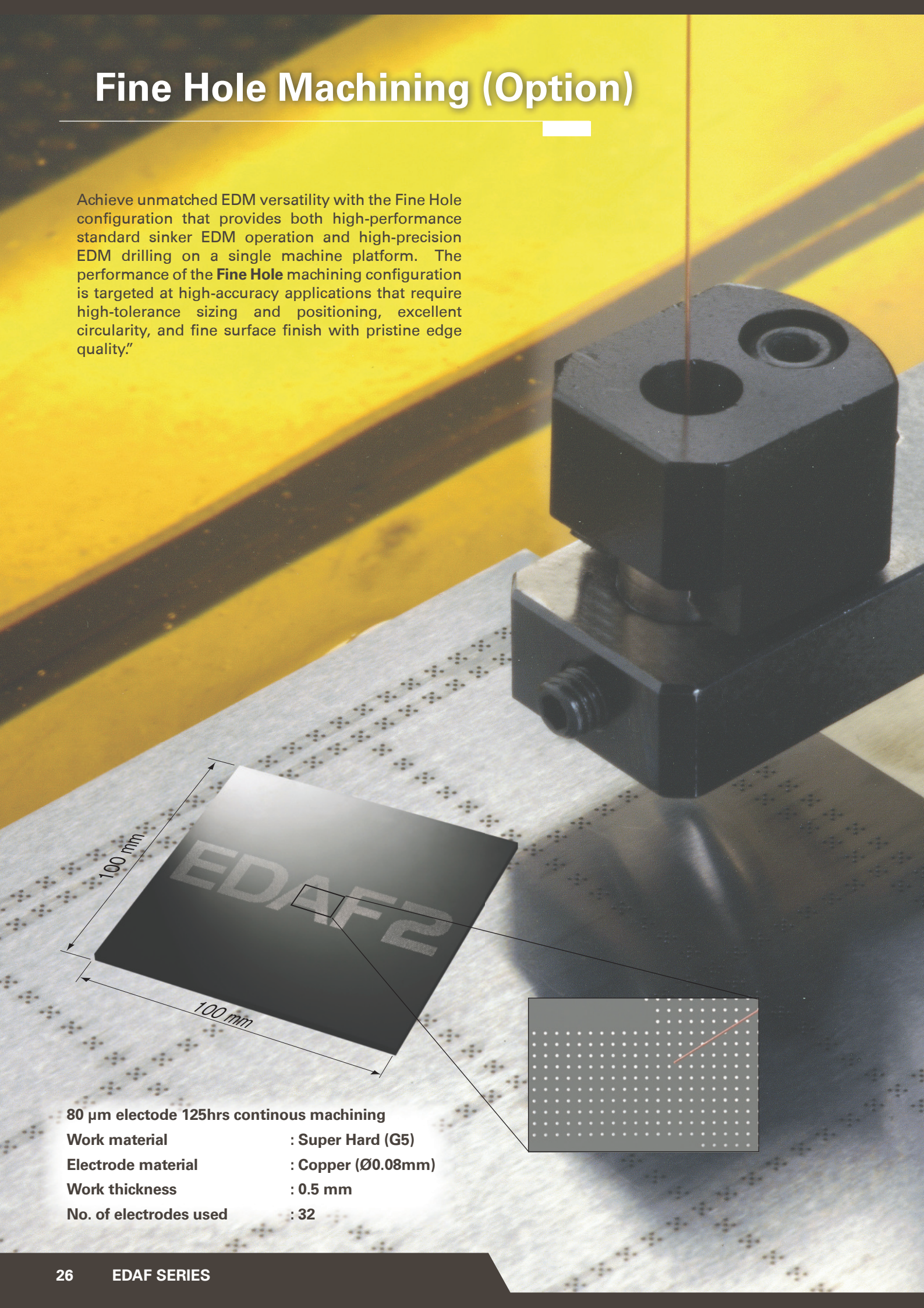
## Inert to environmental temperature change > Consistent accuracy > Lasting performance




Ambient temperature can change naturally depending on the environment. This has been a challenge for machine tool builders. The Makino EDAF has shown thermal stability by demonstrating minimal change (0.6 µ per degree Celsius) even with unstable temperature swings.

# Fine Hole Machining (Option)

Achieve unmatched EDM versatility with the Fine Hole configuration that provides both high-performance standard sinker EDM operation and high-precision EDM drilling on a single machine platform. The performance of the **Fine Hole** machining configuration is targeted at high-accuracy applications that require high-tolerance sizing and positioning, excellent circularity, and fine surface finish with pristine edge quality."

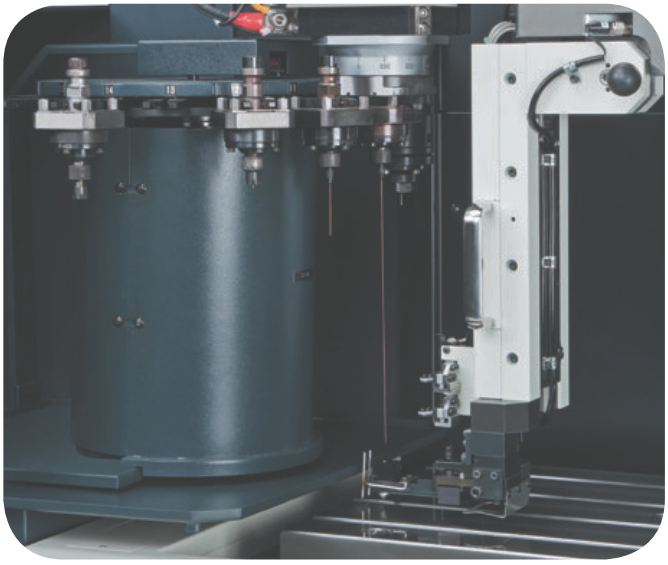



**80 µm electode 125hrs continous machining**

| | |
|---|---|
| **Work material** | **: Super Hard (G5)** |
| **Electrode material** | **: Copper (Ø0.08mm)** |
| **Work thickness** | **: 0.5 mm** |
| **No. of electrodes used** | **: 32** |

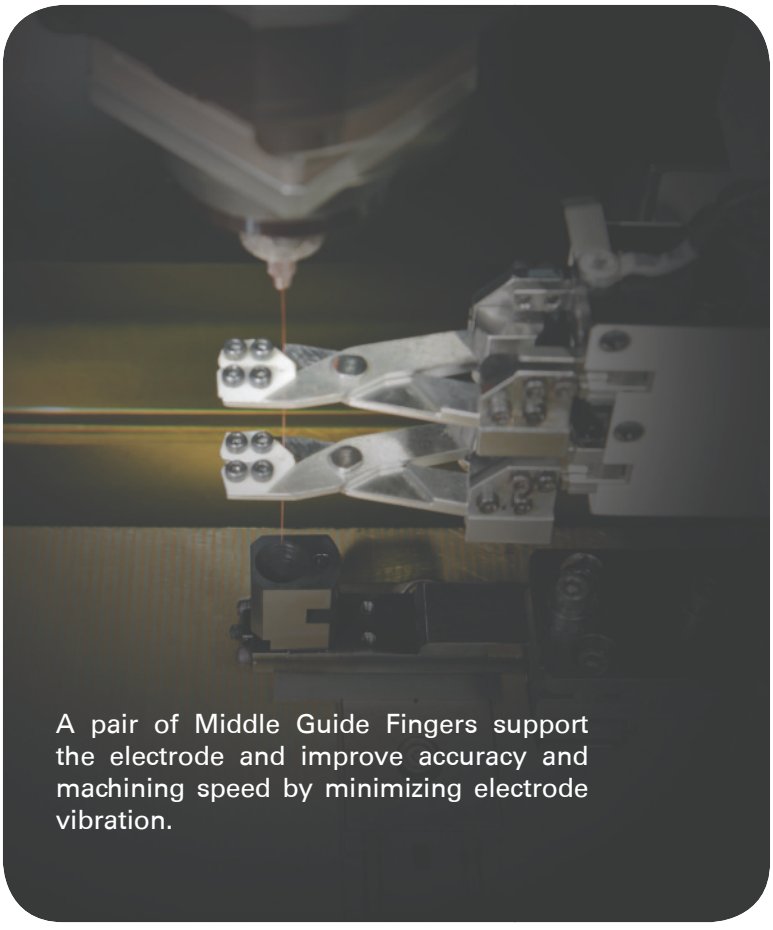
## Easy switch mount/unmount

The EDAF fine hole option can be mounted and unmounted very easily and quickly. This gives the fine hole option a unique characteristic as compared to competitive models.



## ATC for Fine Hole

The EDAF Fine hole option can also accommodate automatic tool change of electrode diameters down to 0.100mm.



A pair of Middle Guide Fingers support the electrode and improve accuracy and machining speed by minimizing electrode vibration.

## MV C-Axis (Option)

Provides rotation only capability to 1,000 rpm. This spindle is for dedicated EDM Drilling production applications, and cannot perform any standard Sinker EDM operations.

MAKINO

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Printed in Germany AH275Ec 1406/3 (H/D)