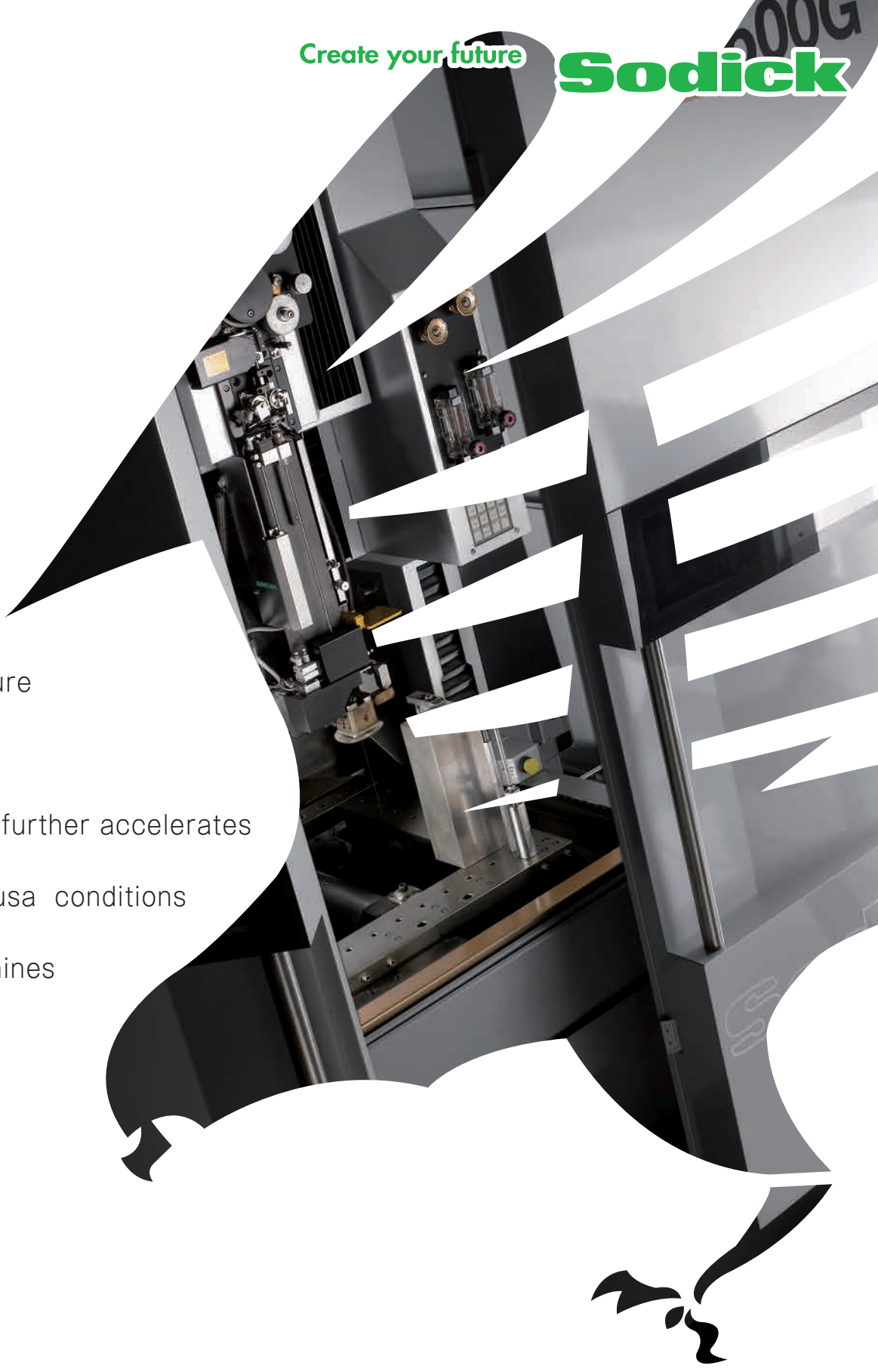
Create your future

Sodick



Changes the future

High-speed wire further accelerates

with new Hayabusa conditions

only for SL machines

SL SERIES + HAYABUSA WIRE

# New Hayabusa conditions now available for SL machine series

# ❶ What is Hayabusa wire?

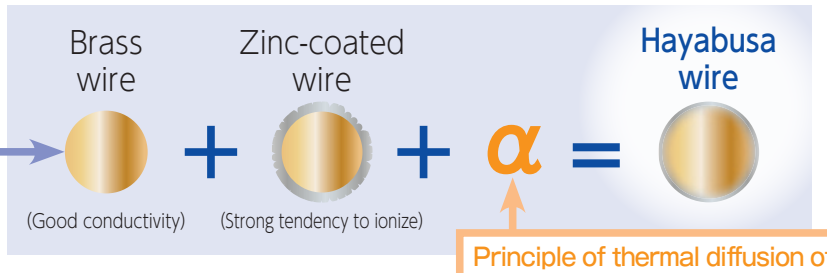
## Principle of Hayabusa wire

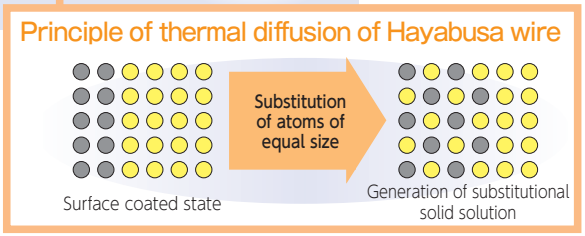
Most high-speed wire is coated with zinc over brass.
Even though the speed is increased, the surface tends to worsen because zinc with high electrical discharge ability is coated.
HAYABUSA conquered this disadvantage by a unique manufacturing method where zinc is diffused utilizing a thermal diffusion reaction.

**Wire suitable for wire electrodes**

① Good conductivity = Cu (copper)

② Good discharge efficiency = Zn(zinc)




## Features of Hayabusa wire

❶ Combines the advantages of brass wire and coated wire

❷ Eco-friendly => No wire breakages even when the wire feed speed is reduced = Lower material costs

❸ Hortened machining time and reduced consumption: a combined total reduction of approximately 30%

❹ Surface roughness is equivalent to BS or more

+

**Customer's machining evaluation**

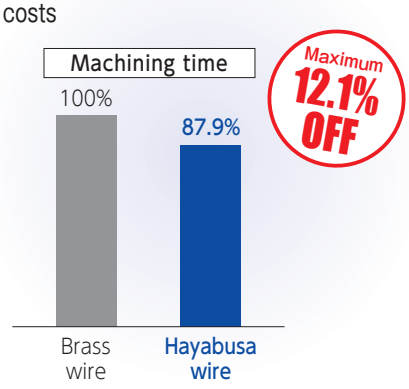
❺ **Hard to break; most suitable when machining thick workpieces**

❻ 10 to 30% speed increase when used on existing Sodick machines; additional 10 to 30% increase when used on SL machines
**⇒ Hayabusa wire+ SL = up to 60% speed increase**

## 3 greatest advantages of Hayabusa wire

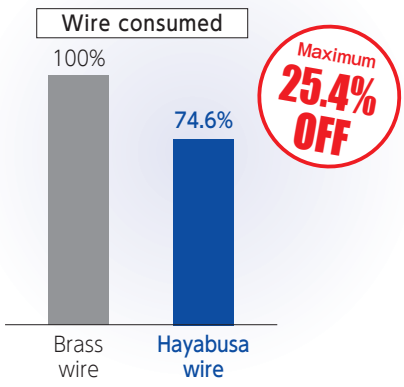
### Advantage 1 High-speed machining

⇒ Reduces machining time and electricity costs



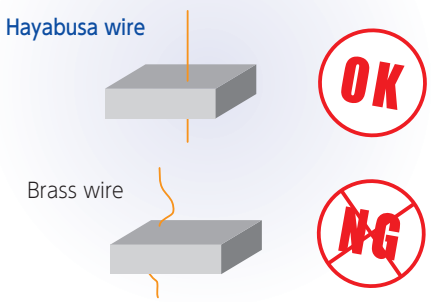

### Advantage 2 Eco-friendly

Eco-conditions ⇒ Lower material costs




### Advantage 3

Wire does not break easily while machining thick materials
⇒ Reduces time as re-setup is not required




* The values of 1 and 2 are from machining example ①

# ❷ Advantages of stable machining

When machining is performed in an SL machine with Hayabusa wire, machining with stable accuracy can be performed without wire breakage or reducing the machining speed even for thick materials.

## Verify "High-speed Machining" and "Ecology" using the new Hayabusa conditions only for SL machines

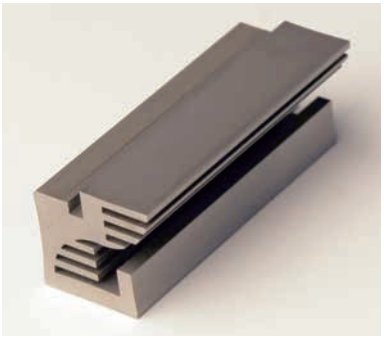
## Machining examples ❶

The effects of machining with Hayabusa wire and Tsubame wire (brass) are compared under "Hayabusa + SL" accuracy-oriented conditions and the brass accuracy-oriented conditions, respectively.

### Machining environment

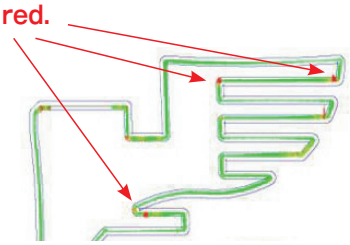
| | | |
|---|---|---|
| Machine | : | SL400Q |
| Workpiece | : | SKD11 |
| Thick | : | 60mm |
| Machining conditions | : | Hayabusa accuracy-oriented conditions (ACR2), 5 cuts (Rz 2.6 μm) |
| | : | Brass accuracy-oriented conditions, 5 cuts (Rz 2.6 μm) |
| Wire | : | Hayabusa wire φ0.20 mm |
| | : | Brass wire φ0.20 mm |

### Machined shape



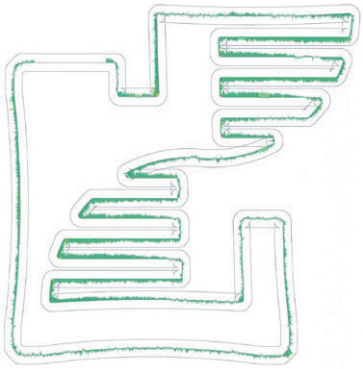
### VideoCheck measurement

Where the error exceeds ± 3μm, the relevant section is **shown in red.**

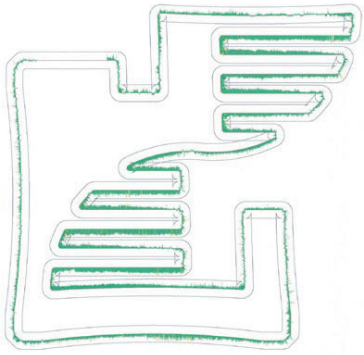


## BERTH・VideoCheck measurement results

**Hayabusa wire**



**Brass wire**



**No difference in accuracy**

## Machining comparison results

| | Hayabusa wire Φ 0.20mm | | | Brass wire Φ 0.20mm | | |
|---|---|---|---|---|---|---|
| Machining conditions | NEW Hayabusa accuracy-oriented conditions, **5 cuts** | | | Brass accuracy-oriented conditions, **5 cuts** | | |
| Wire consumed | 3,305 m **(25.4% reduction compared to brass wire)** | | | 4,433 m | | |
| Total machining time | 5 hours, 57 minutes, 36 seconds **(12.1% shorter)** | | | 6 hours, 46 minutes, 44 seconds | | |
| | 1st : 2:03:12 | 2nd : 1:27:16 | 3rd : 0:51:53 | 1st : 2:19:36 | 2nd : 2:04:20 | 3rd : 0:49:08 |
| | 4th : 0:40:31 | 5th : 0:54:44 | | 4th : 0:38:33 | 5th : 0:55:07 | |
| Surface finish | **Rz 2.230μm** | | | Rz 2.392μm | | |

* The above machining data is obtained by machining steel material 60 mm thick with a φ0.2-mm wire under conditions determined by Sodick.
* 0.2-mm wire 1 kg = approx. 3,750 m

# Machining examples ❷

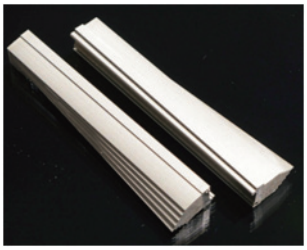
## Verify "Thick Material Machining" using the conditions only for SL machines

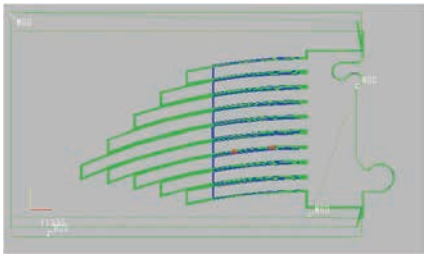
The machining conditions between the Hayabusa wire and BS wire were compared in tapered machining of a fine shape with a 70mm thickness, 0.4mm width and 5° tip angle, and fitted machining of a round groove on the end surface, using the Hayabusa accuracy-oriented conditions only for SL machines, and brass accuracy-oriented conditions.

### ■ Machining environment

Machine : SL400Q
Workpiece : SKD11
Thick : 70mm
Machining conditions : Hayabusa accuracy-oriented conditions, 8 cuts (Rz1.6μm)
: Brass accuracy-oriented conditions, 8 cuts (Rz1.6μm)
Wire : Hayabusa wire φ0.20mm
: Brass wire φ0.20mm

### ■ Machined shape





## Machining photograph

**Hayabusa wire**

**Brass wire**

## Thick 70mm Machining comparison results

### Realized speed and cost reduction even in thick material machining

| | Hayabusa wire Φ0.20mm | | | Brass wire Φ0.20mm | | |
|---|---|---|---|---|---|---|
| Machining conditions | NEW Hayabusa accuracy-oriented conditions, **8 cuts** | | | Brass accuracy-oriented conditions, **8 cuts** | | |
| Wire consumed | 3,463 m **(22.8% reduction compared to brass wire)** | | | 4,485 m | | |
| Total machining time | 6 hours, 9 minutes, 14 seconds **(7.8% shorter)** | | | 6 hours, 40 minutes, 28 seconds | | |
| | 1st : 2:16:24 | 2nd : 0:37:16 | 3rd : 0:33:38 | 1st : 2:29:41 | 2nd : 0:44:24 | 3rd : 0:33:30 |
| | 4th : 0:43:08 | 5th : 0:26:54 | 6th : 0:28:21 | 4th : 0:46:36 | 5th : 0:34:23 | 6th : 0:28:22 |
| | 7th : 0:28:22 | 8th : 0:35:10 | | 7th : 0:28:22 | 8th : 0:35:10 | |
| Surface finish | **Rz 2.151μm** | | | Rz 2.943μm | | |

* The above machining data is obtained by machining steel material 70 mm thick with a φ0.2-mm wire under conditions determined by Sodick.
* φ0.2-mm wire 1 kg = approx. 3,750 m

# ❸ Advantages which allow machining with different wire diameters

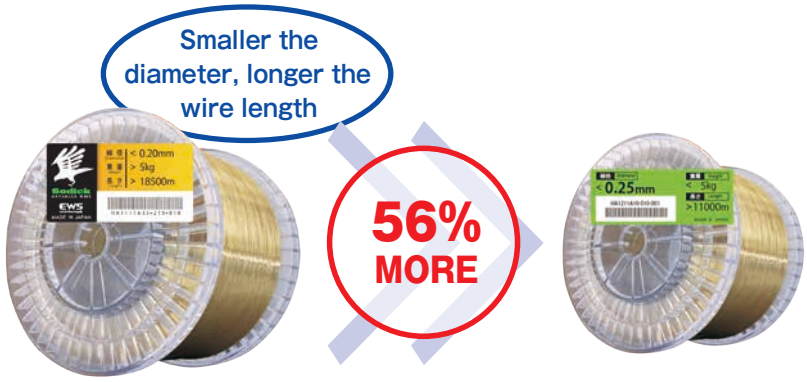
Although machining accuracy with good surface roughness can be acquired when thinner wire diameters are used in a wire EDM, there is a disadvantage where the wire tends to break due to the thinness of the wire, and a sufficient machining speed cannot be acquired.
Verification was performed on the advantages that can be acquired if machining can be performed by changing the diameter of the "Hayabusa  wire" which suppresses these disadvantages, and Brass wire.

## Difference in the length which changes by the wire diameter even with the same weight (kg)

### Standard weight of one spool (5 kg)

| Diameter | Hayabusa wire ϕ 0.20 mm | Brass wire ϕ 0.25 mm |
|---|---|---|
| Weight per spool | 5kg | 5kg |
| Length per kilogram | 3,750m | 2,400m |
| Length per spool | **18,750m** | **12,000m** |

* 0.2-mm wire 1 kg = approx. 3,750 m , 0.25-mm wire 1 kg = approx. 2,400 m

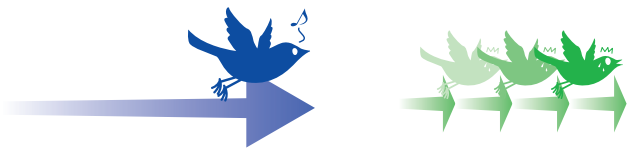



Hayabusa wire Φ 0.2 mm (5kg)
**18,750m**

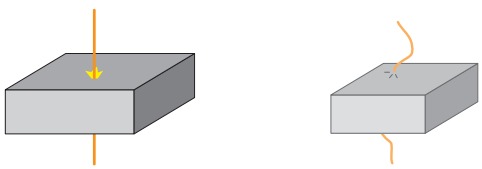
Brass wire Φ 0.25 mm (5kg)
**12,000m**

When machining is performed in eco-conditions (Hayabusa  accuracy-oriented conditions only for SL machines), the feed rate (WS) can be reduced, and the wire consumption amount can also be suppressed because the wire is strong against breakage which occurs often in the machining of thick materials.
If the weight (kg) is the same, costs can also be reduced by machining with ϕ 0.2 with a larger spool.

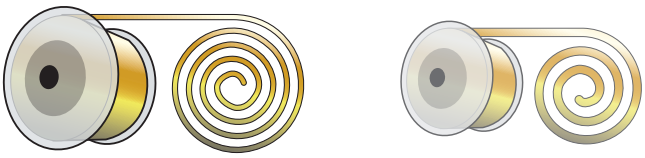
**Reduces wire consumption amount by suppressing the feed rate**



**Reduces wire consumption amount as it is strong against breakage**



**Reduces costs with a larger spool**



# Machining verification with different wire diameters

Verification was performed on the advantages of machining with different wire diameters of ϕ0.2 and ϕ0.25

## Machining example ❶ : P-type shape contact punch process with 70mm thickness

### ■ Machining environment

Machine : SL400Q
Workpiece : SKD11
Thick : 70mm

Machining conditions : Hayabusa accuracy-oriented conditions (ACR2), 5 cuts (Rz2.6μm)
: Brass accuracy-oriented conditions, 5 cuts (Rz2.6μm)
Wire : Hayabusa wire ϕ0.20 mm 5kg
: Brass wire ϕ0.25 mm 5kg

### ■ Machined shape

## Machining comparison results

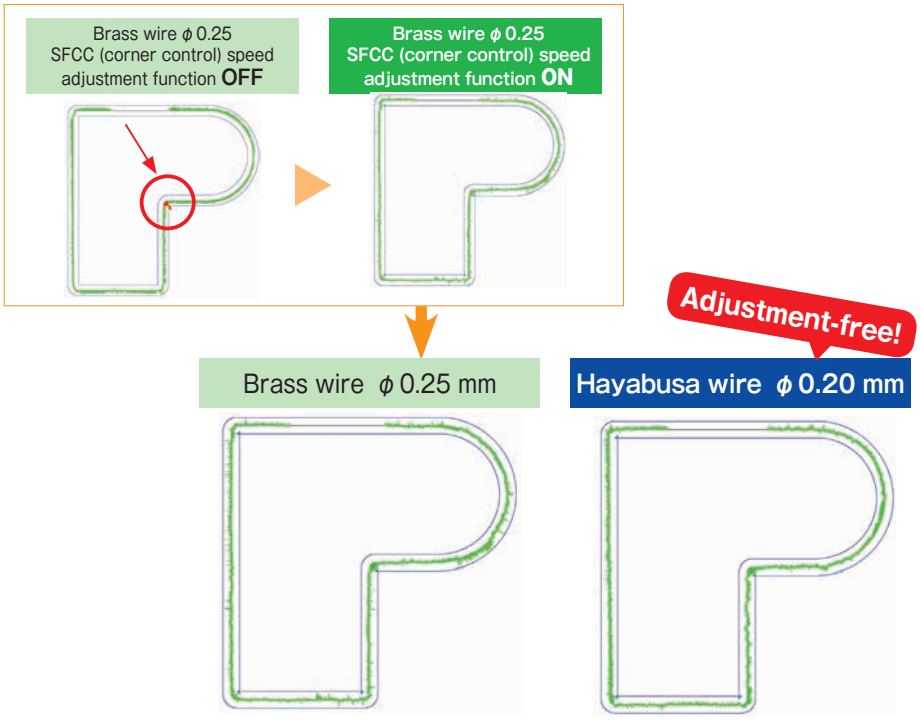
| | Hayabusa wire ϕ0.20 mm | | | Brass wire ϕ0.25 mm | | |
|---|---|---|---|---|---|---|
| Machining conditions | Hayabusa accuracy-oriented conditions, **5 cuts** | | | Brass accuracy-oriented conditions, **5 cuts** | | |
| Wire consumed | 618 m **(9.0% reduction)** | | | 678 m | | |
| Total machining time | 1 hours, 04 minutes, 31 seconds (6.6% increase) | | | 1 hours, 00 minutes, 31 seconds | | |
| | 1st : 26:02 | 2nd : 15:58 | 3rd : 09:58 | 1st : 19:46 | 2nd : 11:11 | 3rd : 16:01 |
| | 4th : 04:50 | 5th : 07:43 | | 4th : 04:19 | 5th : 09:14 | |
| Surface finish | **Rz 2.345μm** | | | Rz 2.535μm | | |

* The above machining data is obtained by machining steel material 70 mm thick with a ϕ0.2-mm wire and ϕ0.25-mm wire under conditions determined by Sodick.
* 0.2-mm wire 1 kg = approx. 3,750 m , 0.25-mm wire 1 kg = approx. 2,400 m

# BERTH · VideoCheck measurement results

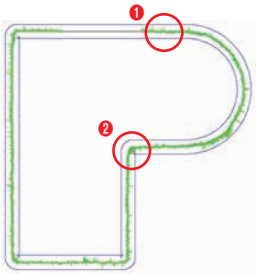
## How to machine a shape accuracy within ± 3μm?

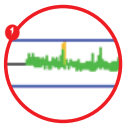
Although an inside corner (R0.2) accuracy could be acquired with the SFCC (corner control) only with ϕ0.2 Hayabusa wire, a shape accuracy within ± 3μm cannot be met with ϕ0.25 BS wire unless the speed adjustment function of the SFCC is set.
When a magnified Brass wire is checked, there are portions where the difference in the fluctuation is as large as ± 3μm, which makes corner control difficult.



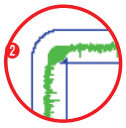

### Viewpoint of VideoCheck measurement results

* Where the error exceeds ± 3μm, the relevant section is shown in red.




Target accuracy of the middle line of the three lines. If machining of this line can be performed accurately the green line becomes thinner, and if the green line looks thicker it means there is greater fluctuation in the machining, and the targeted accuracy could not be acquired.




In the case of machining with ϕ0.25, since inside corner control is difficult and an accurate inside shape cannot be acquired, fine adjustment of the machining conditions is required.

* SFCC = Automatic control which eliminates undercuts and incomplete cuts of corners and edges to improve the machining accuracy of corners

## Machining example ❷ :
## Comparison results of M-type shape contact punch process with 100mm thickness

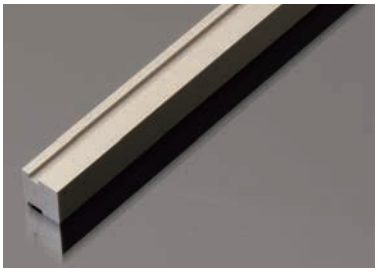
### ■ Machining environment

Machine : SL400Q
Workpiece : SKD11
Thick : 100mm

Machining conditions :
Hayabusa accuracy-oriented conditions (ACR2), 5 cuts (Rz2.6μm)
Brass accuracy-oriented conditions, 5 cuts (Rz2.6μm)

Wire :
Hayabusa wire ϕ0.20 mm 5kg
Brass wire ϕ0.25 mm 5kg

### ■ Machined shape



## Machining comparison results

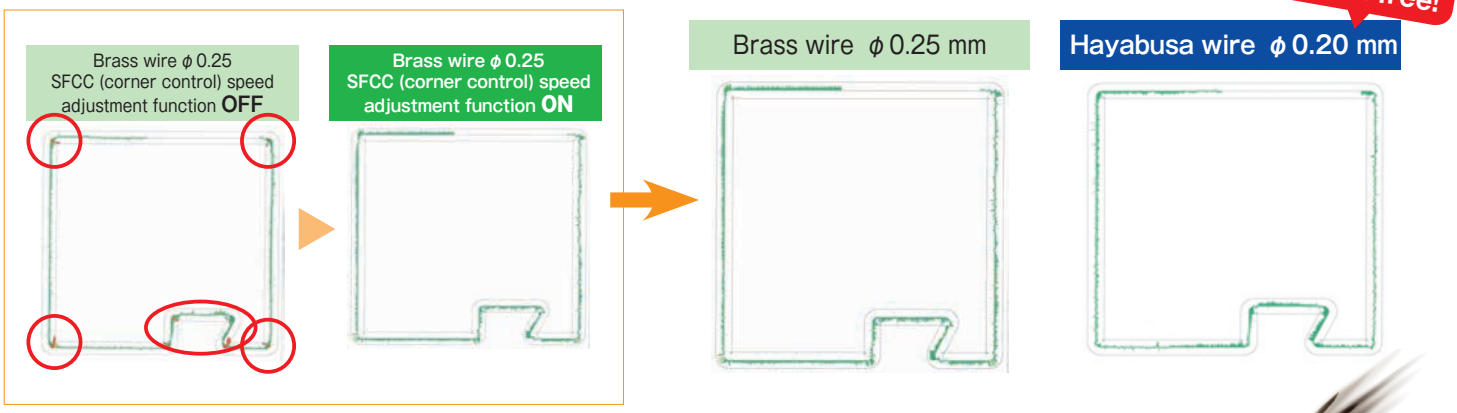
| | Hayabusa wire ϕ0.20 mm | | | Brass wire ϕ0.25 mm | | |
|---|---|---|---|---|---|---|
| Machining conditions | Hayabusa accuracy-oriented conditions, **5 cuts** | | | Brass accuracy-oriented conditions, **5 cuts** | | |
| Wire consumed | 1,163 m (0.3% increase) | | | 1,160 m | | |
| Total machining time | 1 hours, 49 minutes,041 seconds (10.9% increase) | | | 1 hours, 38 minutes, 19 seconds | | |
| | 1st : 52:13 | 2nd : 18:39 | 3rd : 10:49 | 1st : 40:16 | 2nd : 12:05 | 3rd : 18:21 |
| | 4th : 05:42 | 5th : 21:41 | | 4th : 06:42 | 5th : 20:55 | |
| Surface finish | **Rz 2.530μm** | | | Rz 2.664μm | | |

* The above machining data is obtained by machining steel material 100 mm thick with a ϕ0.2-mm wire and ϕ0.25-mm wire under conditions determined by Sodick.
* 0.2-mm wire 1 kg = approx. 3,750 m , 0.25-mm wire 1 kg = approx. 2,400 m

## BERTH・VideoCheck measurement results

### How to machine a shape accuracy within ±3μm? (Machining adjustment of Brass wire)

The setting of the speed adjustment function of the SFCC is required for the Brass wire, the same as the machining of the P-type.




* SFCC = Automatic control which eliminates undercuts and incomplete cuts of corners and edges to improve the machining accuracy of corners

## Conclusion

**Hayabusa wire reduces running costs with excellent machining accuracy**

Distributor

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**Sodick Co.,Ltd.**

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●Due to ongoing research, specifications are subject to change without prior notice.
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