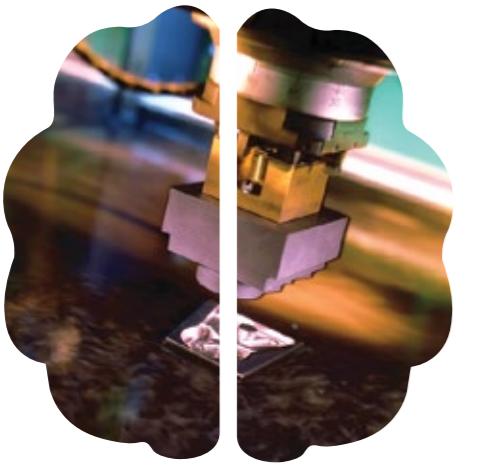


# EDAF SERIES

High Precision Sinker EDM





# 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.

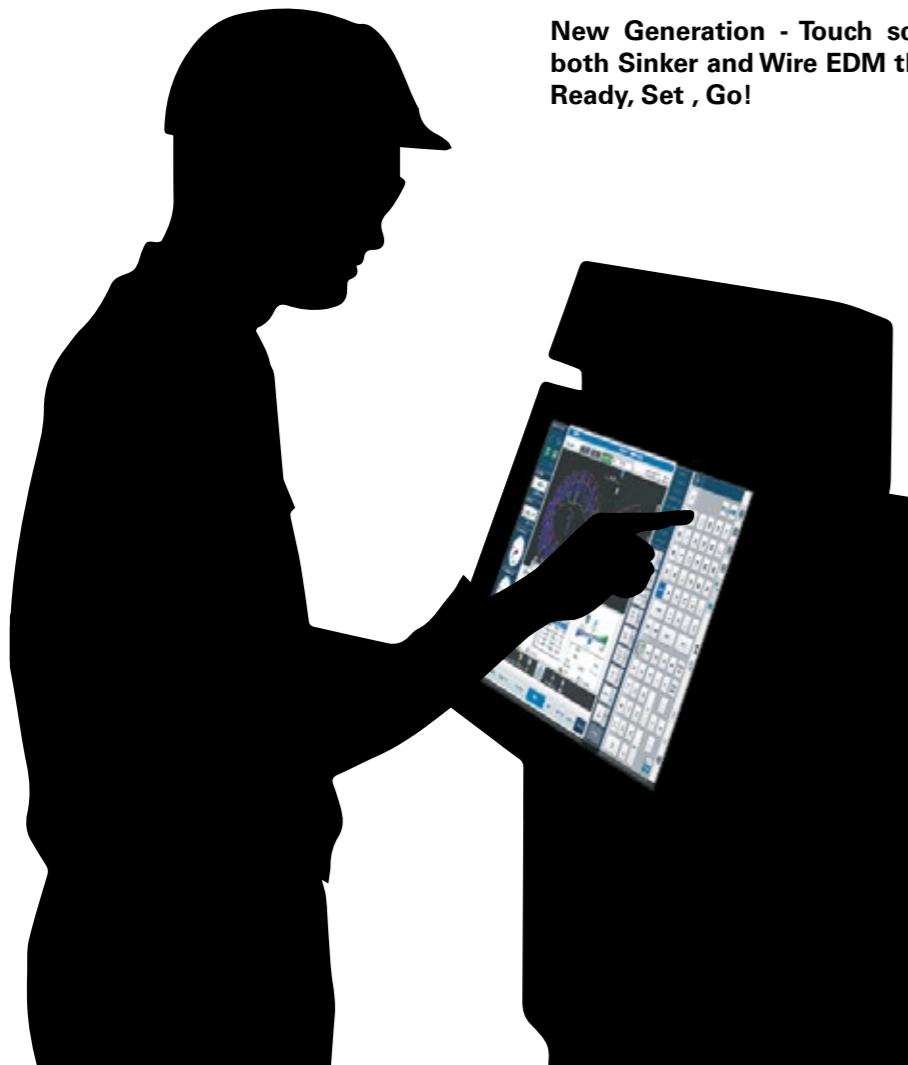


New Generation - Touch screen controller available for both Sinker and Wire EDM that makes machining easy as Ready, Set , Go!

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

## Hyper *i*

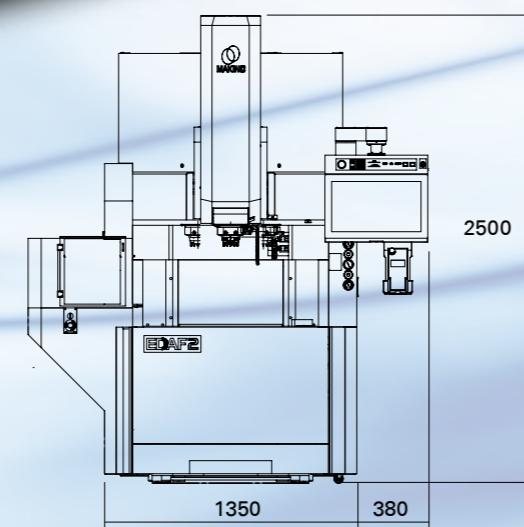
New Generation - Touch screen controller available for both Sinker and Wire EDM that makes machining easy as Ready, Set , Go!



# EDAF2



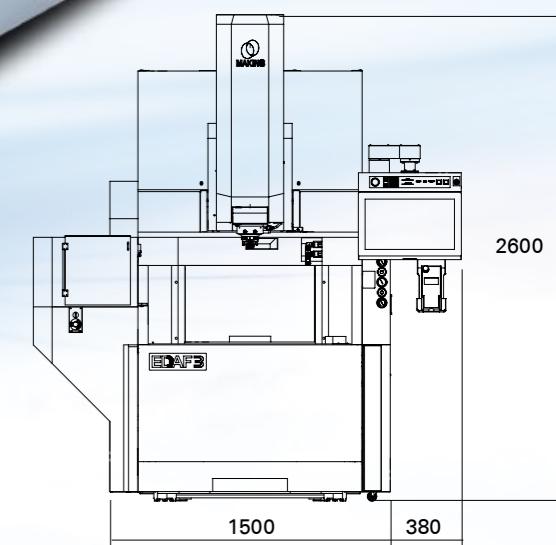
<b>Axis travel X x Y x Z</b>	<b>350 x 250 x 250 mm</b>
<b>Work tank size</b>	<b>550 x 350 mm</b>
<b>Maximum electrode weight</b>	<b>50 Kg</b>
<b>Maximum workpiece weight</b>	<b>500 Kg</b>

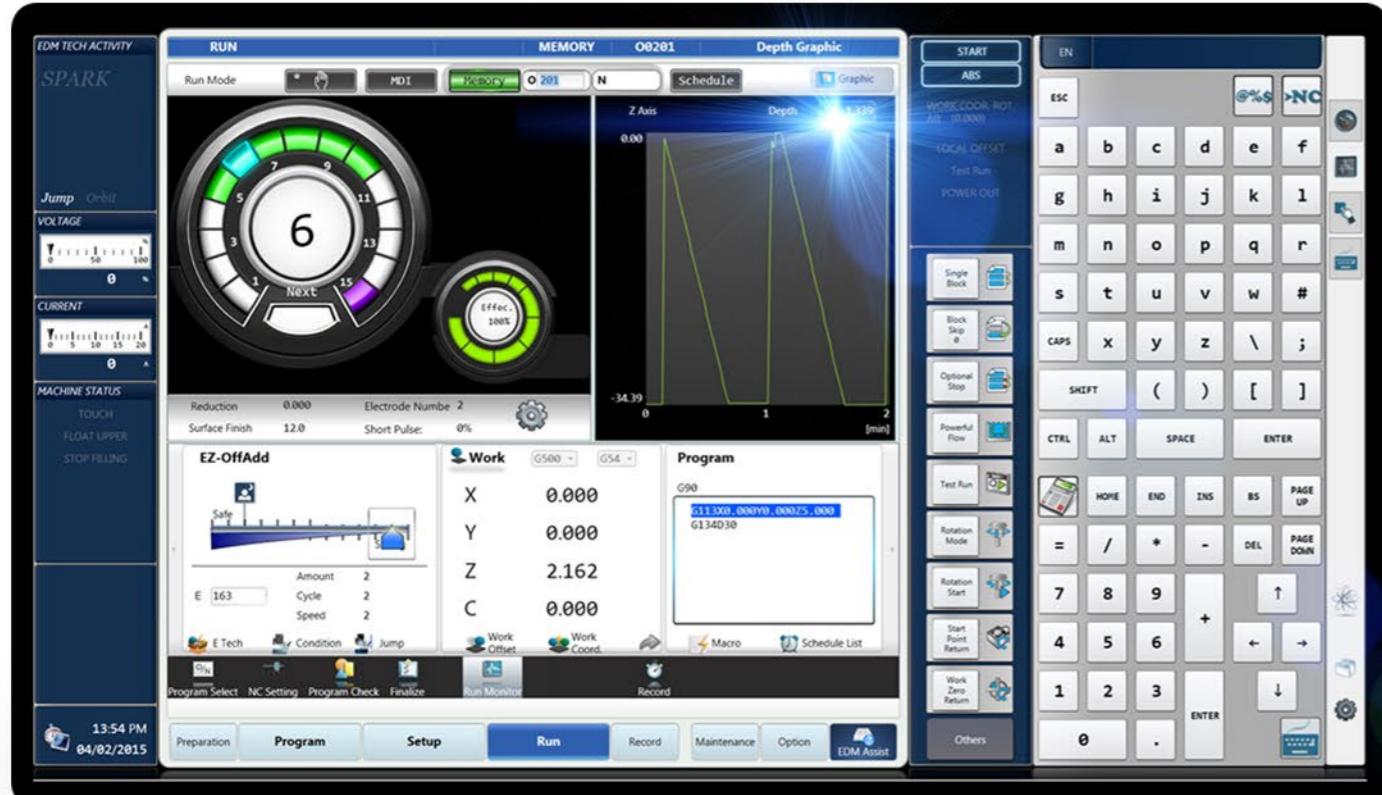


# EDAF3



<b>Axis travel X x Y x Z</b>	<b>450 x 350 x 350 mm</b>
<b>Work tank size</b>	<b>700 x 500 mm</b>
<b>Maximum electrode weight</b>	<b>75 Kg</b>
<b>Maximum workpiece weight</b>	<b>800 Kg</b>



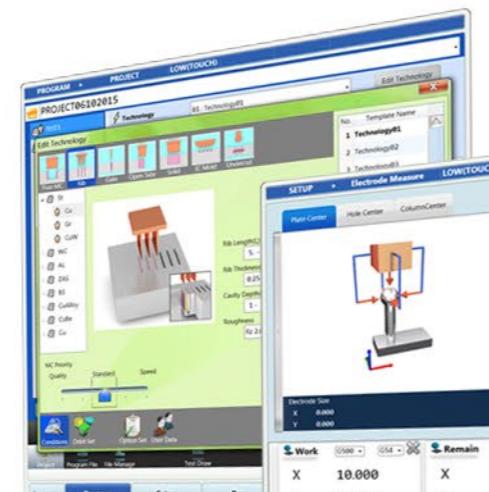


## intuitive | intelligent | interactive

Makino's new **Hyper i** control revolutionizes the interface between the operator and the machine. Using the most current interface technologies used by Smart-Phones 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 userfriendliness 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 i 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

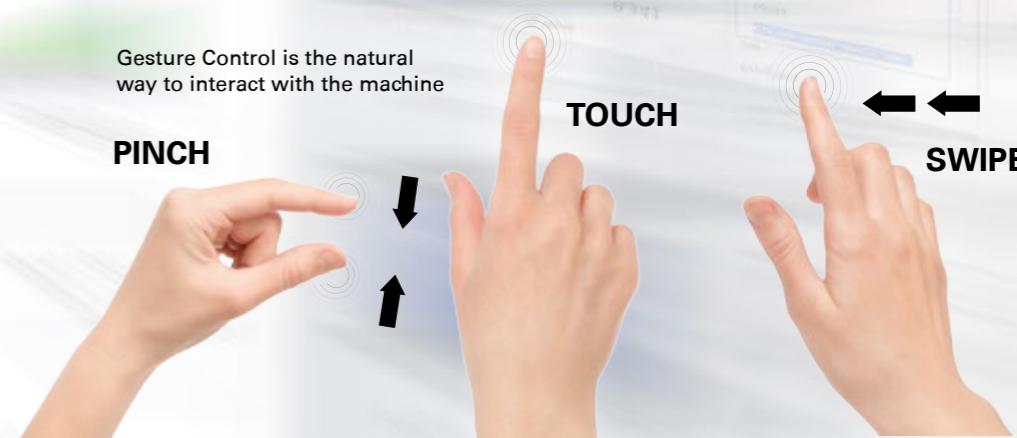


## 3. Run



Gesture Control is the natural way to interact with the machine

### PINCH



### TOUCH



**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.

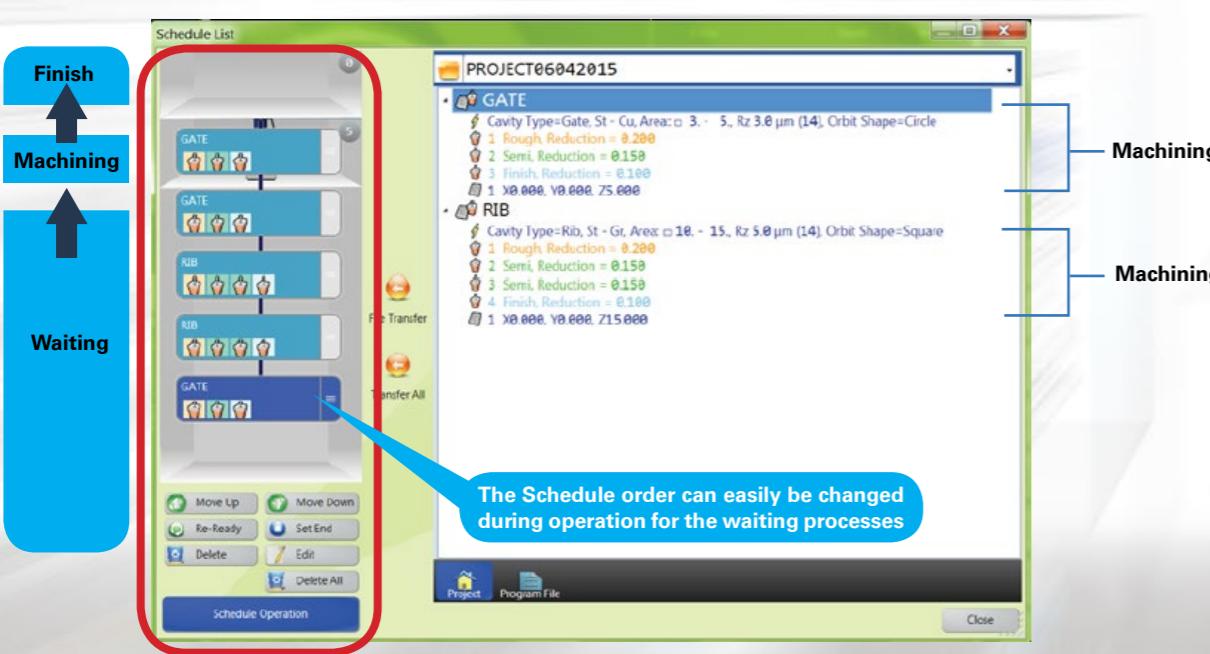
Specify Work Piece and Electrode data

Specify Electrode orbit pattern

Assign machining locations and depth

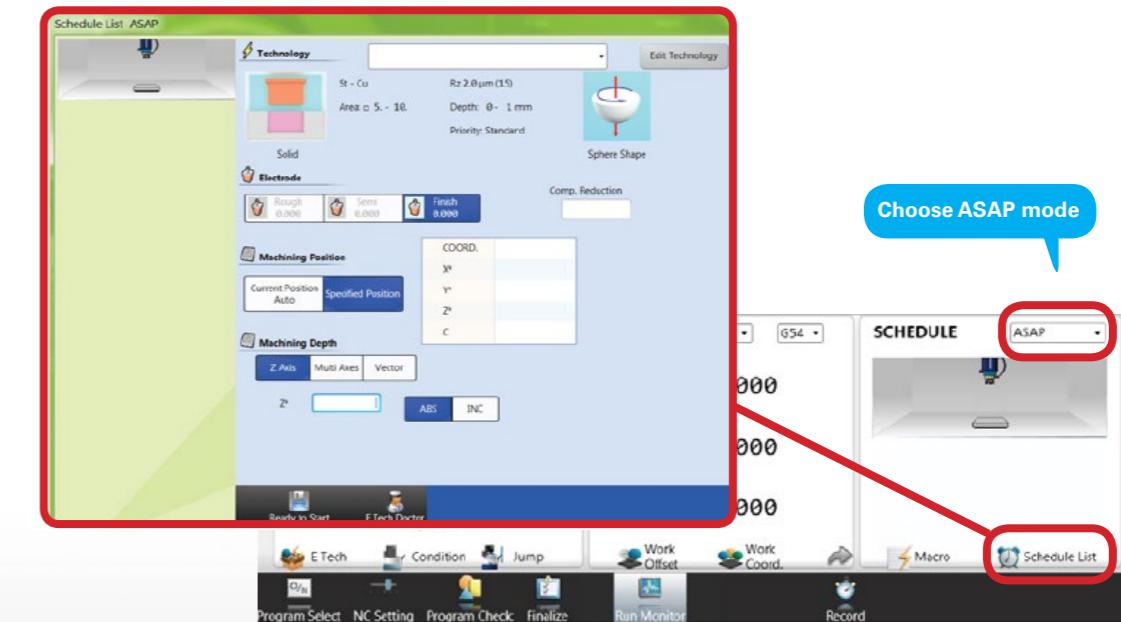
## Scheduling

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



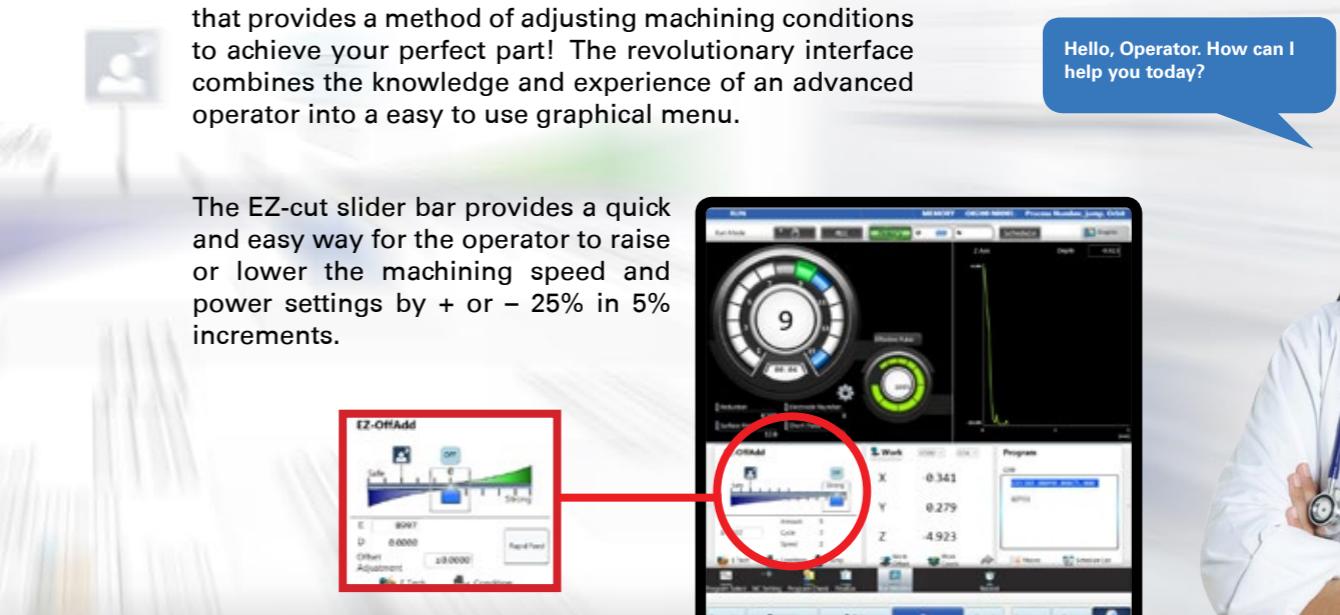
## ASAP function (As Soon As Possible mode)

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.

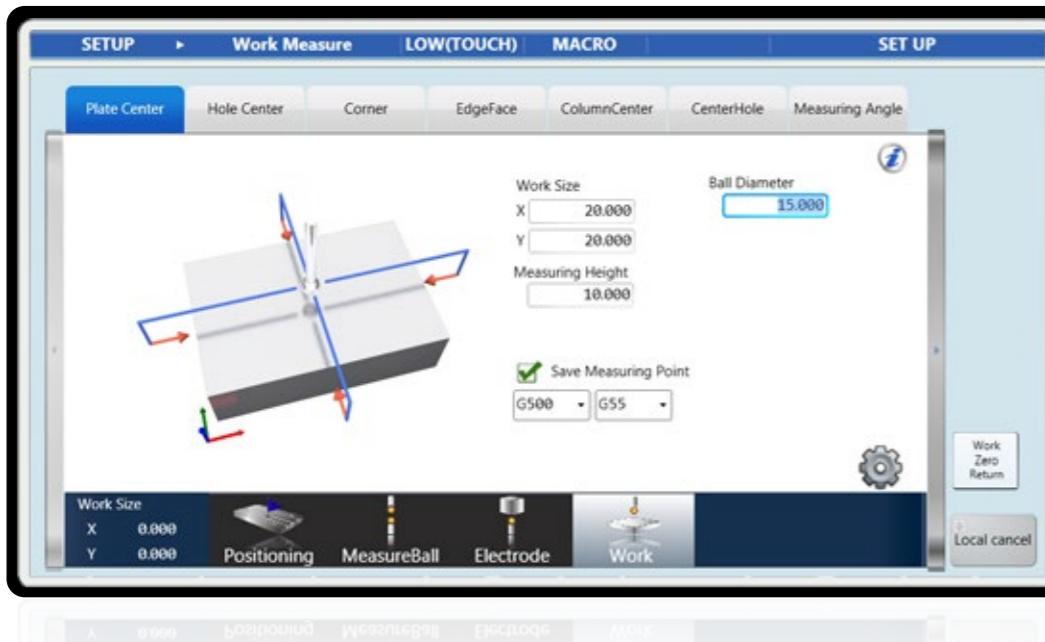


Adjusting to reduce the machining time It is a very useful function to safely cut parts during the night.



## Setup Function

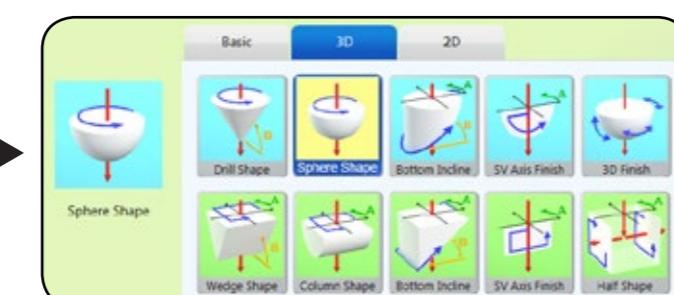
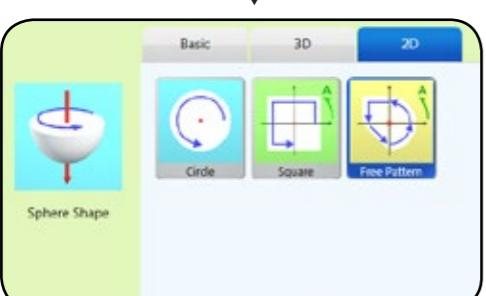
Provides the operator with an easy and streamlined method for aligning the Work Piece and Electrode. There are multiple standard Pick-Up cycles that help reduce setup time.



## 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.



## 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.

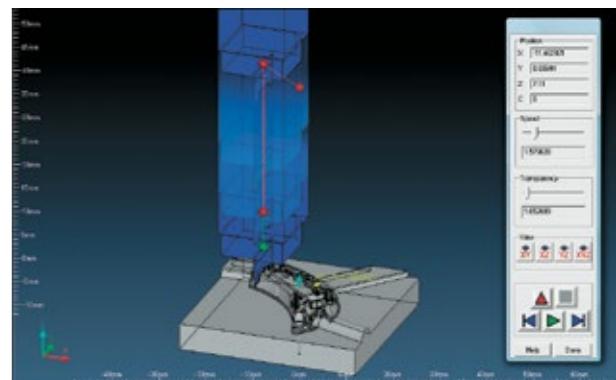
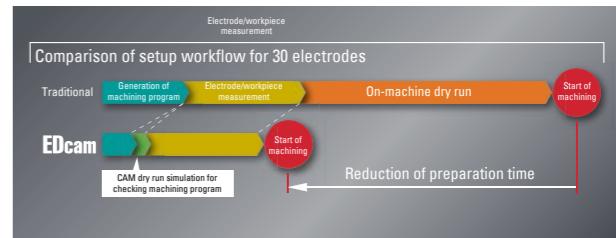
- Import 3D model
- Create NC program by EDcam
- Upload program to machine

### 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)

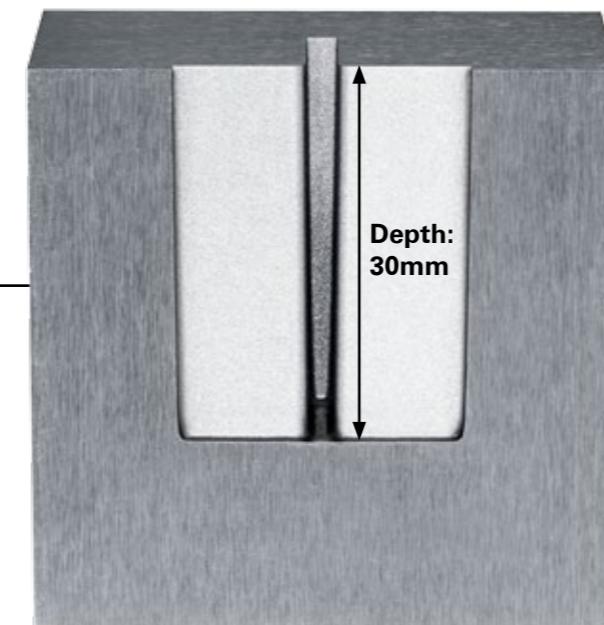
Enables the operator to access the machine control from a remote PC to view machining status, or to verify and create new machine programs.



# HyperCut

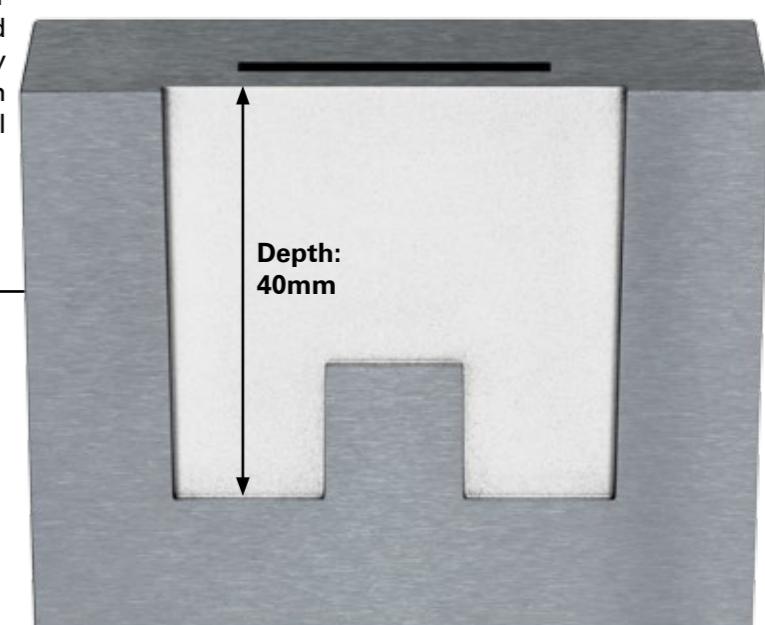
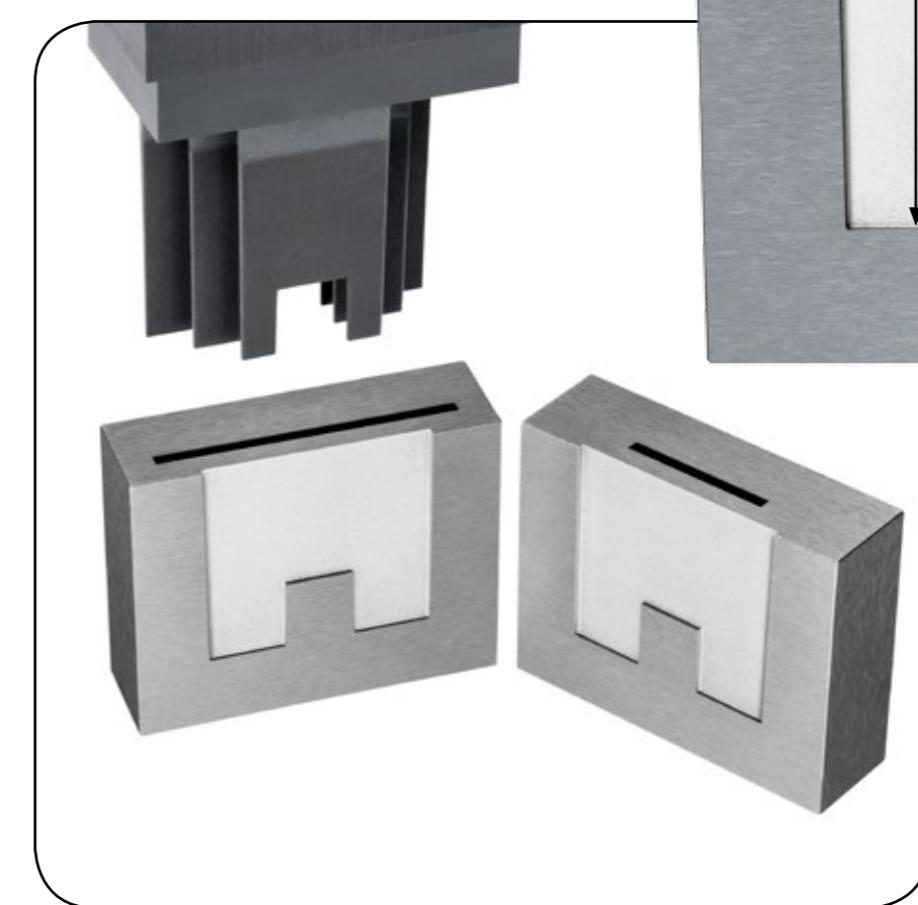
HyperCut technology for Sinker EDM are Precision-based settings that utilize a new generator function that allows increased power levels without requiring additional reduction on the electrode. Improvements in Roughing speeds by as much as 30% can be realized without affecting work piece accuracy or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

Cross Rib

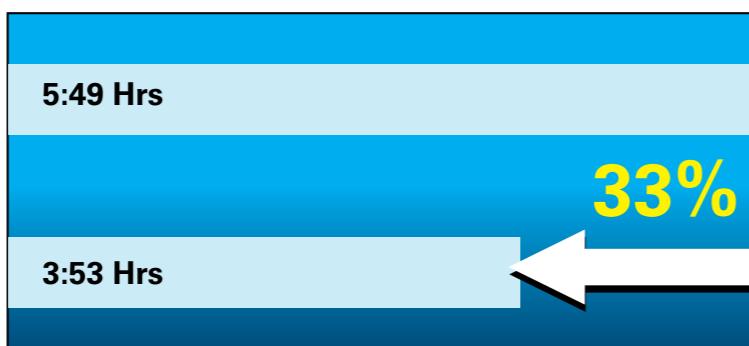


SuperSpark IV technology provides advanced adaptive control over machining discharge power and electrode jump motions during roughing and finishing operations. This technology is especially effective on rib or drafted electrodes, and when combined with HyperCut settings, can reduce total machining time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

Multi Rib Machining



Conventional  
Machining



HyperCut

Conventional  
Machining

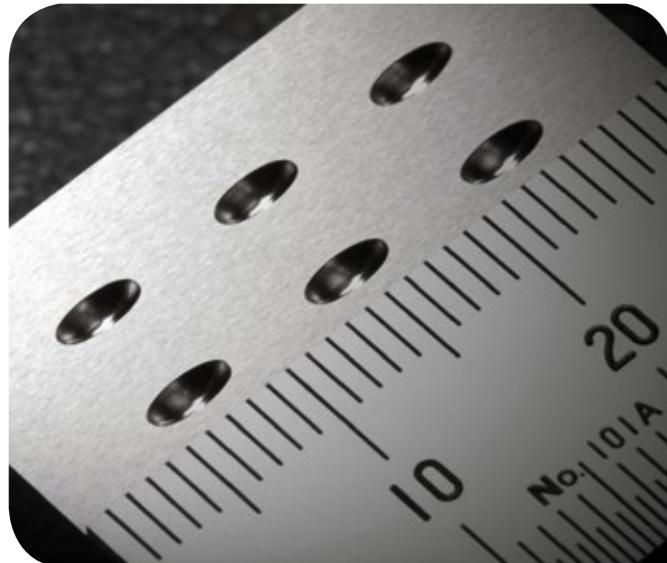
HyperCut  
+ Super Spark IV



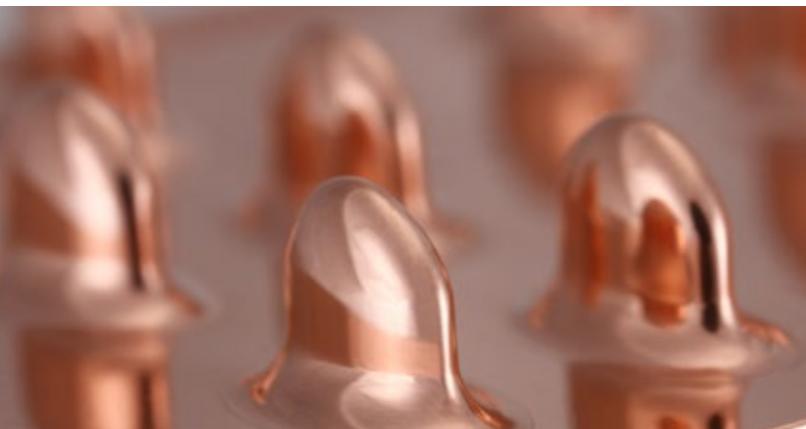
# Surface Finish

## LED MOLD

Best Glazed Surface Roughness  $0.05 \mu\text{m Ra}$

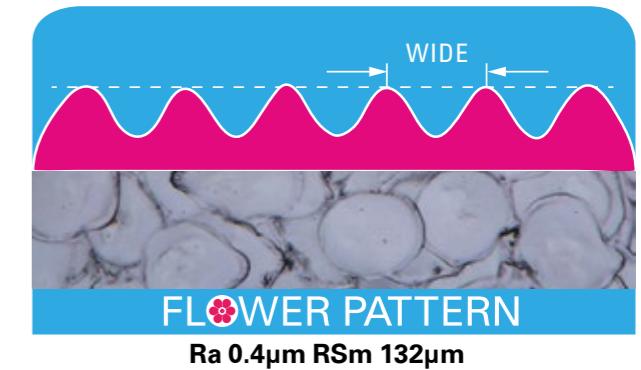
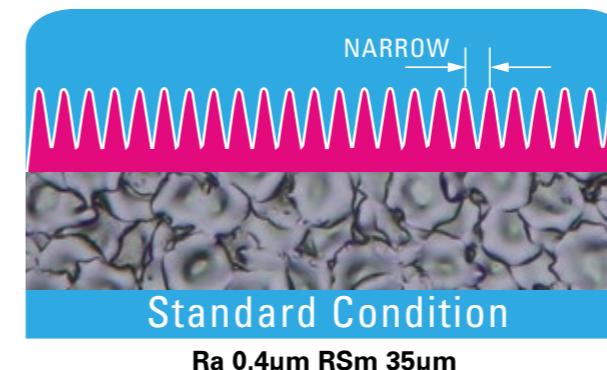


Electrode Material : Copper (Oxygen Free Copper)  
Work Piece Material : ELMAX  
Surface Finish :  $0.32 \mu\text{m Rz}$  ( $0.05 \mu\text{m Ra}$ )  
Machining Time : 3h 15min



## HyperCut <sup>+FLOWER PATTERN</sup>

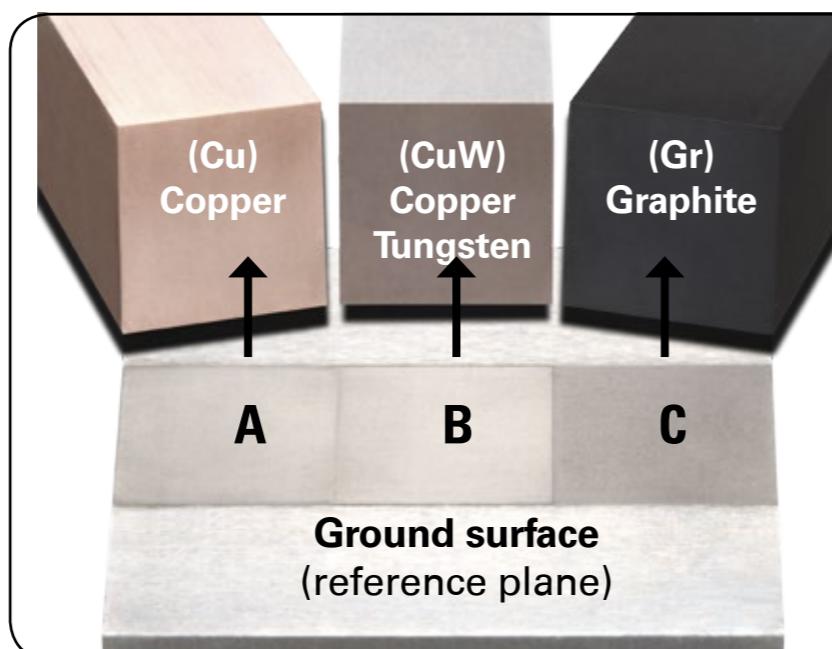
Improving the performance of mold tooling requires more than just fine surface finish. Makino's Flower Pattern technology achieves a unique combination of even and consistent surface finish with a large RSm value. The large RSm surface quality provides a more open surface structure that promotes easier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



## Predictable Results

Attain  $\pm 2 \mu\text{m}$  step difference between ground and EDM surfaces using different electrode materials in unmanned operation as a result of precise construction and thermal stability.

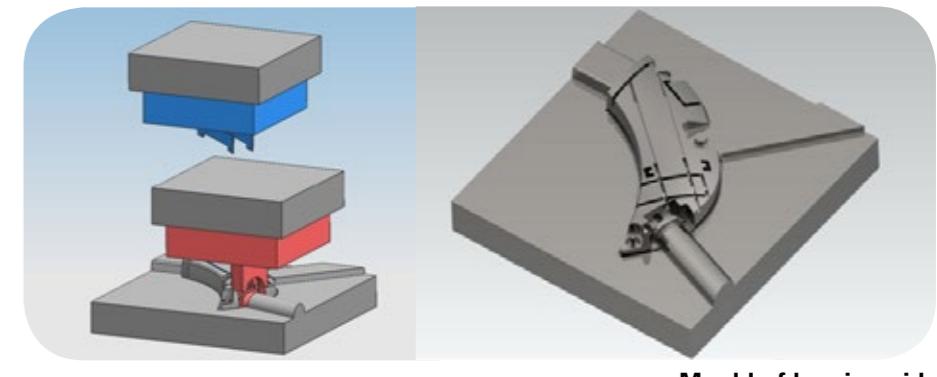
Conventional process	Process using EDAF
Start machining	Start machining
Stop machining 5-10 $\mu\text{m}$ before final finish	
Clean workpiece	
Measure machining depth	
Clean electrode	
Resume machining	
Interface step difference of $\pm 2 \mu\text{m}$	



## <sup>+FLOWER PATTERN</sup> 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



# 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



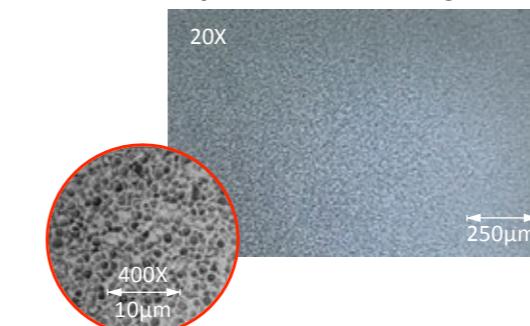
## Super Surface

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.

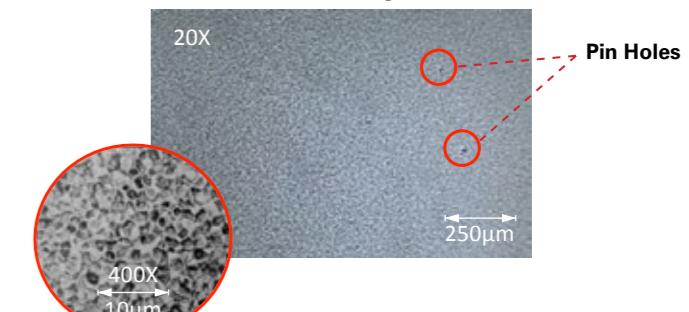
### Watch Bezel Surface roughness up to $0.6 \mu\text{m Rz}$ ( $0.2 \mu\text{m Ra}$ )

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

#### Super Surface Machining



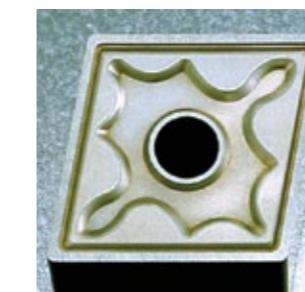
#### Traditional Machining



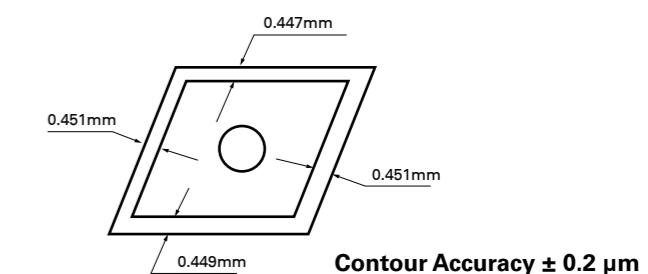
## Carbide Machining Circuit (option)

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  $\pm 2\mu\text{m}$  accuracy for the most difficult tungsten carbide tooling applications.

#### Workpiece



#### Electrode



Electrode Material : Copper Tungsten (CuW)  
Workpiece Material : Carbide (WC)  
Depth : 0.5mm  
Surface Finish :  $0.6 \mu\text{m Rz}$  ( $0.2 \mu\text{m Ra}$ )  
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.



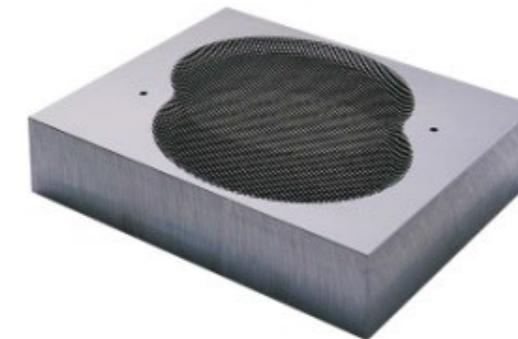
### HEAT SINK for Aluminum Die Cast Head Light

Workpiece material	: Steel (St)
Electrode material	: Graphite (Gr)
Machining depth	: 10mm
Electrode reduction	: 0.15mm
Surface finish	: Ra0.55 µm



## 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  
Workpiece Material  
Electrode Reduction  
Depth of Cut  
No. of Electrode Used

: Graphite (POCO-EDM3)  
: Stainless Steel (STAVAX) (200 x 200 mm)  
: 0.15mm / side  
: 7mm  
: 3

	Without HQSF	With HQSF	With HQSF
Machining Time	20hr.	20hr.	18hr.
Surface Finish	10µm Rz (1.7 µm Ra)	5µm Rz (0.9 µm Ra)	10µm Rz (1.7 µm Ra)
		<b>50% Better Finish</b>	<b>10% Faster Time</b>

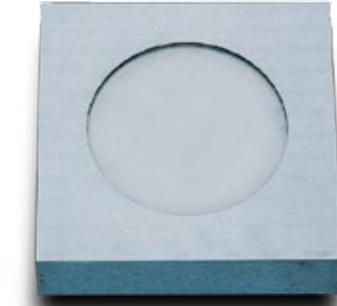
OR

## 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.

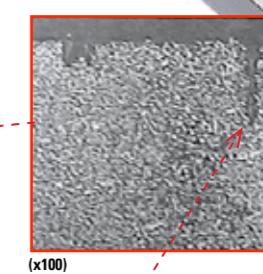
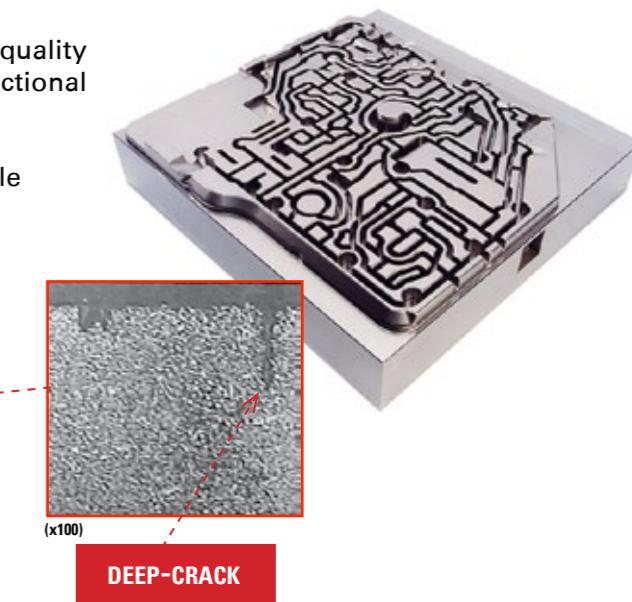
Cross-section views of crack morphology after a 2000-cycle heat crack test (Material: SKD610)



**HQSF Process**



**Conventional Process (EDM + Polishing)**

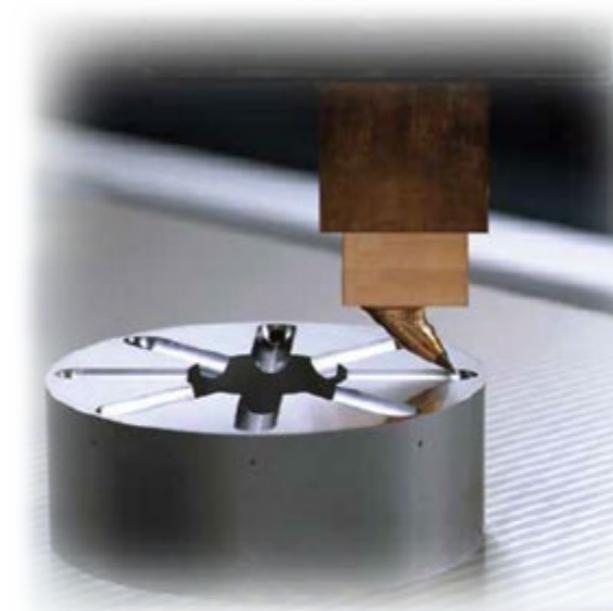
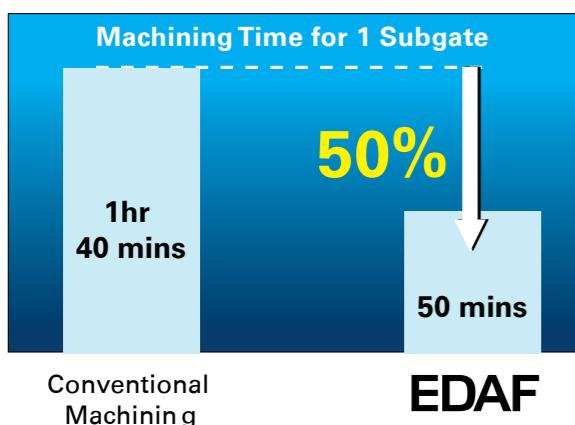


**DEEP-CRACK**

# Mold Machining

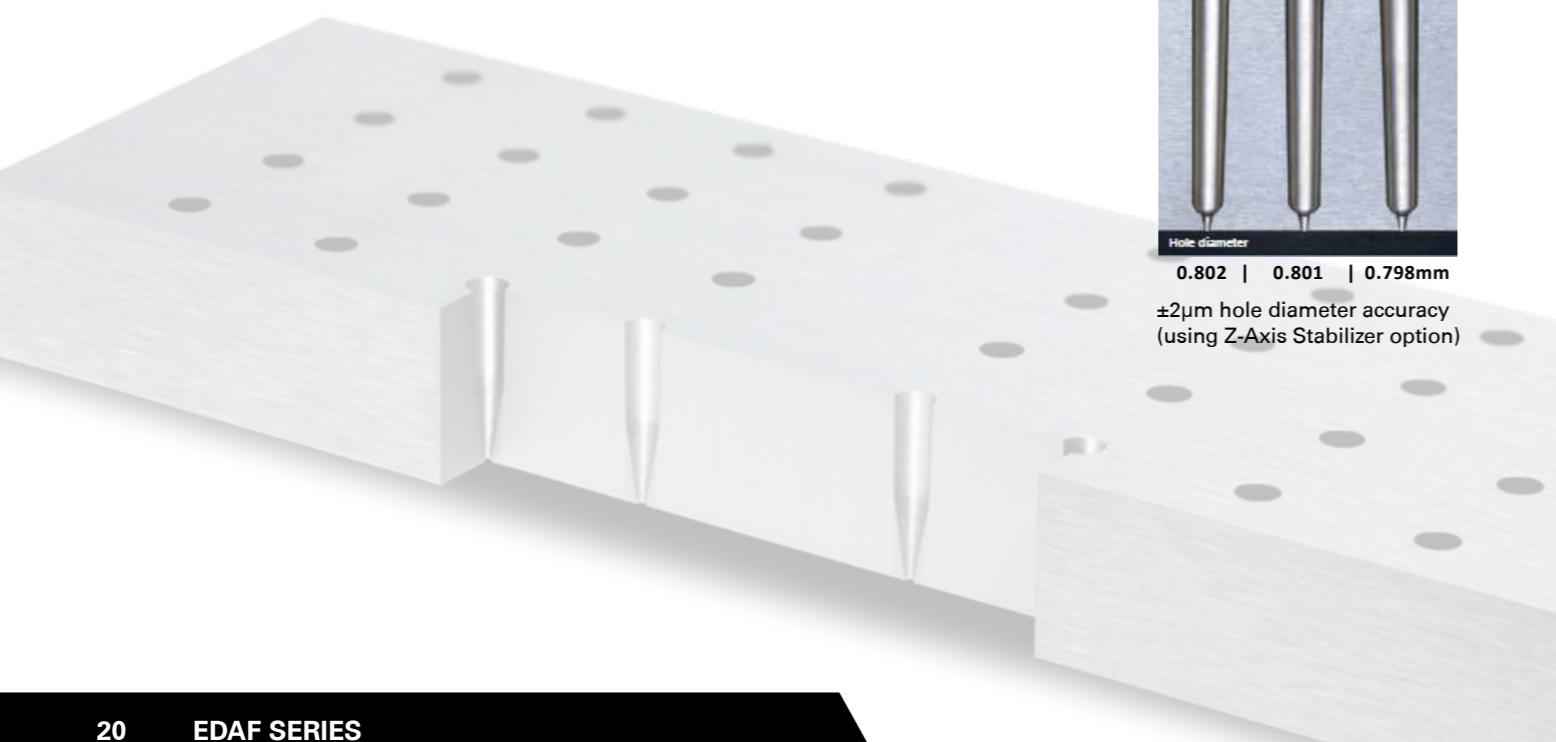
## Pin Gate / Sub-Gate Machining

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.



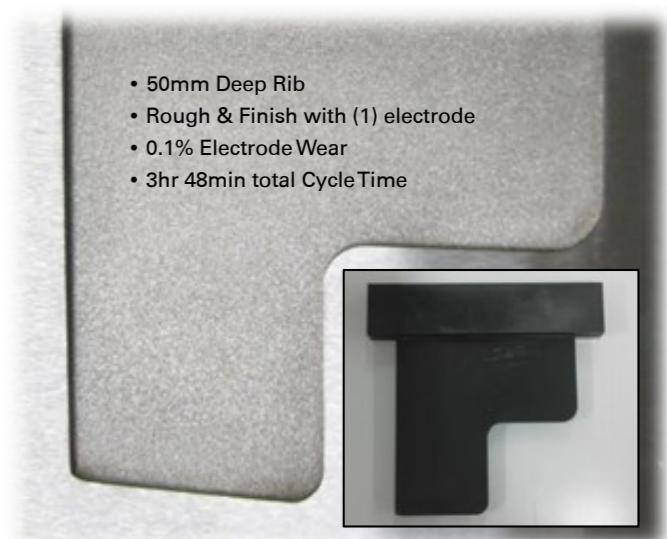
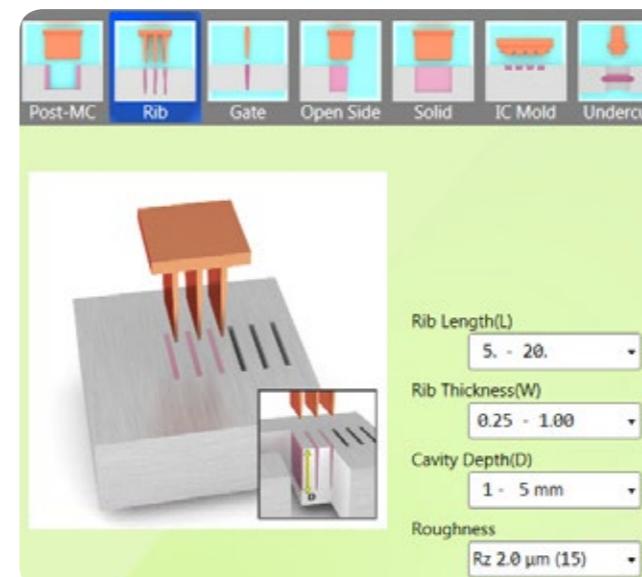
### High speed jump on side machining

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



## Rib Machining

Machining of support rib details are a common occurrence in Die/Mold tooling, and Makino makes completing these tasks easy and efficient. There are settings available to the operator that provide optimum results no matter what the condition. Technology for common tool steels and copper alloy materials, and conditions that provide productive high-speed machining with low electrode wear are all standard settings available to the operator.



## SuperSpark-Graphite

Super Spark-Gr. is a generator technology that enables faster rough machining of deep features by an overwhelming 50%! This speed-based technology adjusts machining power polarity to provide the highest level of material removal with minimized electrode wear.



## Low Electrode Wear Technology

- Rough and Finish using a single electrode process
- No sacrifice to part quality or Cycle Time
- Achieve fast machining speeds with electrode wear below 0.1%
- Produce results with even and consistent side-wall surface finish

## ArcFree Technology

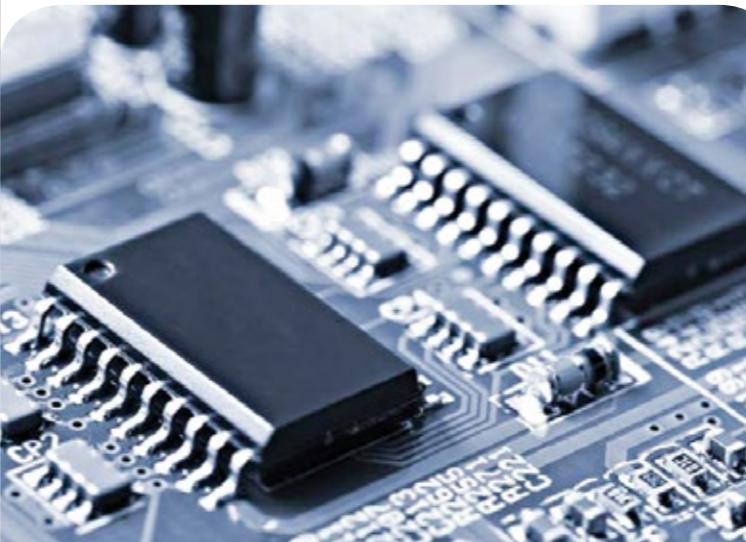
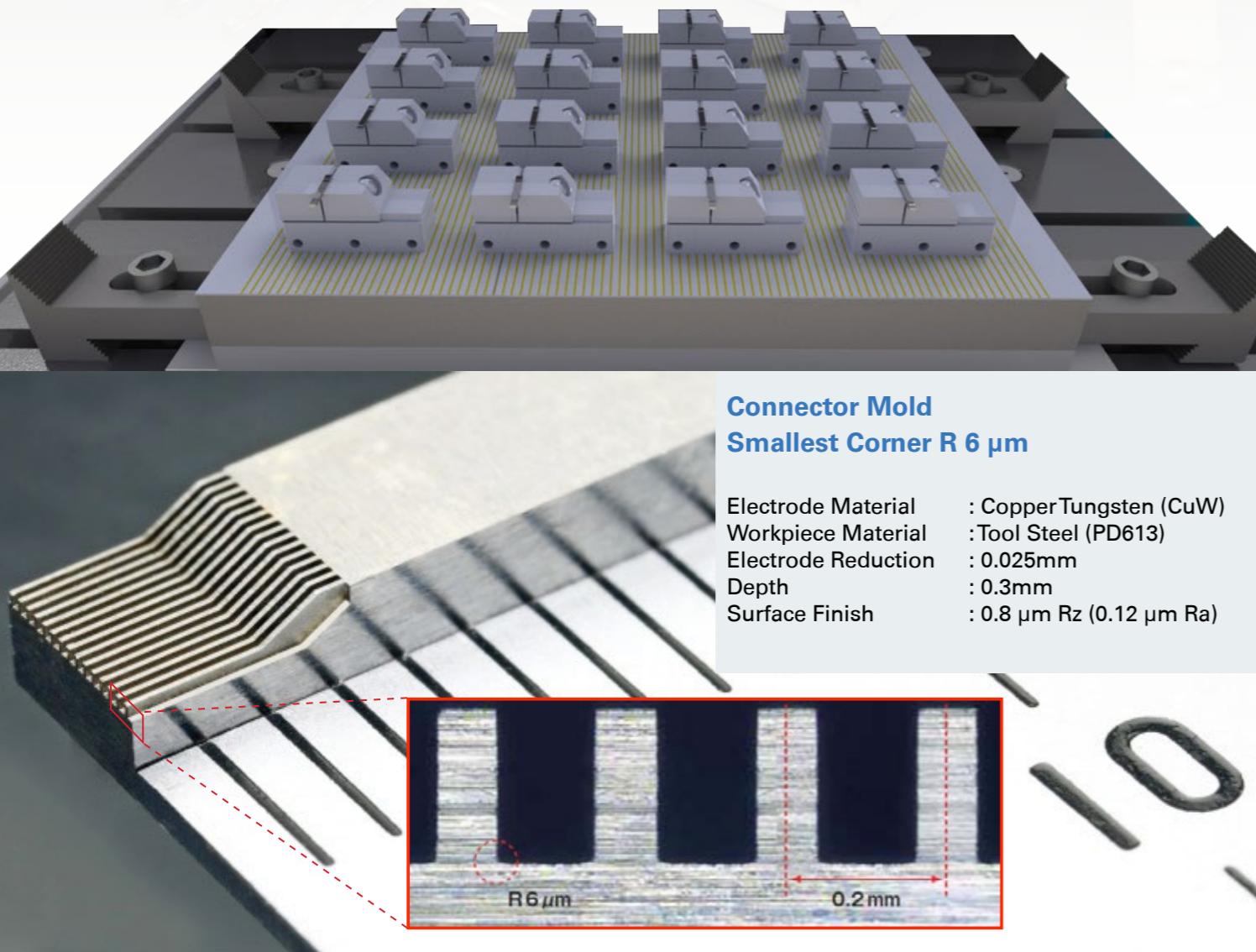
Arc Free Technology is one of Makino EDM's latest technological achievements! Arc Free is a safety focused technology that monitors and controls spark current density, and results in stable machining under the most difficult applications. Destructive DC arcs are no longer a threat as a result of our Proprietary spark gap monitoring, coupled with 2msec servo response time on all Axis. Arc Free Technology virtually guarantees Arc Free operation during critical burns.

# Electronics Tooling Applications

As electronic devices continue to become smaller in size, so do the die/mold tools 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.

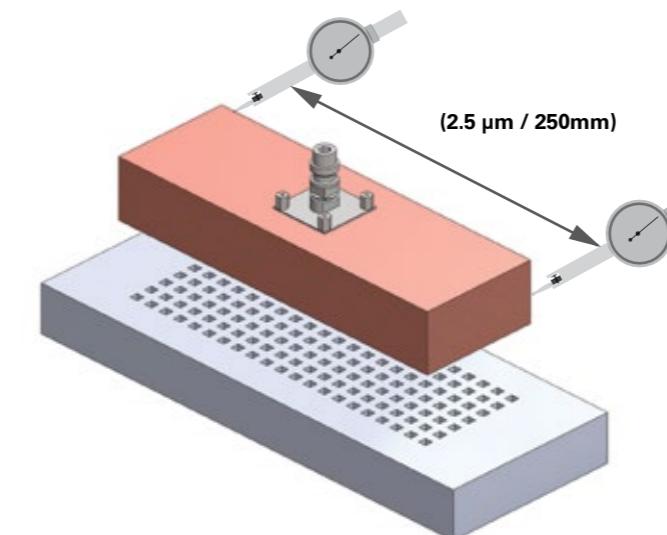
## Connector Multicavity

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.



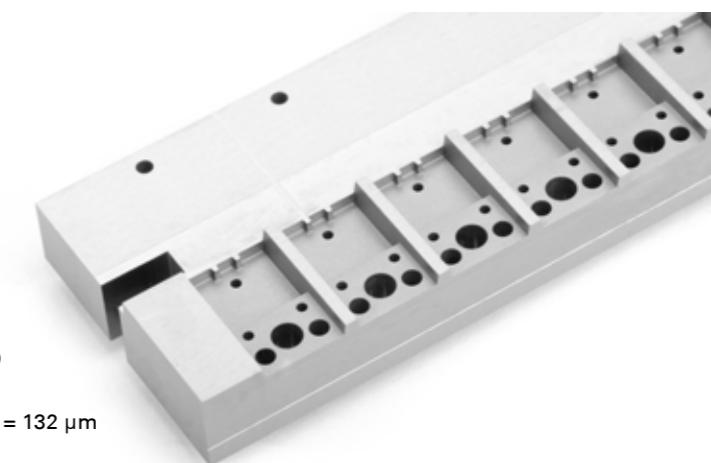
## Semiconductor

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)

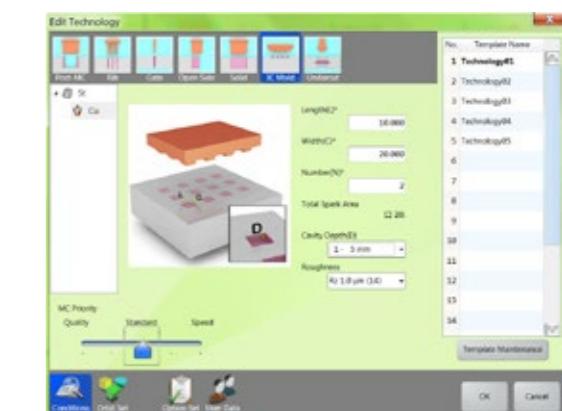
The EDAF machine provides a Semiconductor process package that aids the operator in the setup and preparation of electronics tooling. This function helps to improve and maintain accuracy of straightness and flatness to within 2.5 µm.



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

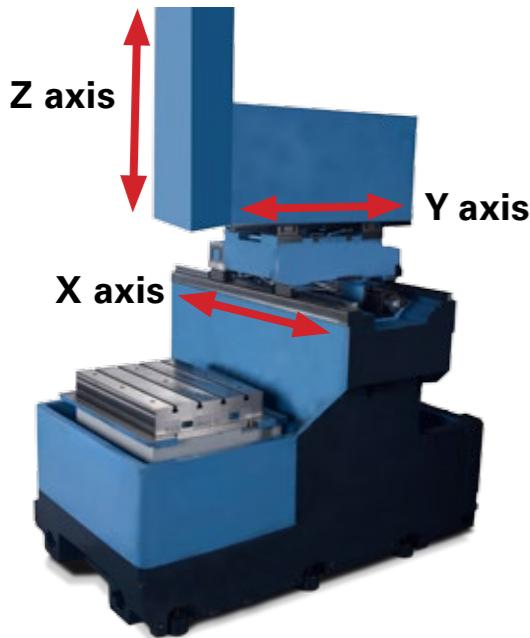
Operators are able to create productive and efficient programs for Cavity Bar tooling without having extensive experience using the Semiconductor package.



# 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



## Compact Design

The compact machine design pursues enhanced ease of operation and maximizes footprint usage on the production floor. Minimal spacing is required for maintenance access, and multiple machines can be installed with efficient use of floor space.



## Table Down Configurations

For enhanced flexibility, the EDAF-Series can be configured in (3) different table configurations. These optional specifications provide additional work tank depth to accommodate tall work pieces, or additional clearance for an optional integrated rotary axis.

### Standard Table

T-Slot Work Table  
Standard work tank depth and fluid height

○	○	35
		110
○	○	110
		50
EDAF2-Standard and 50mm Down Table		110
○	○	85
		700

### 50mm Down Table (Option)

T-slot Work Table  
(+50mm additional work tank depth and fluid height)

### 100mm Down Table (Option)

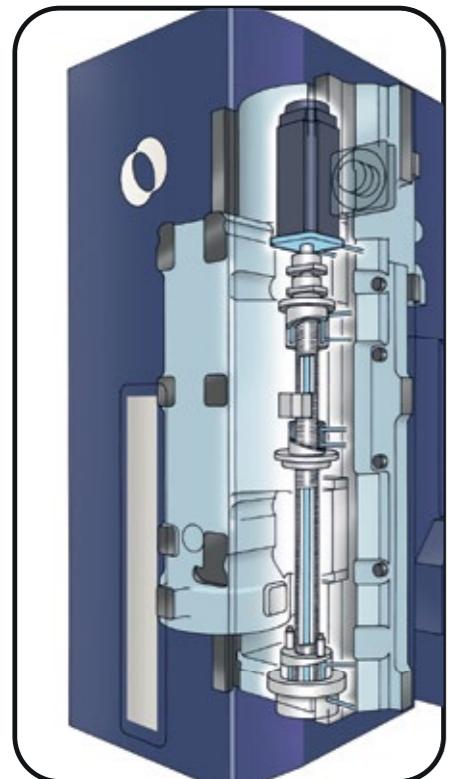
Tapped hole pattern Work Table (No T-Slots)  
(+100mm additional work tank depth and fluid height)

• ○ • • • • • ○	50	100	100	100	100	100	100	50
• • • • • • • •	50	100	100	100	100	100	100	50
• • • • • • • •	50	100	100	100	100	100	100	50
• ○ • • • • • ○	50	100	100	100	100	100	100	50
EDAF2-100mm Down Table								700

# 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.

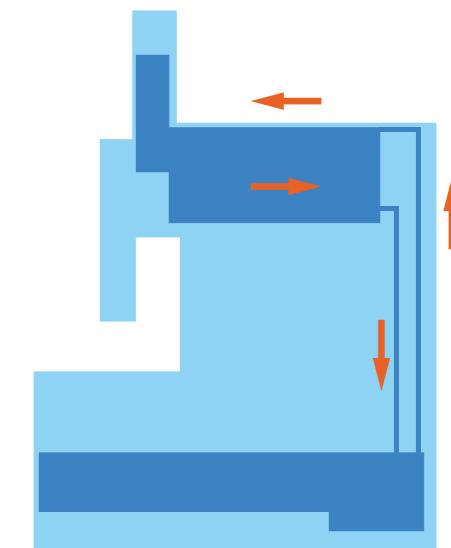


Insulation is used between the machine structure and electrical cabinet to minimize heat transfer



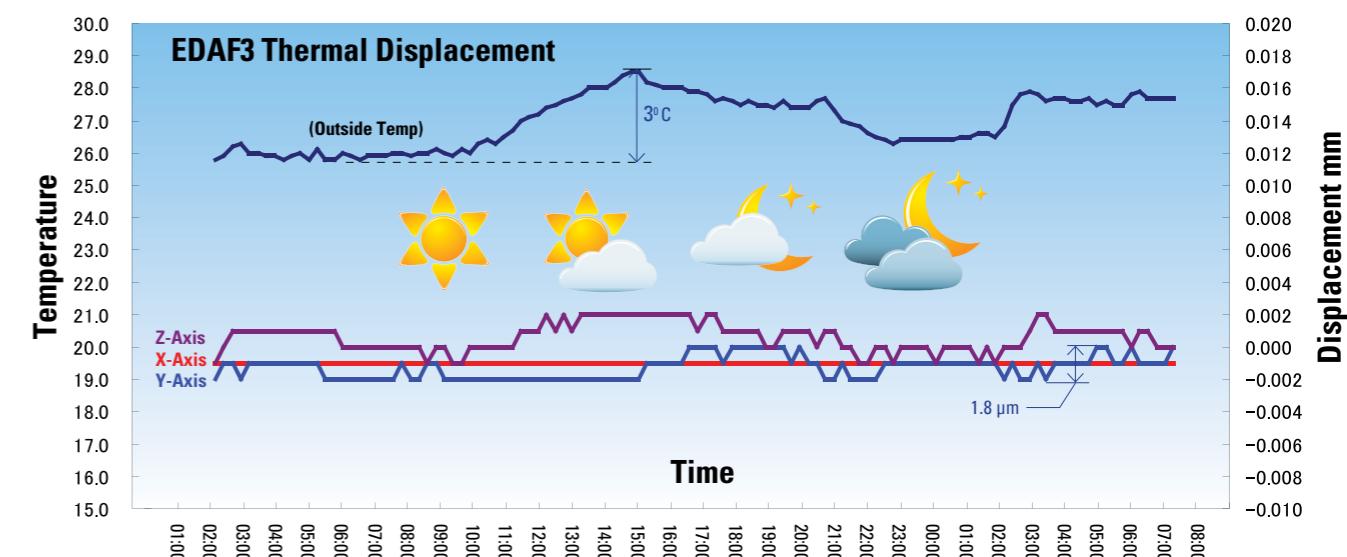
Electrical Cabinet and the Machine structure is separated to avoid heat transfer and achieve thermal stability.

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 ( $0.6 \mu$  per degree Celsius) even with unstable temperature swings.

# 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.

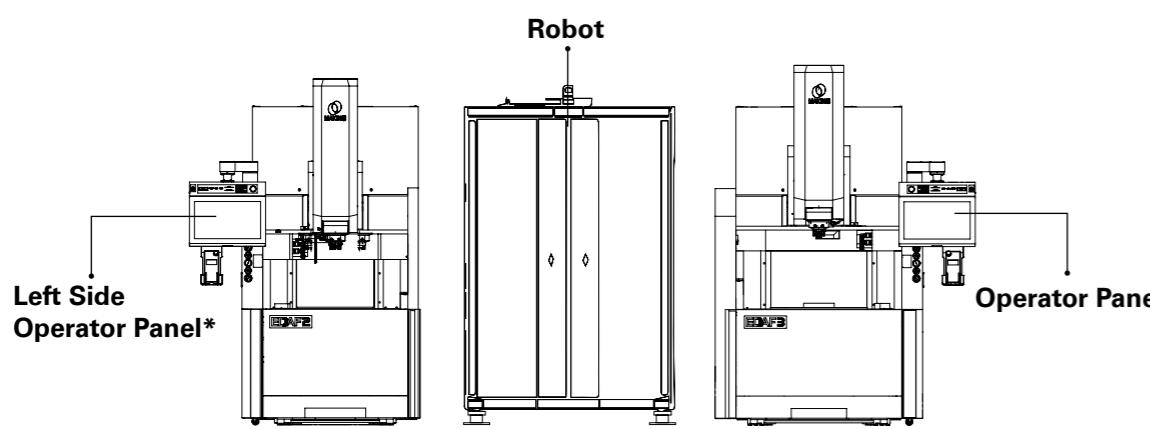
## Full-function Advanced Handbox (Standard)

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.



## Left and Right Side Controls

An optional Left-Side control panel is available. Ideal configuration for robot automation that services two machines side-by-side.



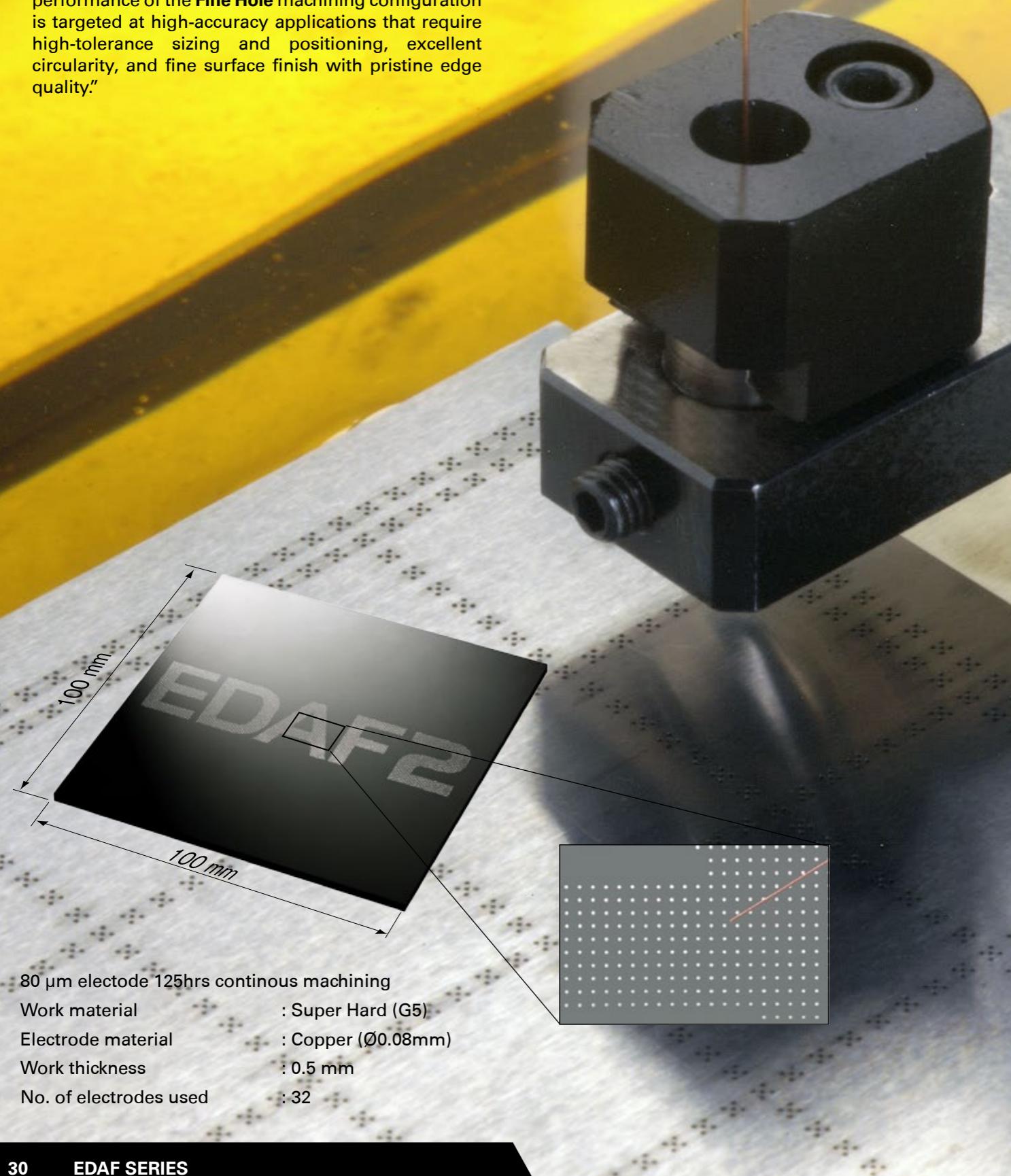
Unobstructed access is provided from the sides of the work tank, making it remarkably easy to set up and center workpieces.



The work tank height can be adjusted so that the dielectric fluid level matches the thickness of the workpiece being machined. This allows excellent visibility to check the machining process very easily.

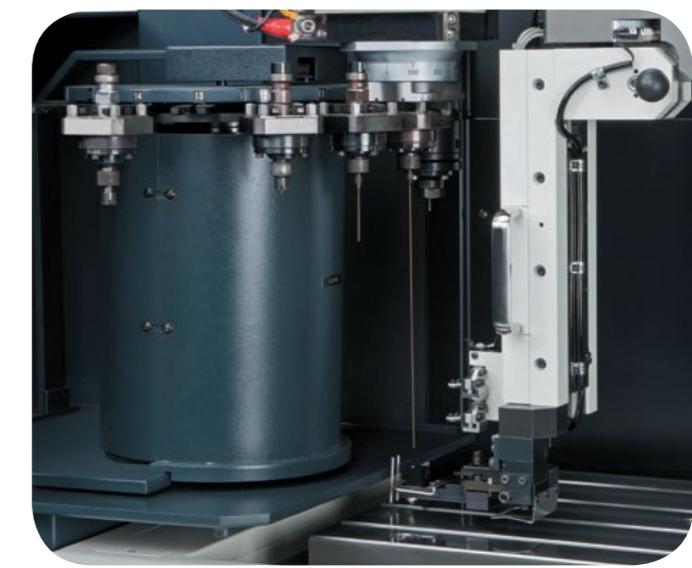
## Fine Hole Machining (Option)

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."



**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.

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\*The specifications in this catalog may be changed without prior notice to incorporate improvements resulting from ongoing R&D programs.

\*The machines displayed in this catalog are fitted with optional equipment.

\*This product, including technical data and software, may be subjected to the Singapore Foreign Exchange and Foreign Trade Law.

\* Prior to any re-sale or re-export of controlled items, please contact Makino to obtain any required authorization or approval.