High Speed and High Precision AI Wire-cut Electric Discharge Machine

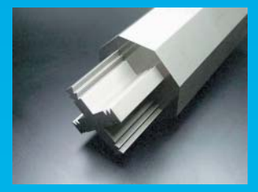
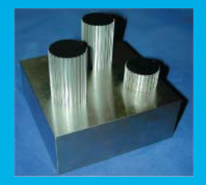
FANUC ROBOCUT

α-0*i*C/α-1*i*C

High Speed and High Precision AI Wire-cut Electric Discharge Machine

FANUC ROBOCUT α-*i*C series

ROBOCUT meets the real needs in the field of machining.

High-speed

Achieves the world's highest speed with economical brass wire.

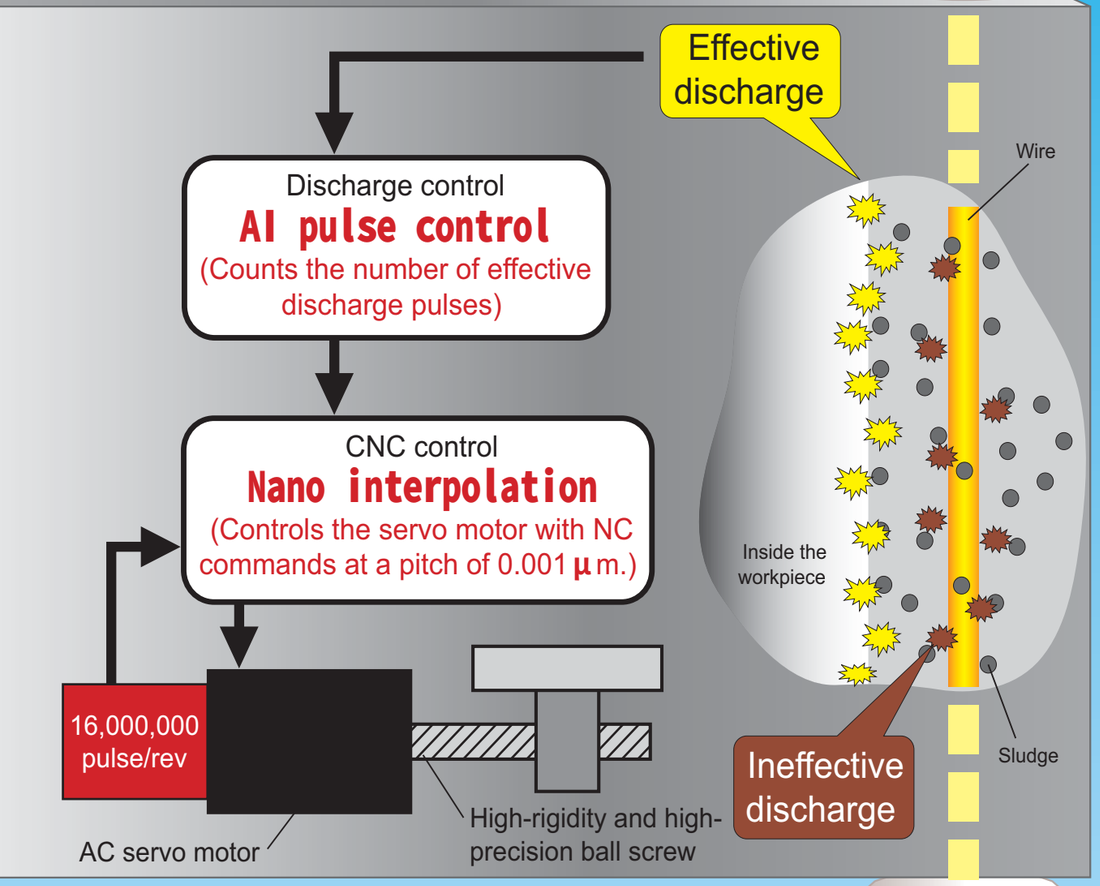
330 mm²/min (ϕ 0.3 brass wire)

250 mm²/min (ϕ 0.25 brass wire)

High-precision

Roundness **1.2** μm
(for 30 mm dia. hole cutting)

Further fine roughness **0.7** μm Rz



What is AI pulse control?

- ROBOCUT generates several tens of thousand discharge pulses per second.
- Of them, AI pulse control accurately selects and counts the number of effective discharge pulses, which have actually contributed to cutting.
- It then controls the feedrate according to the number of effective discharge pulses per unit time.
- This velocity control keeps the cutting energy uniform, thereby preventing wire break due to concentrated discharge, and enabling stable high-speed cutting. In addition, it offers a uniform cutting surface, thereby achieving high-precision cutting.

What is Nano interpolation?

- Nano interpolation enables the CNC to distribute positioning commands more accurately with a pitch of 0.001 μm (1 nano meter).
- In accordance with these commands, the servo motor equipped with the ultrahigh-resolution of 16 million pulse coder feeds all machine axes accurately for positioning.
- This excellent FANUC CNC and servo system achieves ROBOCUT high-precision cutting.

ROBOCUT α-1*i*C

Cutting stroke 550×370×310mm

ROBOCUT α-0*i*C

Cutting stroke 320×220×180mm

Automatic workpiece search by 3D sensor

Saving of running cost

The improvement of the electrode pin life time and the filter life time saves the running cost of production.

High quality

ROBOCUT machines are manufactured at ISO9001- and ISO14001-certified factories.

ROBOAUTO

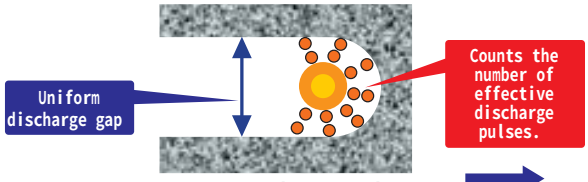
- Automatic workpiece supply
- Automatic core collection

High-speed and high-precision cutting with AI pulse control and Nano interpolation

The high-performance discharge power supply and the latest control unit, the FANUC Series 180*i*s-WB, have further advanced.
ROBOCUT, which has achieved high-speed and high-precision cutting in the range of practical cutting, meets the real needs in the field of machining.

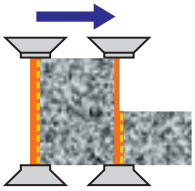
AI pulse control (patent pending)

AI pulse control accurately counts the number of discharge pulses effective to cutting per unit time and issues velocity commands in accordance with the number of effective discharge pulses. As a result, the energy density and the discharge gap are kept uniform, thereby achieving machining of both high precision and high speed, with an increase in cutting feedrate by about 40% from that of conventional FANUC machines.



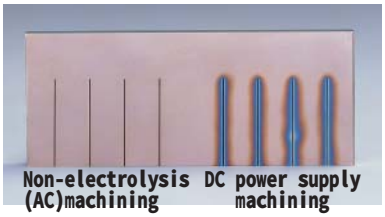
AI pulse control

AI pulse control can recognize sensitively the state of discharge between wire and workpiece, so that feedrate control functions smoothly at cutting into an edge of workpiece or at workpiece thickness changing, which is effective to the prevention of wire break.



High-speed non-electrolysis AC cutting (up to 330mm²/min)

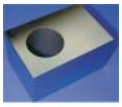
If economical brass wire with a diameter of 0.3 mm is used, high-speed, electroless cutting (AC cutting) of 330 mm²/minute is possible.
If coated wire is used, higher speed cutting of 360 mm² is possible without changing the standard power supply.
With practical brass wire with a diameter of 0.25 mm, high-speed, electroless cutting of 250 mm²/minute is possible.
AC cutting can prevent electrolytic corrosion, enabling high-definition cutting. In die cutting, AC cutting has excellent rust and corrosion protection effects, greatly reducing damaged layers in comparison with DC cutting. This prevents decreases in hardness of the discharge-cut surface, greatly improving the life of the die.

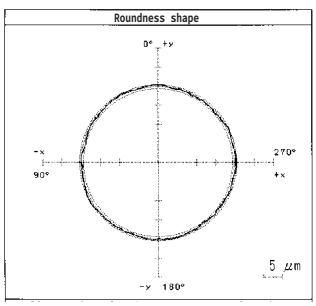


Machining titanium alloys

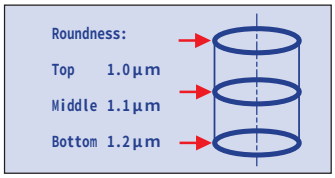
High-precision circle cutting

Excellent high-precision circle cutting is possible because of high-speed and high-precision cutting with AI pulse control, accurate and smooth axis control with nano interpolation, and the approach cut-in prevention function.





Wire: 0.25 dia. brass wire
Workpiece material: SKD11
Workpiece thickness: 40 mm
Cutting times: 5
Machining profile: 30 dia. hole cutting
Surface roughness: 2.0μmRz (Ra: 0.22μm)

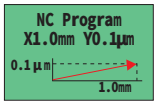


*All cutting results contained herein are those obtained under FANUC-designated conditions and FANUC measurement conditions.

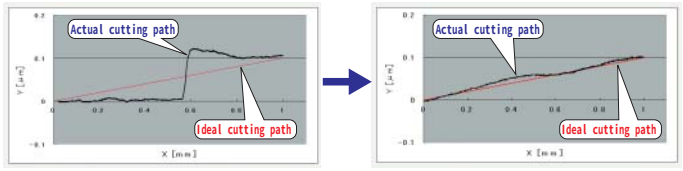
Nano interpolation

In nano interpolation, the CNC control unit sends commands to the servo with a fine pitch of 0.001μm (1 nm). It eliminates the accumulation of axial movement errors, enabling very accurate and smooth axial movement.
As a result, further enhanced high-precision machining is achieved.

Without Nano interpolation
NC command = **0.1μm**

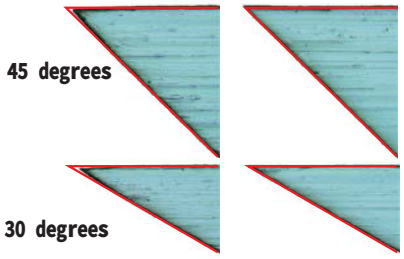


With Nano interpolation
NC command = **0.001μm**



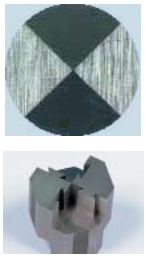
New AI corner control

This control achieves high corner precision at all corners ranging from sharp ones to circular ones. With FANUC's unique method that removes a wire slack immediately before a corner, it is possible to have high corner precision without changing the cutting path.
And high precision in a wide range regardless of the cutting type (rough or finish), the wire diameter, the workpiece material and thickness, and other factors.



Corner control off AI corner control

Effect of AI corner control
(Comparison of convex sharp corners)



Examples of sharp corner cutting using AI corner control

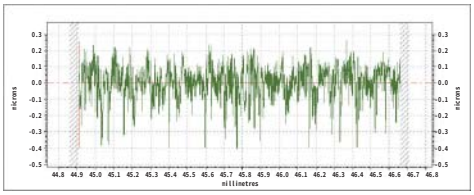
Further fine roughness of 0.7μmRz (option)

The micro finish power supply (MF power supply, optional) provides fine discharge pulse to generate a fine surface roughness of 1.5μmRz or less. Use of the insulation jig achieves a further fine roughness of 0.7μmRz or less.

WORK/WIRE	
MATERIAL	= TUNGSTEN CARBIDE
THICKNESS	= 20mm
WIRE	= ϕ0.20 BS

MEASURED CONDITION	
HORIZONTAL DIRECTION	
LENGTH	= 2.0mm
CUT OFF	= 7X0.25mm
FILTER	= GAUSSIAN

SURFACE ROUGHNESS	
Ra	= 0.0763μm
Rz	= 0.5417μm
Rt	= 0.6652μm



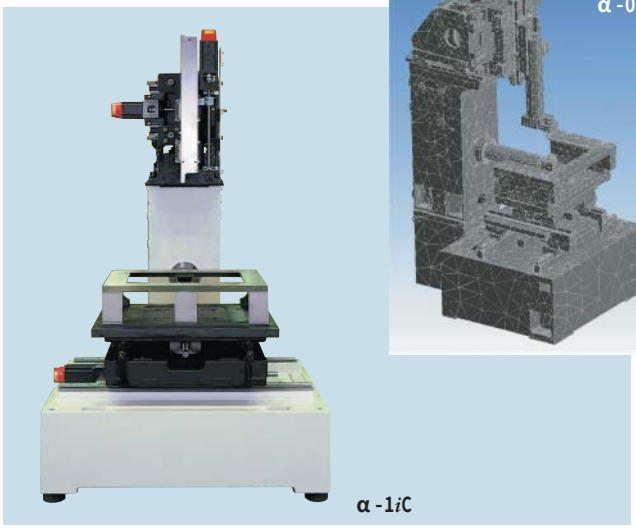
MF power supply cutting result

Highly Rigid Mechanical Unit

**The mechanical unit of ROBOCUT has been designed through minute analysis, in consideration for rigidity and thermal balance.
In accordance with the table traverse method that is suitable to high precision machines, the mechanical unit realizes high cutting precision.**

Highly rigid, symmetrical casting structure

The symmetrical casting structure, with the load and thermal balance, ensures stability, and the pyramid structure with large bed eliminates load over-hang during table movement to maintain a high rigidity even for a heavier workpiece.

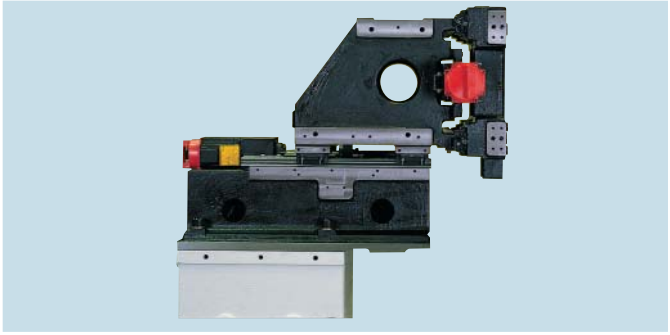


Stable XY table movement

A stable, axial movement method is used, in which the wire (column) is fixed and the XY table on which the workpiece is mounted is moved.
This method can offer high machine precision stably in comparison with a column movement method in which the workpiece is fixed and the wire is moved.
Besides, the high-performance FANUC α series Servo Motor and the drive axis on which a high-precision ball screw and an LM guide are mounted assure high cutting precision for a long time.

U/V-axis mounted on top of the column
(Japanese patent No. 1831312)

Both axes support a long stroke of ±60mm, so as to realize a large taper easily to be machined on a thick workpiece.
Large castings, highly rigid ball screws, and LM guides are employed even on the U and V axes, thus enabling high precision taper cutting.

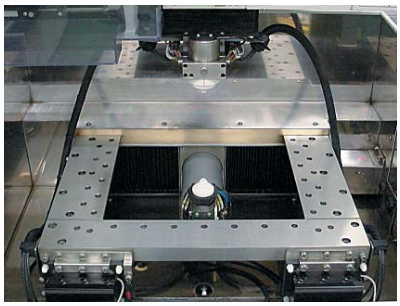


High performance Servo system

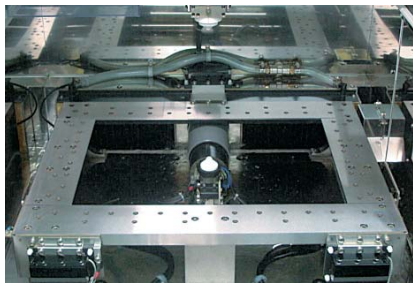
High accuracy current detection, high response servo HRV control, and the ultra-high resolution pulse coder (16 million pulses) achieve extremely smooth feed and high cutting precision.

Highly rigid work table

The rigid and high precision work table allows even a larger workpiece to be clamped with stability.



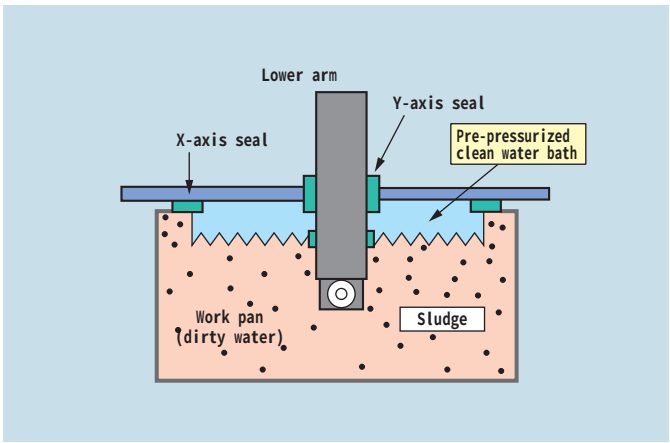
Work table for α-0iC



Work table for α-1iC

Pre-sealing mechanism

It is important to control the mechanical friction not to be increased during the axes moving, in order to maintain stable and high precision cutting at all times.
The ROBOCUT features a pre-pressurized clean water bath that keeps the sludge away from the seal plate, preventing the mechanical friction, which ensures good cutting precision. In addition, it can maintain high cutting precision for a long period of time by automatically adjusting the supply of clean water.



Linear glass scale (option)

Full closed loop control using a linear scale with a high resolution of 0.05μm maintains stable precision for a long time.
The adoption of a linear scale of absolute type eliminates the need for a reference position return each time the power is turned on, enabling automatic power failure recovery.

World's fastest (disconnection to connection: 12 second) high-speed Automatic Wire Feed (AWF)

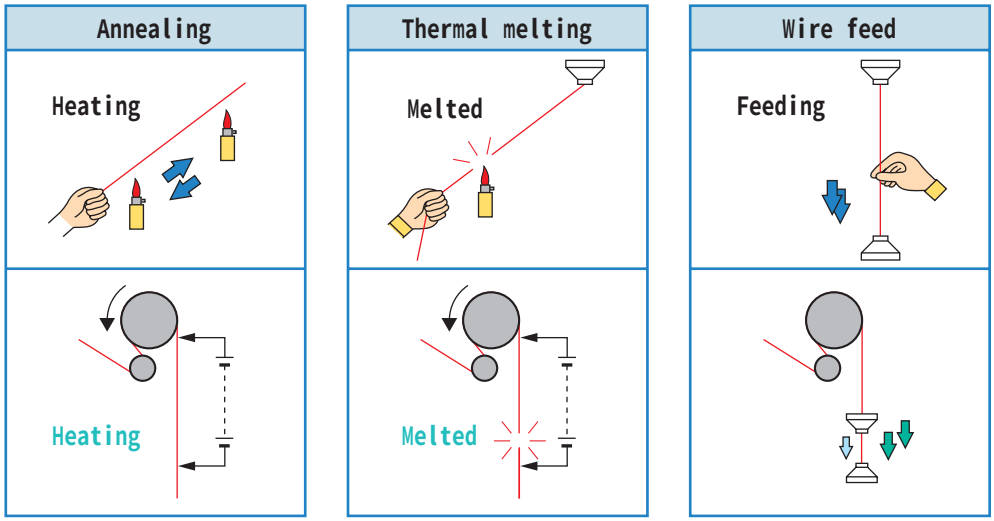
ROBOCUT was the first in the world to establish auto wire feed technology using wire disconnection (annealing plus thermal cut off). Our long-time achievements assure the excellent rate of wire feed and high reliability. Further advanced AWF has achieved the world's fastest 12 seconds.

Wire cut off by heat

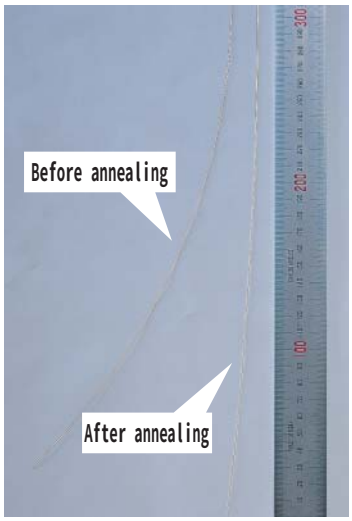
The principle of wire disconnection follows the simple operation in which the operator heats and fuses wire with a lighter. This principle has been applied in FANUC's unique thermal cut off method.
The annealing effect of wire makes the straightness of the wire and a very sharp wire edge.

12sec. threading cycle AWF

Reliable AWF has advanced further and further, achieving auto wire feeding with a cycle time as short as 12 seconds (wire disconnection: 4 seconds / wire connection 8 seconds).
(Wire diameter: 0.20 to 0.30)
In unmanned machining in which automatic wire feed is required, this function can be fully used to greatly contribute to reductions in total machining time.



Wire cutting principle



Annealing effect

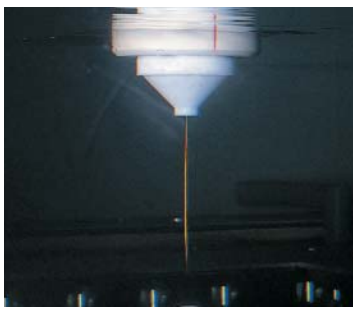
Simple wire feed and guide system

Wire cutting through thermal melting method leads simple guide assemblies with only a few parts. This structure provides stability over long period of time, to minimize maintenance.

Structure parts of upper guide assemblies

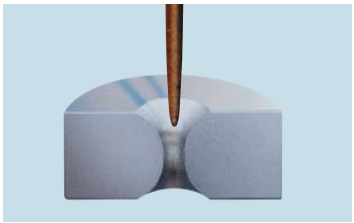
Connection in water

Submerged wire threading is possible for workpiece thickness of up to 100mm. Time is also saved with work tank draining and filling.
Workpiece is always submerged, contributing to rust prevention and stable cutting accuracy.



Wire insertion to a die guide

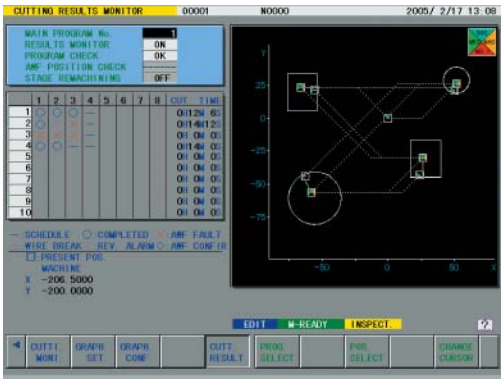
The thermal melting method leads a sharp and smooth edge of the wire so as to insert the wire to a die guide. No split guide is required.



Sharp wire edge

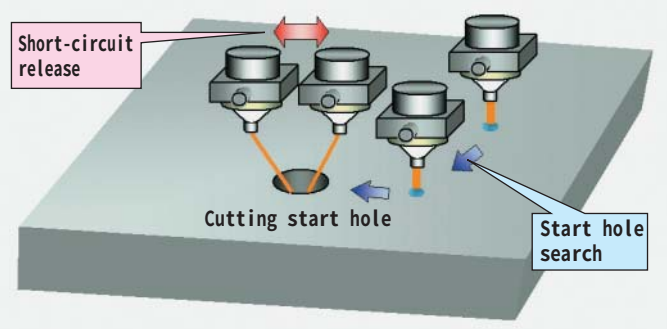
Cutting result monitor screen

The cutting profile, the cutting position, the number of cutting, and the times of cutting are displayed with graphic, so that the operator can confirm them in advance. Besides, it makes easy to confirm the AWF position or to re-cut the points where the cutting has failed.



Start hole search / Short-circuit release function

If the cutting start hole has a very small diameter or the hole is not in the right position, this function automatically searches for a position where connection is possible and makes a connection. If a short-circuit occurs after a connection, it automatically searches for a short-circuit released position. This greatly improves the reliability of continuous unmanned operation.

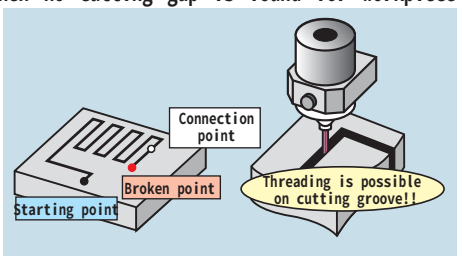


φ0.05AWF (Option for 0*i*C)

Even if φ0.05mm or φ0.07mm wire diameter, FANUC's unique wire cut off with annealing and thermal melting method realizes highly reliable AWF and AWR.

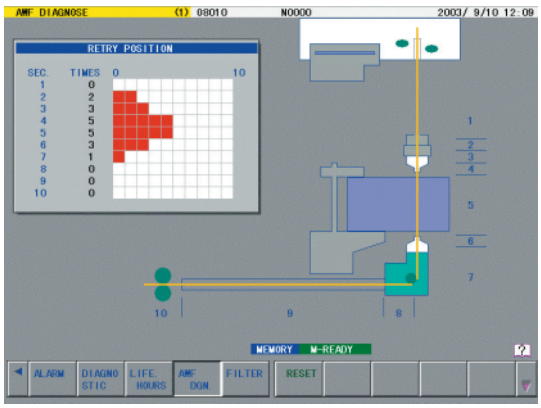
AI wire break repair function (option)

AI wire break repair function provides automatic re-connection of wire at the close position where the broken wire without re-turning to the start hole position. Broken wire can be reliably re-connected even when no cutting gap is found for workpiece movement or rust. Time saving is al-so significant due to no return to the start point. (Thickness:Max. 40mm/wire diameter φ0.2, φ0.25)



AWF monitor screen

The AWF monitor provides valuable maintenance information such as positions where non-smooth wire feed for retries and frequency of retries, in addition to locations of wire breaks.



•Automatic wire feed(AWF)specifications

		Standard AWF specifications		Fine wire 0.05 dia. AWF specifications (option)
Wire diameter		φ0.2 /φ0.25 /φ0.3mm	φ0.1 /φ0.15mm	φ0.05 /φ0.07mm
Max. workpiece thickness		α-0*i*C :180mm (Standard) / 250mm (In case of stroke option Z255mm) α-1*i*C :300mm (Standard) / 400mm (In case of stroke option Z410mm)		20mm
Max. workpiece thickness in water		100mm	30mm	20mm
Initial hole diameter	Standard	Min.φ1.5 mm		Min.φ0.18mm
	Option	Min.φ0.5mm (φ0.2mm wire) Jet nozzle for small hole AWF is necessary	Min.φ0.2mm Jet nozzle for small hole AWF is necessary	—
AI-Wire breakage repair function		Max. workpiece thickness 40mm Jet nozzle for small hole AWF is necessary	Max. workpiece thickness 30mm Jet nozzle for small hole AWF is necessary	—
Recommended wire		SUMITOMO ELECTRIC SBX-H(N) / HITACHI CABLE HBZ-U(N) / FURUKAWA ELECTRIC FSH / OKI CABLE OB-PZN ＊without paraffin		SUMITOMO ELECTRIC TWS(Tungsten) SUZUKI METAL SP(Brass/piano wire)

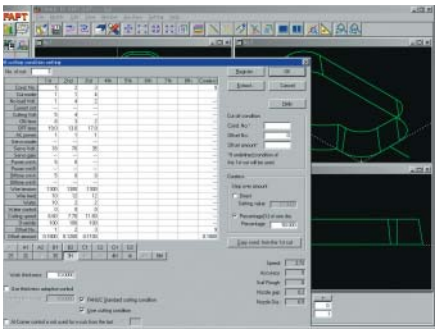
FANUC PC FAPT CUT *i* (Option) High Performance

PC FAPT CUT *i* is a CAM system, for the ROBOCUT, with versatile features.

High affinity with the ROBOCUT

PC FAPT CUT *i* has various types of functions dedicated to the ROBOCUT. They can be used to create optimal NC data. PC FAPT CUT *i* also incorporates ROBOCUT cutting conditions, which can be output as NC data.

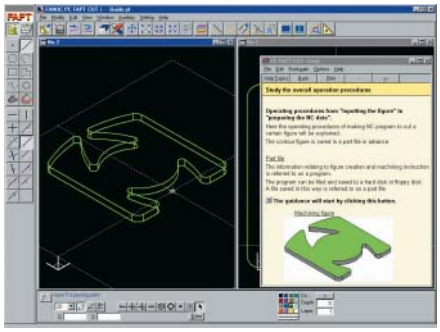
- AI cutting condition setting
- AI corner control
- AI thickness adaptive control
- Automatic wire feed (AWF)
- AWF result monitor
- AI feed control, etc.



AI cutting condition setting

User friendly design

A self-learning function is available. Simply practicing using this system as directed by guidance messages displayed by the function, a novice operator can master the operating procedures. Moving the cursor to a desired icon displays the related description, so the operator can learn how to use the machine by himself or herself.
On top of that, each function is provided with sufficient help information.

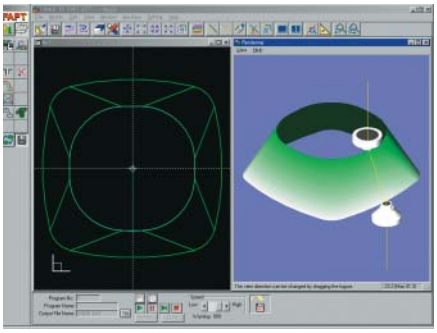


A self learning function

Available functions

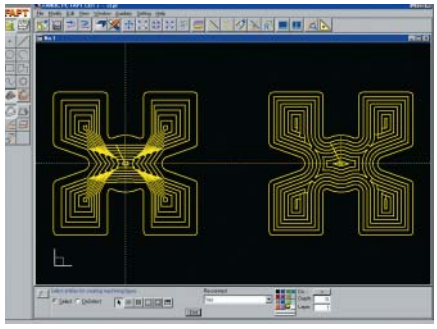
Different shape patterns at top & bottom

NC program for taper cutting as well as a pattern with different shapes at its top & bottom.
3-dimensional animation with higher reality is available by the rendering function.



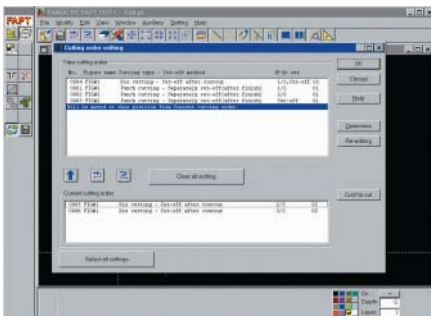
Core-less cutting function

NC programs can be created easily which make holes by making them larger gradually. Core-less cutting can also be available for multiple circular pattern at the same time. Either a polygon method or offset method can be selected for wire path creation.



Specifying cutting methods and editing cutting sequences

Commonly and frequently used cutting methods are available. With these methods, it is easy to create NC programs. Diverse cutting is supported by editing the cutting sequence for these standard cutting methods in units of processes, such as roughing, finishing, and cutting-off.



CAD data exchange

PC FAPT CUT *i* can exchange figure data with other CAD systems, using DXF™ or IGES format. Figure data received from a CAD system can be used to create NC data.

Dimension measurement

The dimensions of figures can be measured and displayed in the drawing window.

Printing

Figures in the drawing window can be printed.
The precision of the print size can be adjusted.

FAPT language input

In addition to interactive NC data creation, FAPT language programming function is available.

CAM System Dedicated to the ROBOCUT

Specifications of PC FAPT CUT*i*

Function	Contents	Function	Contents
Point definition	Point on element, etc., (4 kinds)	Machining function	Multiple skims (Max. 8 times)
Plural points definition	Grid, etc., (7 kinds)		Closed area cutting (Punch: 6 kinds, Die: 4 kinds)
Line definition	Passing through 2 points, etc., (13 kinds)		Open area cutting (4 kinds)
Circle/Arc definition	A point as its center and radius r, etc., (14 kinds)		Contour cutting/Coreless cutting
Involute gear	Addendum mod. coef.: Direct/Displacement over teeth/Over pin dim.		Reverse cut
Continuous figure definition	Polyline, etc., (3 kinds)		AI cutting condition setting
Modifying the figure	Extension/Trimming, Erase section, Break, etc.,		Cutting condition registration
Move/Copy	Parallel/Rotation/Mirror/Reverse/etc.,		Cutting function dedicated to the ROBOCUT (Note 1)
CAD data exchange	DXF™ Format, IGES Format		Cutting order editing
Machining figure	Taper/Different shape patterns at top & bottom/Die with relief	NC data preparation	NC data format setting, Confirmation of execution
Figure printing	Prints figures from the drawing window and adjusts the precision of the print size.	FAPT language input	Programming in FAPT language (Note 2)

(Note 1) This system supports the ROBOCUT α-0B/1B and higher.
(Note 2) The specification of the FAPT language input function of this system partly differs from that of SYSTEM P.

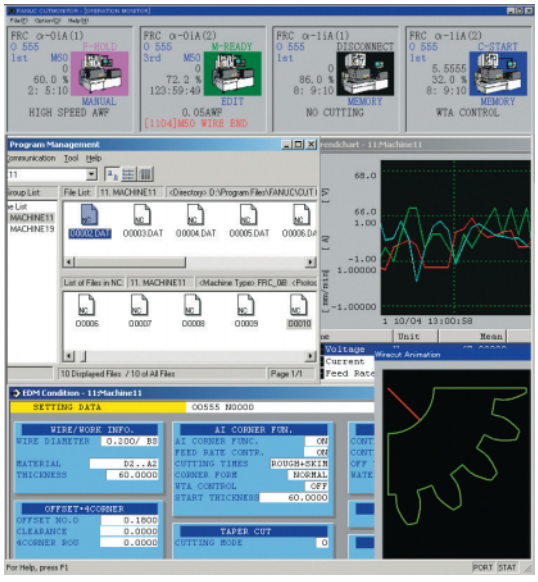
Operating platform
Compatible Pentium® -based systems
CPU Pentium®2 or higher (Operating systems mentioned below has to operate properly)/Memory 64MB or more (128MB or more for Windows XP. Larger capacity might be required when the rendering function is used)/Floppy disk drive/CD-ROM drive/ Parallel port for printer or USB interface/ Display resolution 1024×768 or higher/Hard disk (Free area 100MB or more)/Keyboard /Mouse
Other device and component are required when the rendering function is used.
(Please contact our sales dept. for details)

Operating system
Microsoft® Windows® 98/Me/NT4.0(SP5 or more)/2000/XP
(Rendering function is not available under Windows NT® 4.0)

Network System for ROBOCUT

CUT MONITOR *i*

The CUT MONITOR *i* can be used in a place away from the ROBOCUT to check the machining status, send and receive NC programs, and change cutting conditions.

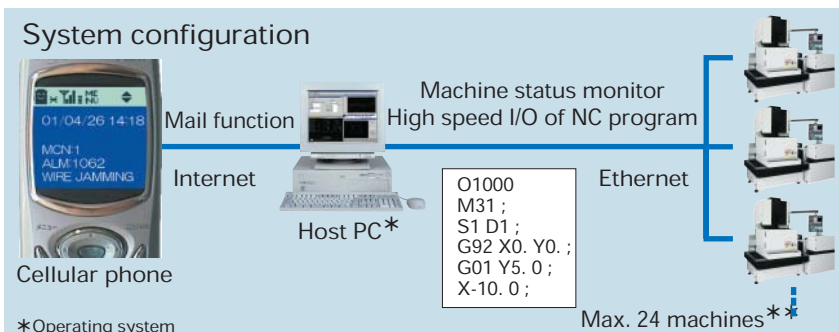


Machine status monitor screen
(Host computer)

Main features

- Ethernet connection to max. 24 machines and confirm the status of machine in real time.
- NC programs can be sent and received from the ROBOCUT at high speeds on the management computer.
- The same screen as on the machine is displayed on the management computer, enabling the cutting status to be checked with ease in real time.
- Modify the ROBOCUT cutting condition remotely.
- Mail can be sent to your cellular phone when cutting is completed or an alarm occurs.

System configuration



∗Operating system
Microsoft® Windows®NT4.0 (SP5 or more)/2000/XP

∗∗Plural machine monitor is option.

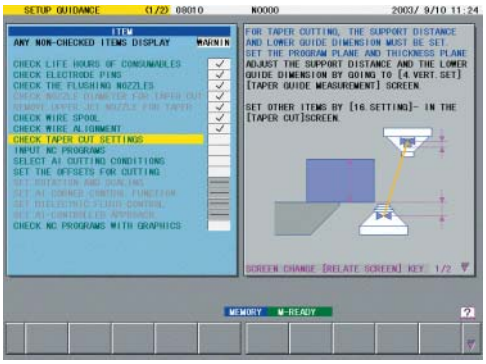
AI Functions that are Becoming More and More Intelligent

AI cut function

This function enables the machine to provide optimum cutting conditions merely by entering a wire diameter, a workpiece material and thickness, and a nozzle distance.
The practical, high-speed rough cutting condition (R1) allows switching among four modes, enabling the operator to easily select optimum cutting conditions according to changes in thickness and the cutting type such as tapering. Switching is possible even during machining.

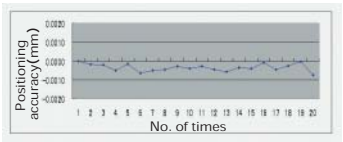
Setup guidance

Setting up of workpiece, confirmation of setting items/NC program/consumables can be done without failure by following the guidance on the screen.
Performance of ROBOCUT can be brought out easily and certainly.



AI edge finding function

In case of positioning to the edge of workpiece, very small stains and particles of dust on the workpiece surface, as well as cutting sludge and wire chips, worsen the positioning accuracy.
The AI edge finding function uses high-sensitivity detection pulses for positioning purposes to increase the positioning accuracy.
It achieves stable workpiece positioning, enabling high-precious position cutting.



Results of positioning repeatability with a workpiece (20 mm in thickness)
Repeatability 0.0007mm

Setting screen for AI edge finding

∗Under FANUC measurement conditions

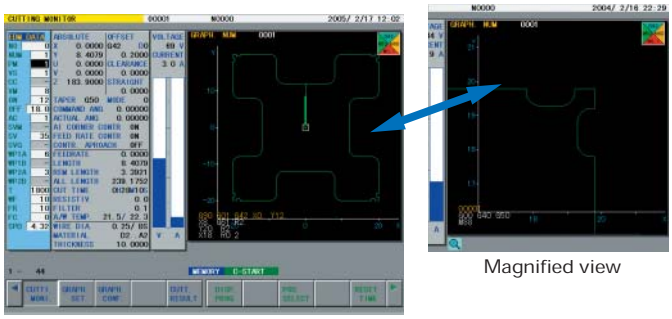
Auto positioning & Measuring

Complicated positioning operation can be done certainly with minimum data input by following the guidance.

Cutting path monitoring screen

All data required during cutting can be checked on one screen.

- The cutting path that has been processed is colored according to your specification.
- The cutting current, cutting voltage, ambient temperature, and water temperature are also displayed.
- You can see an original cutting path or a magnified view of the path with one-touch operation.



Magnified view

Maintenance guidance function

To enable machine maintenance at the best timings, inspection timings are displayed on the NC screen. Inspection methods are also displayed on the NC screen, thereby allowing you to check correct maintenance procedures quickly, without having to refer to manuals.

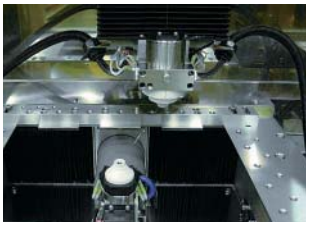
Available options

3.5 ” floppy disk drive

Autoloader for 20kg wire bobbin

20L ion exchanger

Work light



45 ° Taper cutting

Warning light

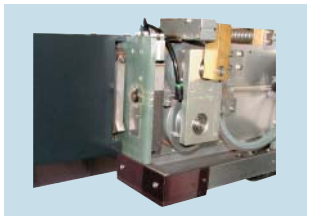
Slide table (0*i*C)

Data input/output unit
FANUC Handy File

M F power supply
(without insulation jig)(*1)

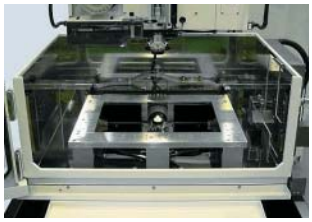
M F power supply
(with insulation jig)(*1)

Auto grease lubrication system



Wire cutter

Rotary axis



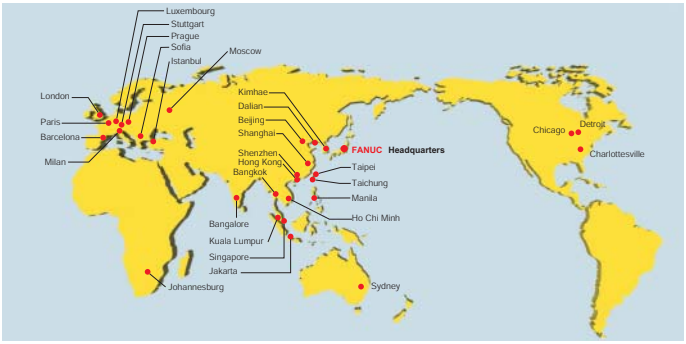
Large size work tank
(1000mm workpiece)

Other options	
Automatic wire feeding mechanism (AWF)	Setting plate (1*i*C)
Z stroke 255mm (0*i*C)	ϕ0.5 Jet nozzle
Z stroke 410mm (1*i*C)	Splash guard curtain
0.05μm Linear glass scale (X,Y-axis)	External die guide
NC program length 100MB (240,000m)	Tension meter
Motorized Z-axis (0*i*C)	5 axes simultaneous control

(*1)MF power supply is not available on α-1*i*C/Z400/large size work tank machine.
(*2)Some options can not be added after installation. For details, contact your FANUC sales representative

Worldwide customer support and service

FANUC operates customer service and support system anywhere in the world through subsidiaries, affiliates and distributor partners. FANUC provides the highest quality service with the quickest response at the location nearest you.



FANUC Training Center

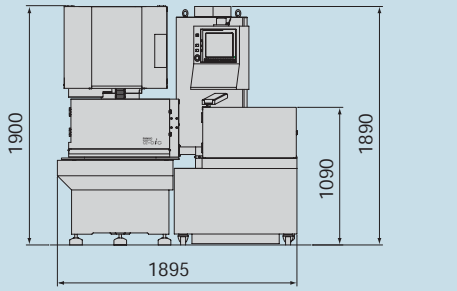
FANUC training center operates training programs on FANUC ROBOCUT throughout the year, which focus on practical operations and programming with machining know how and maintenance.

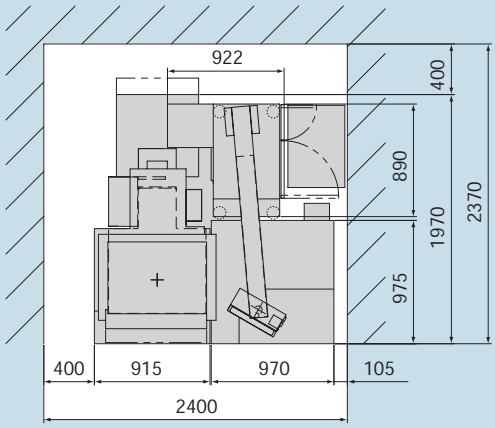
Inquiries : Yamanakako-mura, Yamanashi 401-0501, Japan
Phone : 81-555-84-6030 Fax : 81-555-84-5540

FANUC ROBOCUT α-*i*C series

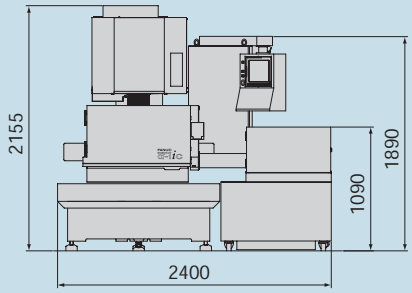
Outer Dimensions and Floor Plan

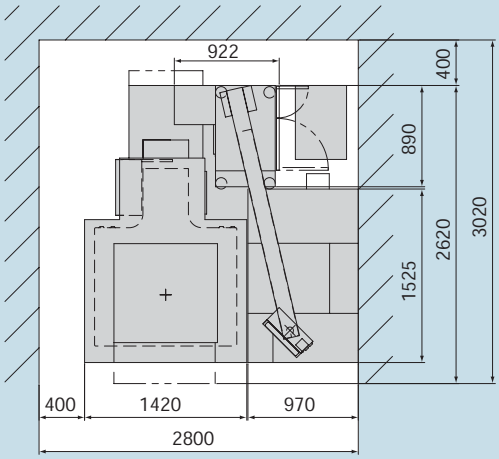
α-0*i*C





α-1*i*C





∗)The floor plan shown above is that of a standard machine. If you want to specify options such as a large-size work pan type, a fine wire type, and a 20KG wire supply unit, please contact us.

Main Specifications

Model		α-0*i*C	α-1*i*C
Maximum work-piece dimensions		650×450×180 mm	820×730×300 mm 1000×730×300 mm (option)
Maximum work-piece mass		500 kg	1,000 kg
Table travel		320×220 mm	550×370 mm
Z axis travel	Standard	180 mm	310 mm
	Option	255 mm	410 mm
UV axis travel		±60 mm×±60 mm	
Max. taper angle	Standard	±30 ° / 80 mm	
	Option	±45 ° / 40 mm	
Wire diameter	Standard	φ0.1～φ0.3 mm	
	Option	φ0.05～φ0.3 mm	——
Max. wire mass		16 kg	
Maximum cutting speed		330 mm²/min(φ0.3 mm Brass wire / AC cutting)	
Machine mass		Approx. 1,800 kg	Approx. 3,000 kg

Installation Conditions

Power supply	200VAC ±10% 3phase 50/60Hz ±1Hz 220VAC±10% 3phase 60Hz ±1Hz	Grounding	The unit must be grounded to avoid damage resulting from electro-magnetic interference or electrical leakage. The grounding itself should be of Type C (grounding resistance of 10Ω max.) as specified in the electrical installation standards and should be carried out independently of the grounding of any other piece of machinery. (One point grounding)
Power consumption	11kVA (without cooling unit) 13kVA (with cooling unit)		
Environment	Ambient temperature : 5～40℃ ∗20±1℃ in case high precision machining is needed. Install under the oil mist free and dust free environment. Humidity : 75%RH or less	Shield room	Wire EDM should be installed in a shield room environment if there is any danger of interference with TV screens in the locality, for example due to electrical discharge noise.
		Air supply	Need only for AWF 0.5MPa or more 100L/min or more 120L/min or more (in case of φ0.05AWF option)

FANUC LTD

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