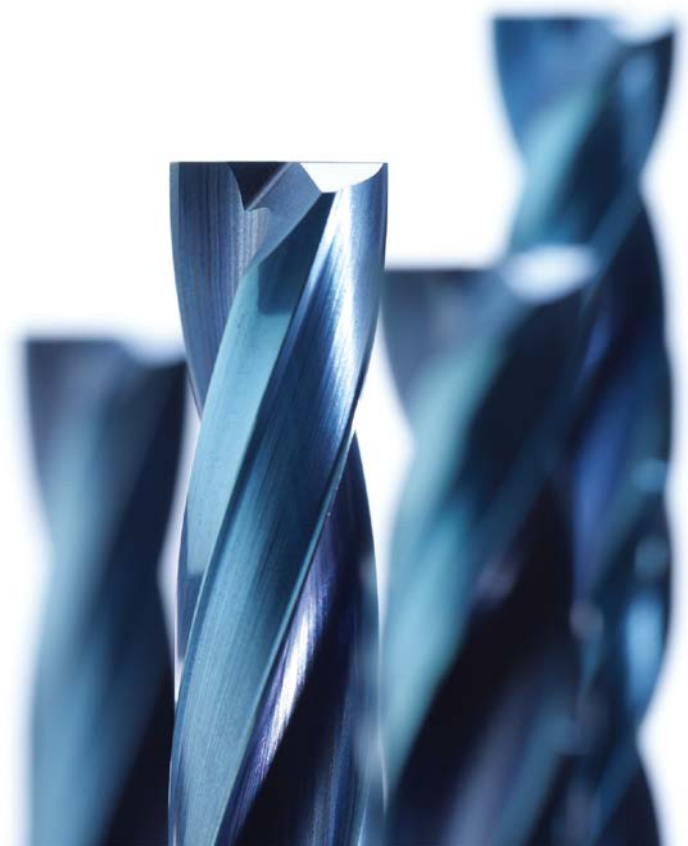


*New Item & New Concept Tools*  
*Aqua EX Flat Drill*

---

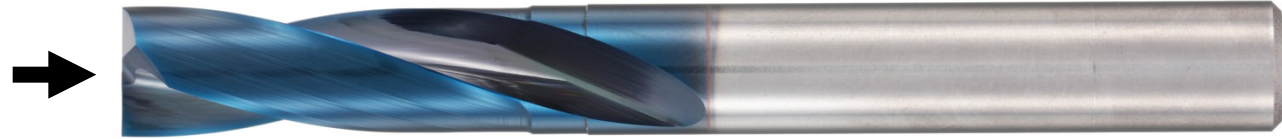
**NACHI**  2012  
1962  
*50 years in America*



# Aqua EX Flat Drill

**Completely Flat  
Point Angle!**

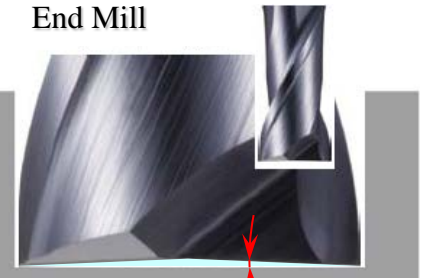
**(Point Angle 180°)**



Aqua EX Flat Drill

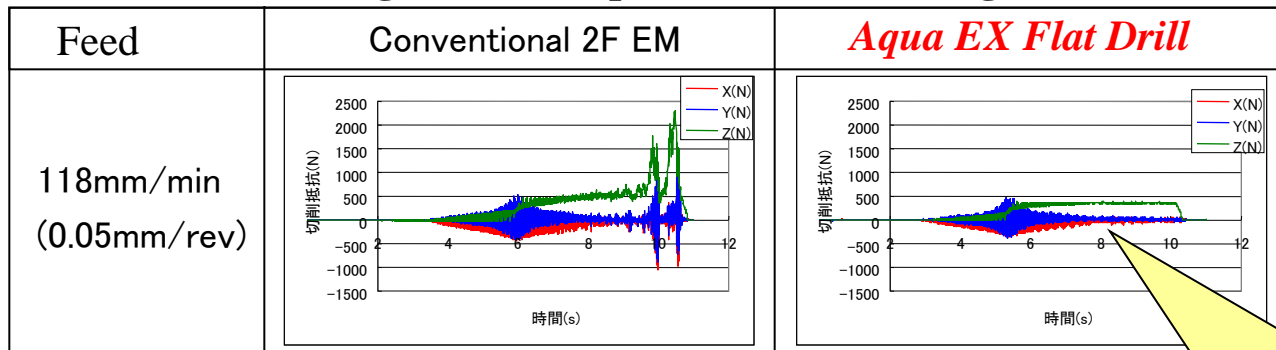


End Mill



**Concave Angle**

### 【Cutting Force Comparison (45° Drilling)】



【Condition】

Tool Dia.:  $\phi 10$

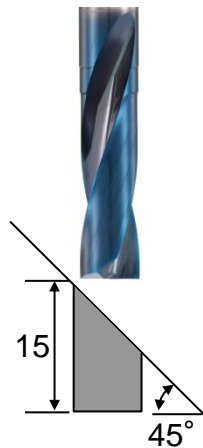
Cutting Speed : 75m/min (2400min<sup>-1</sup>),

Material: S50C

Cutting Depth: 15mm,

Coolant: Water Soluble

**No Chip Jamming Even  
On the Exit of the Hole;  
Excellent Stability**



## *Excellent Counter Bore Performance*

### *Balanced Flute Geometry*

**Designed for High Rigidity  
and Smooth Chip Evacuation.**



### *Aqua EX Coating*

**Superior Heat Resistance  
and Wear Resistance.**



} Lubrication Film

} AlCrTi Oxidation  
Resistance Film

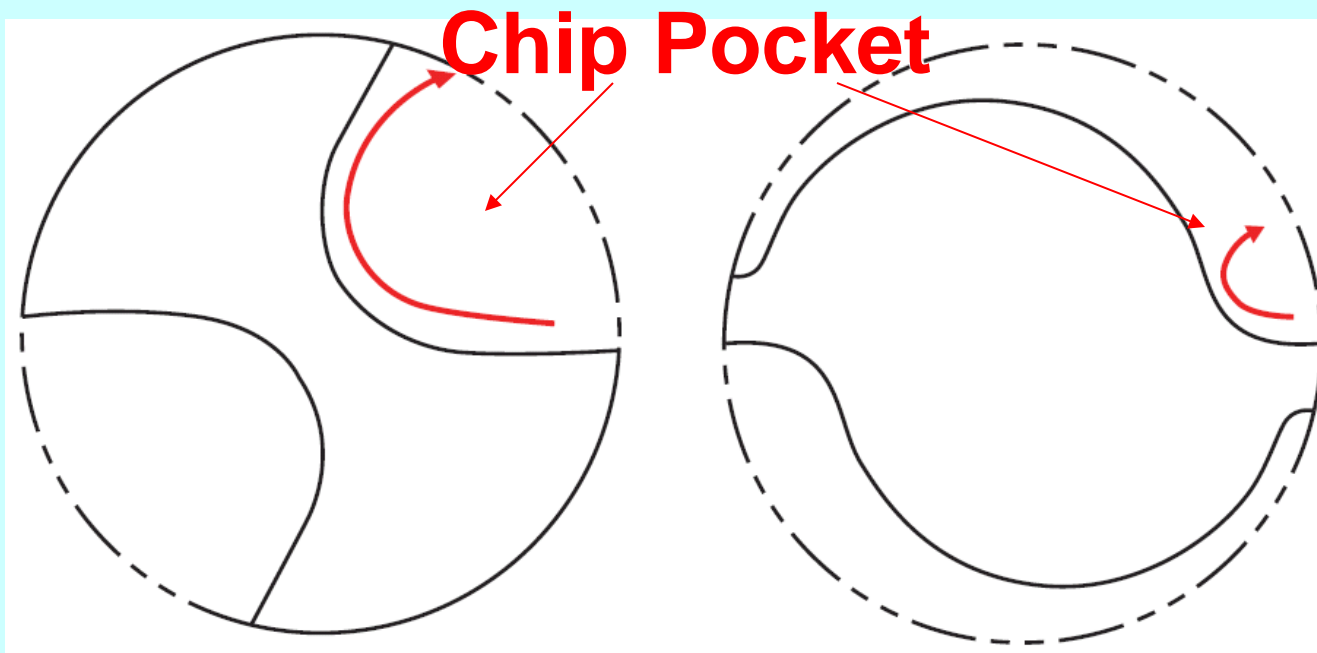
} TiAl Wear  
Resistance Film

} Hard and Tough  
Micro Grain  
Carbide

## *Cross Section Comparison of Flute*

**Aqua EX Flat Drill**

**Carbide End Mill 2Flute**



**Large Chip Pockets**

**Small Chip Pockets**

**Great Chip Ejection**

**Difficult Chip Ejection**

**No Peck Drilling**

**Peck Drilling**

# *Excellent Counter Bore Performance*

## *Absolutely Flat Drill Point*

Suitable for Accurate Counter Boring Surface one Operation



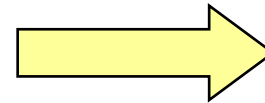
**Flat Face**



**Convex Face**

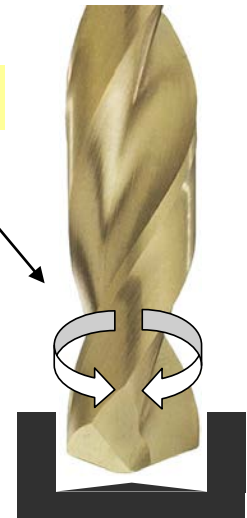
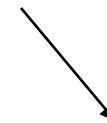


**Flat Surface Makes a Stable Drilling Possible.**



**Convex Face Causes Hole Expansion Uneven Surface.**

**Vibration**



# Drilling Precision of Inclined Surface

**Conventional Drill**

**End Mill 2 Flute**



**Drilling**

**Drilling**

**Drilling**



Breakage by Following  
the Point of Drill

Hole is Bending

Low Efficiency  
And Precision

# Drilling Precision of Inclined Surface

**Conventional Drill**

**Aqua EX Flat Drill**

✗

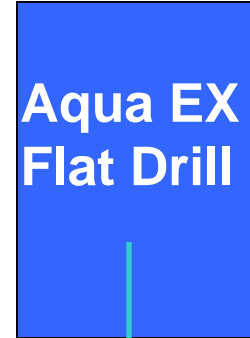
✗

○

Drilling

Drilling

Drilling

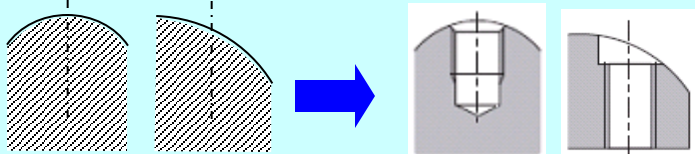


Breakage by Following the Point of Drill

Hole is Bending

Excellent Precision And Efficiency

**Other**

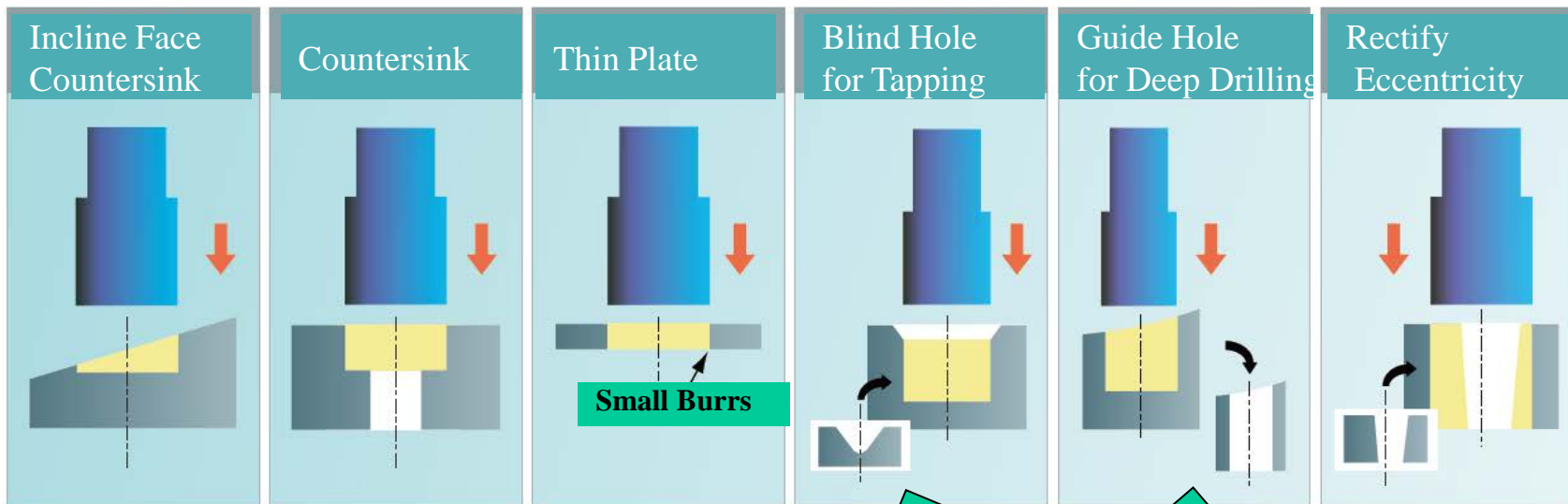
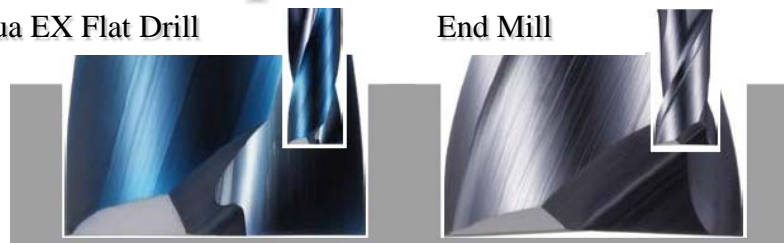


# Aqua EX Flat Drill Multi-Purpose

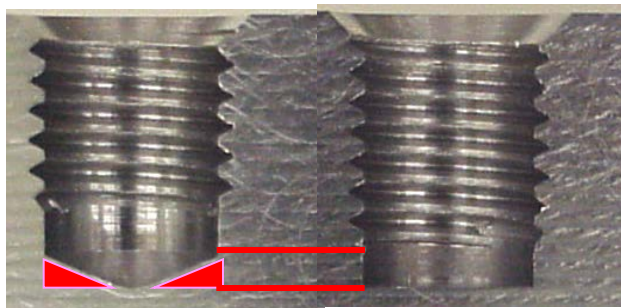
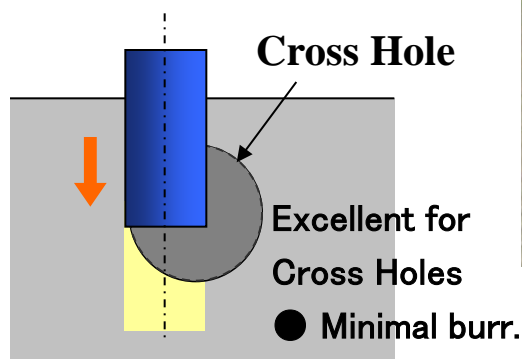
- All in One Tool for Variety of Work Piece
- Replace End Mills with Counter Boring

Aqua EX Flat Drill

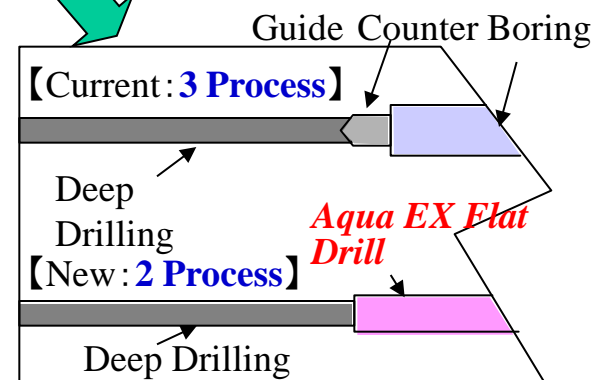
End Mill



- Suitable for Cross-Hole !



*Securing Effective Screw Length with Aqua EX Flat Drill*



*Reduce Process from 3 to 2!*



# New Development Aqua EX Flat Series

**Depth & Position** ↑

**AQDEXZLS**  
突出し長さ 10D ロングシャンク

**AQDEXZOH5D**  
オイルホール 5D用

**AQDEXZR**  
レギュラーサイズ 4D用

**AQDEXZOH3D**  
オイルホール 3D用

**AQDEXZ**  
小径追加

**SGEZ**  
ハイス

Dia. φ1 φ2 φ3 φ6 φ10 φ16 φ20 φ50

**Hydraulic Spool**

**Case of Power Generator**

**Various Electrical Parts**

**Heat-Exchange Plate**

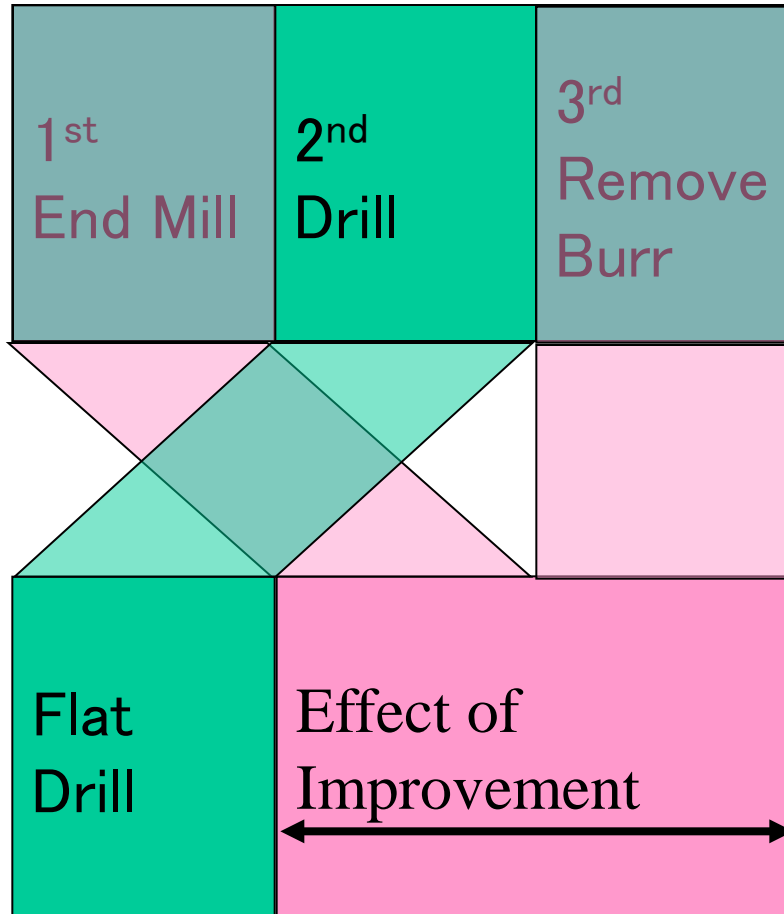
**Cylinder Block**

**Gear**

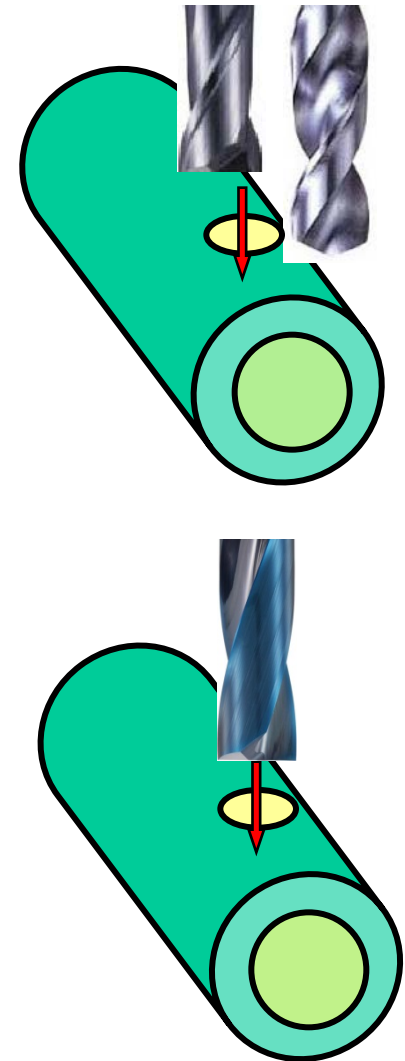
**Construction Machine Frame**

# Reduce Operation Time with Combined Process

Processes  
Before Aqua  
EX Flat



Combined  
Process with  
Aqua EX Flat



**Combine Functions and Achieve High Production Efficiency,  
Before/After Aqua EX Flat**

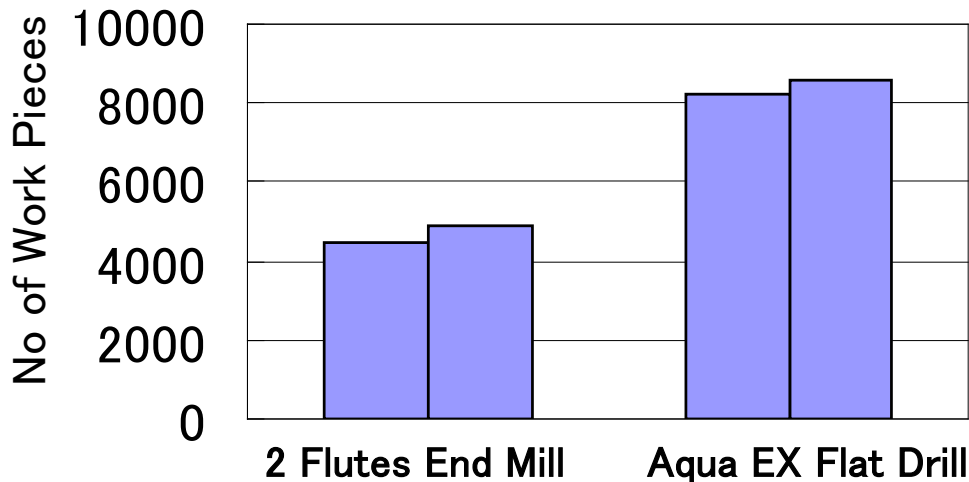
## Application Examples

### ---Comparison of Tool Life---

(Comparison of Tool Life Drilling Piston Holes of Hydraulic Cylinder Barrels)



**AQDEXZ (L9610) has an Optimal Geometry for Counter Bores, and up to 1.6 Times Longer Tool Life than Competitor.**



(Tools)

Aqua EX Flat Drill (NACHI)

L9610  $\phi$  12.5x57x100x  $\phi$  12

Carbide 2 Flute End Mill for Counter Bores  
 $\phi$  12.5x26x100x  $\phi$  12

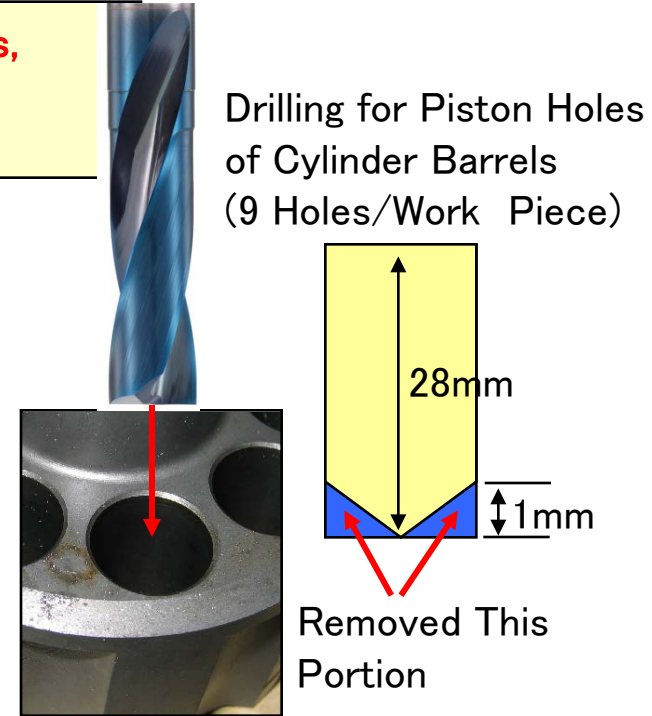
(Cutting Condition)

V65m/min (S1,650min<sup>-1</sup>)

F165mm/min (f0.1mm/rev)

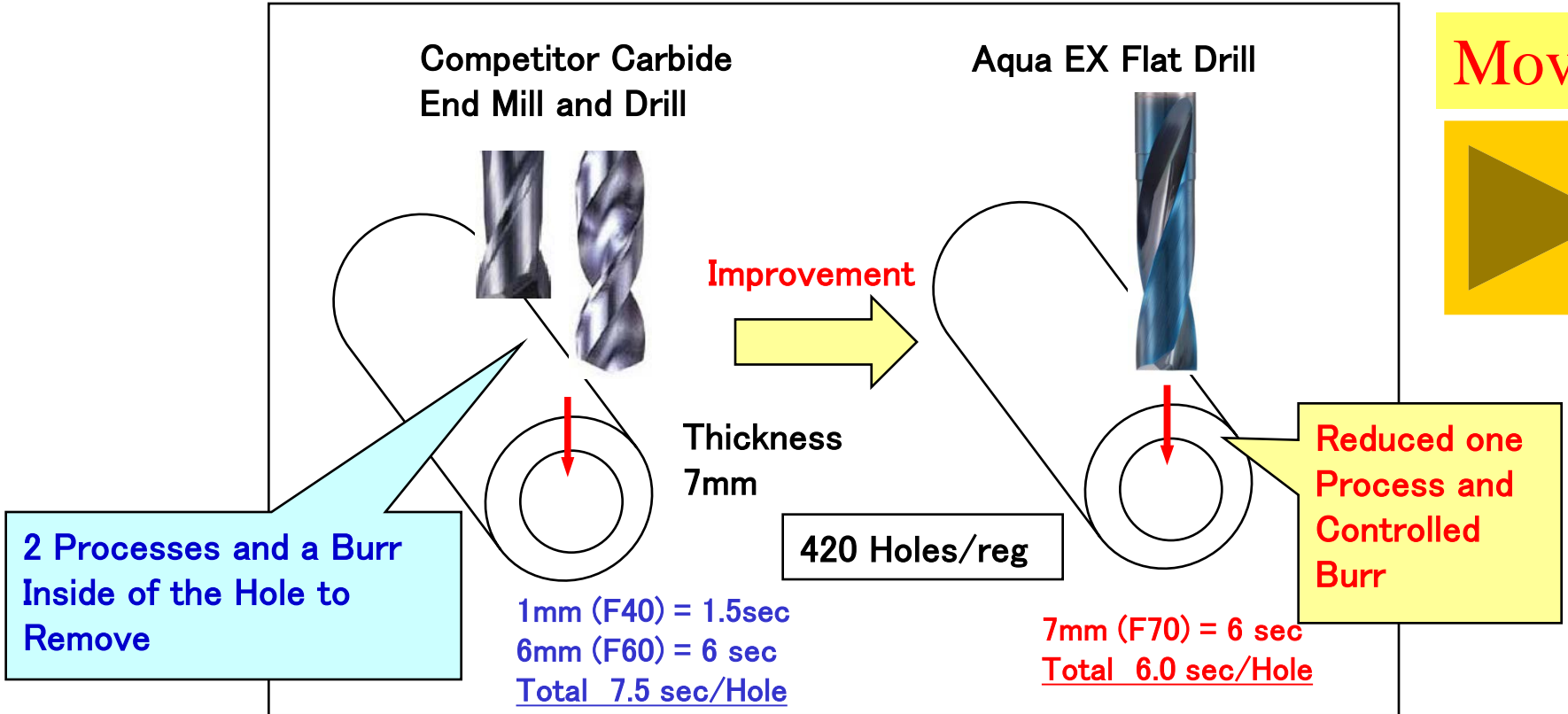
Hole Depth 28mm, Wet, BT40 (Vertical M/C)

FCD500 (Hydraulic Cylinder Barrel)



## Application Success Data

--- **Process Reduction** ---  
(Hydraulics Valve Drilling)



(Tool)

Aqua EX Flat Drill, L9610

AQDEXZ0400  $\phi$  4.0x18x50x $\phi$  6

Competitor  $\phi$  4.0mm

Carbide Coating End Mill and Drill

(Condition)

V 23m/min (S1,860min<sup>-1</sup>)

F 70mm/min (f0.04mm/rev)

Hole Depth 7mm, Water Soluble

Carbon Steel S45C (Hydraulics Valve Parts)

## Application Examples

### --- Cycle Time Reduction ---



(Half Hole Cut by Aqua EX Flat Drill for Oil Grooves in Hydraulic Pump Parts)

	Powder Material HSS End Mill		Aqua EX Flat Drill
Speed	V20m/min (S350min <sup>-1</sup> )		V65m/min (S1,150min <sup>-1</sup> )
Feed	F30mm/min (f0.09mm/rev)	<b>Improved</b> →	F230mm/min (f0.2mm/rev)
Process	Drilling → Contouring x 2passes		One-Shot Drilling
Cycle Time	<b>258 sec/Hole</b>		<b>17 sec/Hole</b>

**Cycle Time Reduced by 94%**

(Tools)

Aqua EX Flat Drill (NACHI)

L9610 φ φ 18x81x125x φ 16

Carbide End Mill + Drill (Competitor)

φ 18.0mm Powder Material HSS End Mill

2 Flute



(Half Size Hole Oil Groove)

Depth 59mm

Flat Shape on the Bottom Face

※Side Milling with End Mill is Impossible.

Wet

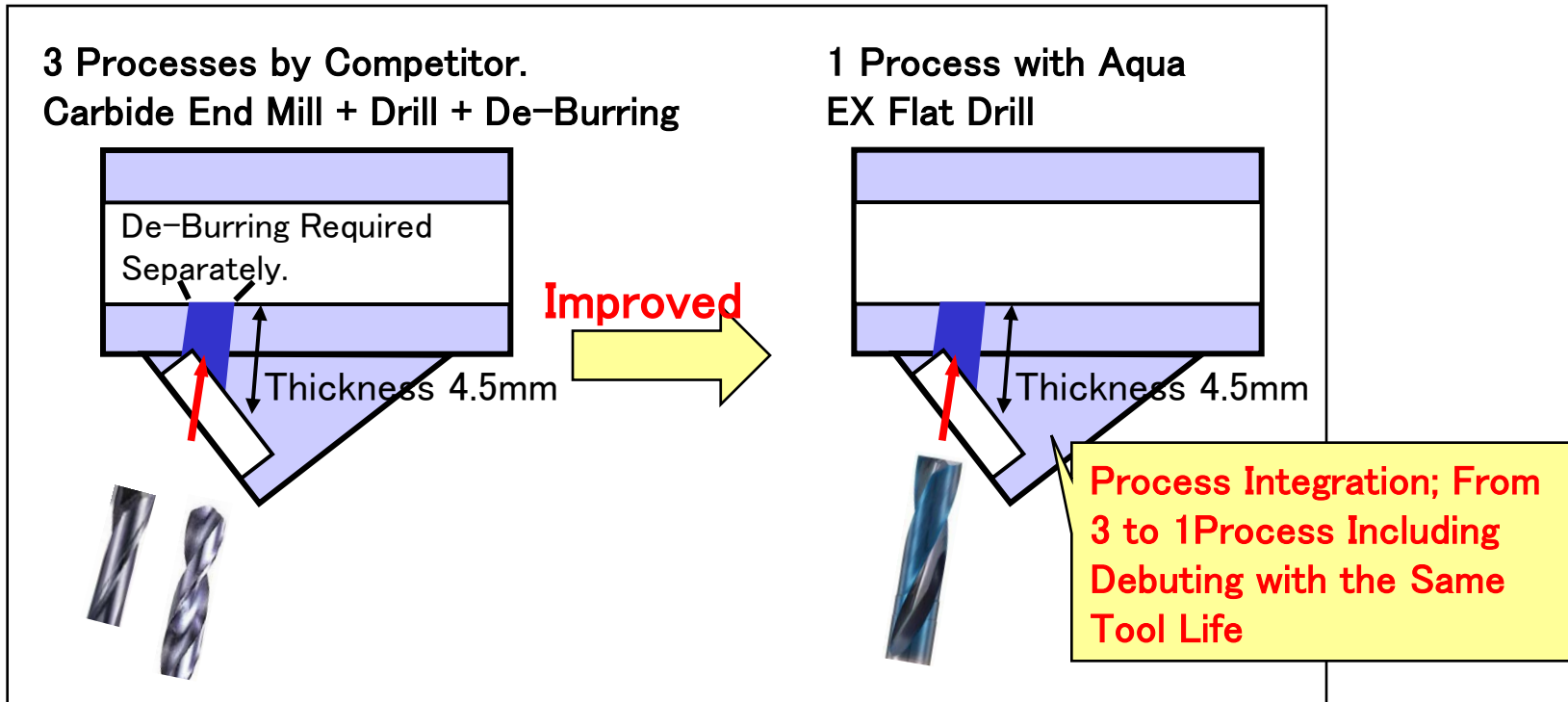
FC200

Horizontal M/C (BT50)

## Application Examples



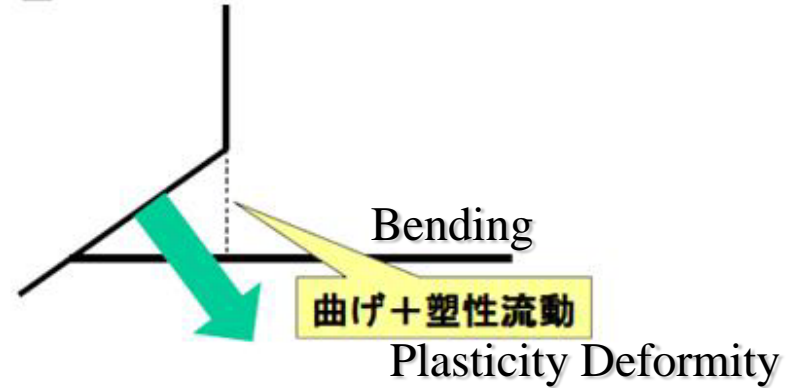
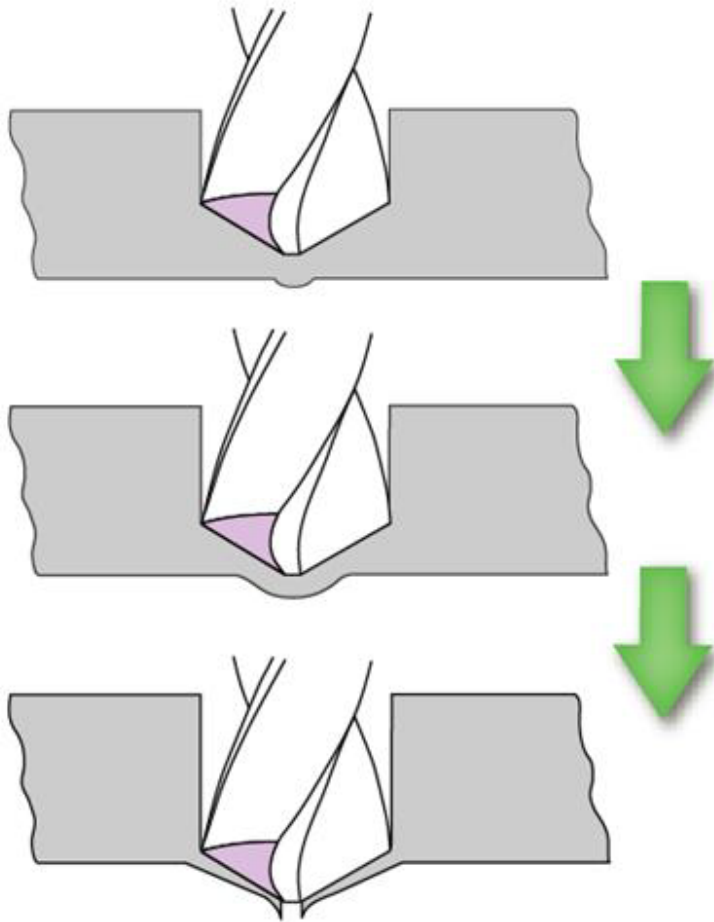
### ---Process Integration and Control of Burrs at the Exit Hole---



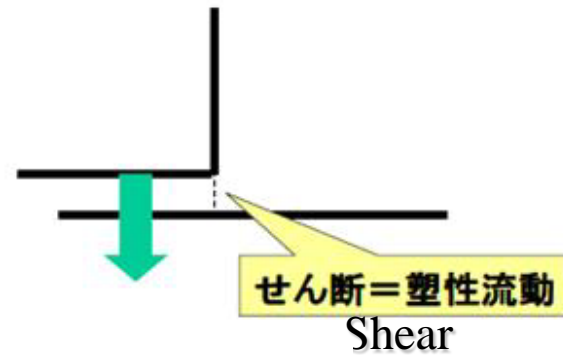
(Tools)  
 Aqua EX Flat Drill (NACHI)  
 L9610  $\phi 2.5 \times 11 \times 50 \times \phi 4$   
 Carbide End Mill + Drill (Competitor)  
 $\phi 4.0 \text{mm}$

(Cutting Condition)  
 $V45 \text{m/min}$  ( $S5,800 \text{min}^{-1}$ )  
 $F210 \text{mm/min}$  ( $f0.036 \text{mm/rev}$ )  
 Hole Depth 4.5mm, Wet  
 Alloy Steels (Injection Parts for Construction Machinery)

# Burr Progression



*Standard Drill*

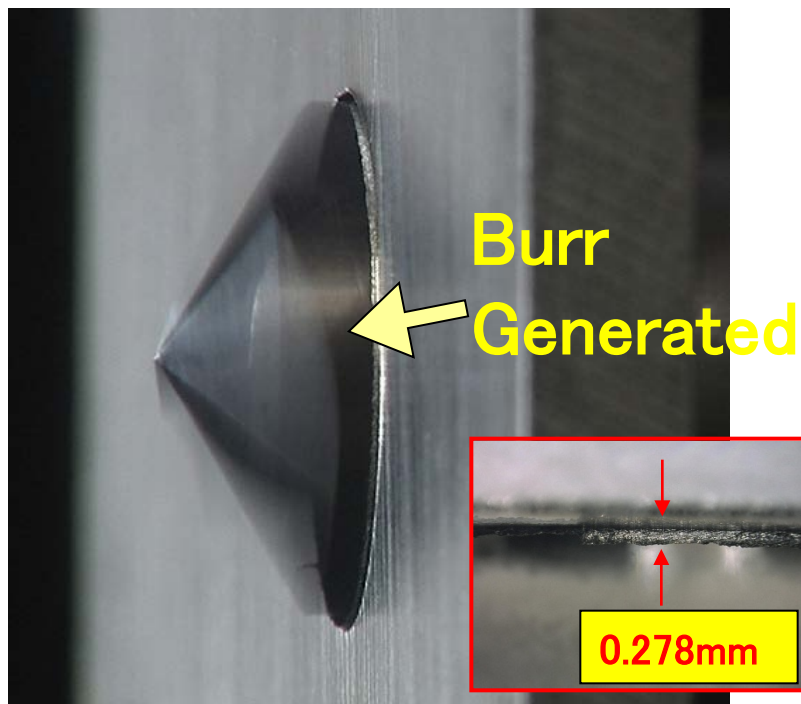


*Flat Drill*

## Application Examples

---Comparison of Burrs at the Exit Hole---

### AQDEXZ



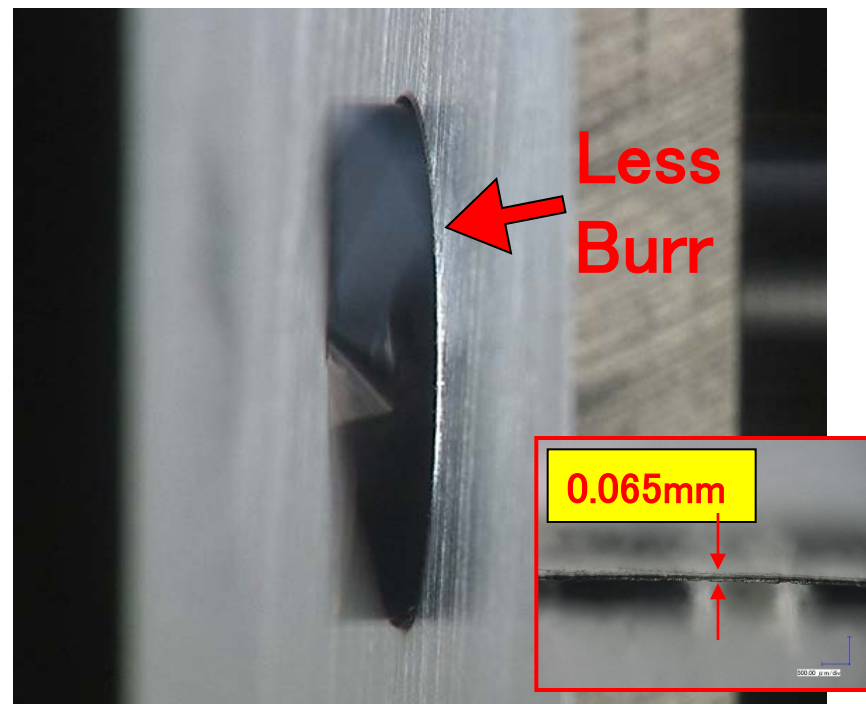
Conventional Carbide Drill

(Tools)

Aqua EX Flat Drill (NACHI)

L9610  $\phi$  10.0x45x80x  $\phi$  10

Conventional Drill  $\phi$  10.0mm Carbide Coated Drill



AQDEXZ(L9610)

(Cutting Condition)

V60m/min ( $S1,920\text{min}^{-1}$ )

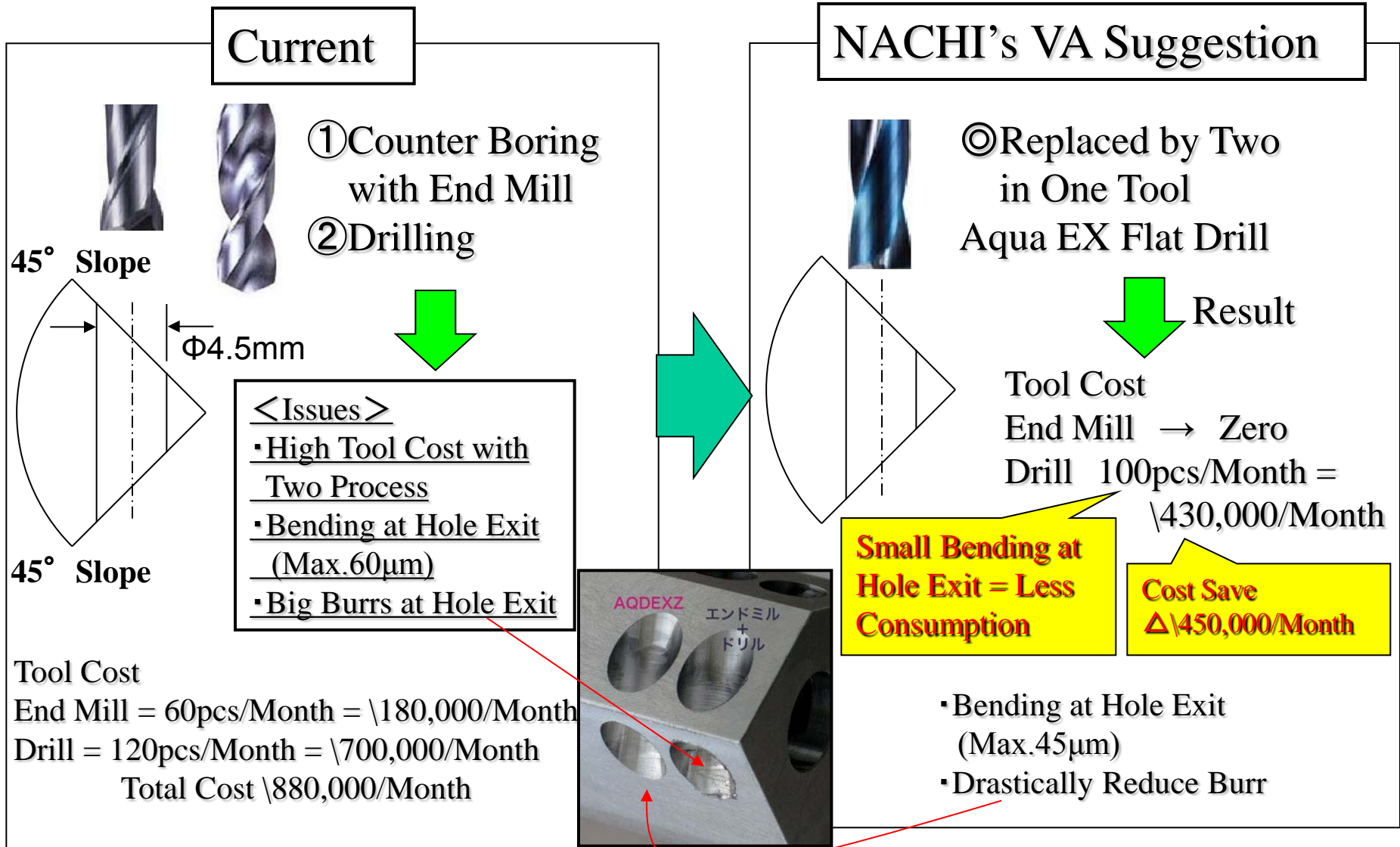
F250mm/min ( $f0.13\text{mm/rev}$ )

Hole Depth 3mm, Carbon Steel S45C



# Successful Example from End User

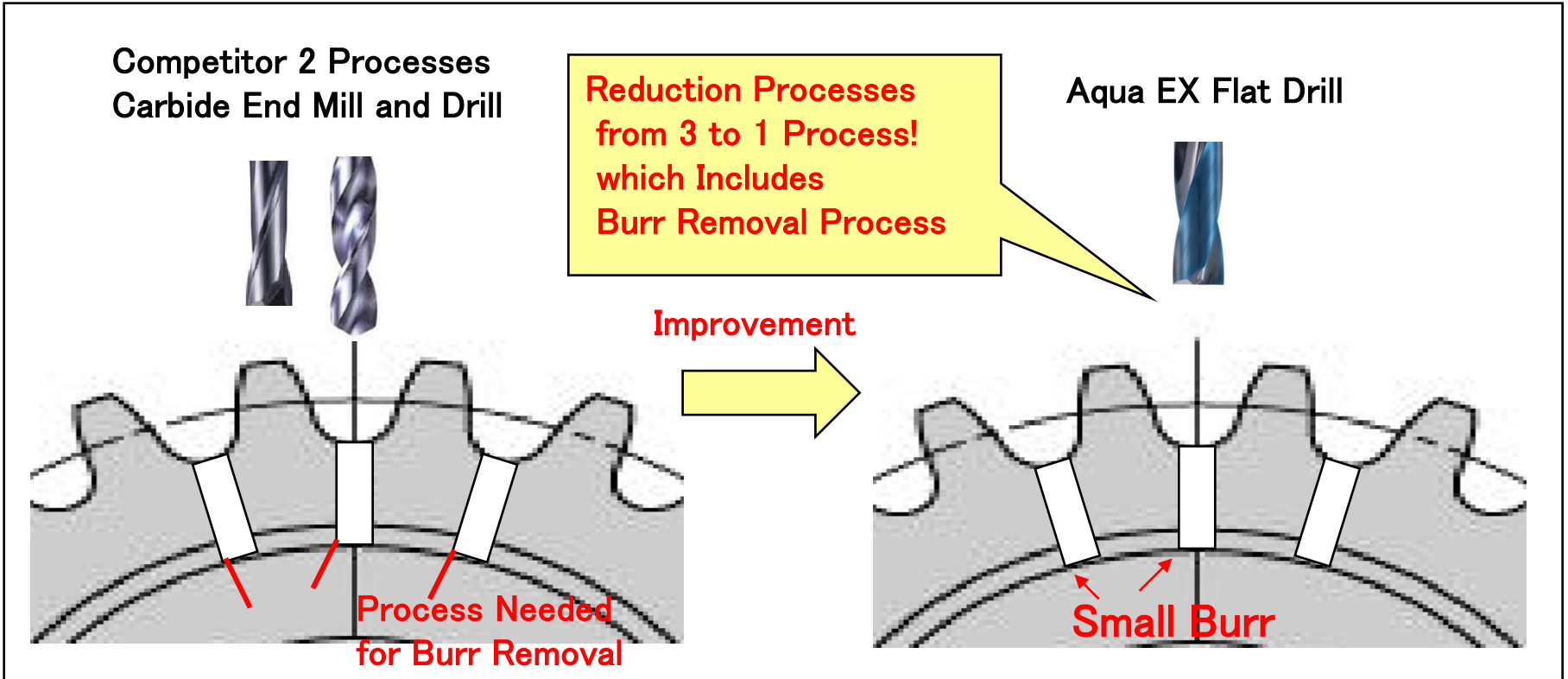
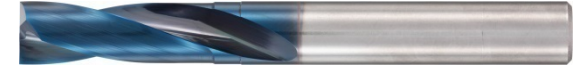
--- Fuel Pump Parts Drilling on the Inclined Surface ---



## Application Success Data

### ---Reduction Process for Drilling Oil Hole of Gear---

(Application Construction Parts)



(Tools)

Aqua EX Flat Drill L9610

AQDEXZ1200  $\phi 12 \times 54 \times 90 \times \phi 12$

Competitor  $\phi 12$ mm Carbide Coated  
End Mill and Drill

(Conditions)

V64m/min ( $S1,700 \text{min}^{-1}$ )

F360mm/min ( $f0.21 \text{mm/rev}$ ) 1.8%D f/r

Depth of Cut 12mm, Water Soluble

SCM Steel (Gear for Construction Parts)

## Inconel 718 Drilling with Aqua EX Flat Drill

### Exit Holes

**1 / 2!**  
Half Amount of Burr  
Height Compared to A  
135° Point Angle Drill

**Exit Hole with Aqua EX Flat  
Drill**

**Exit Hole with Competitor  
135° Point Angle Drill**

#### <Condition>

Size  $\phi 5\text{mm}$   
Speed 8.8m/min  
(Rotation 560rpm)  
Speed 28mm/min  
(Feed Amount 0.05mm/rev)  
Step Amount 0.5mm  
Hole Depth 8.0mm (1.6D)  
Water Soluble  
Vertical MC (BT40)

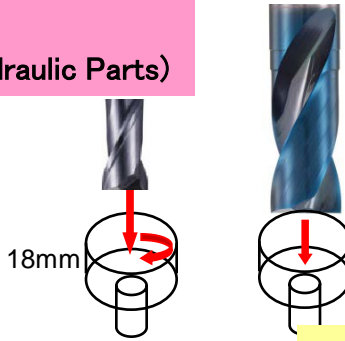
# Application Examples

**Tool:  $\phi 15$  (AQDEXZ1500)**  
**Work: FCD400 (Bolt Head of Hydraulic Parts)**

Conventional: Carbide 2 Flute E/M  
 Problem: Longer Cycle Time

Suggest One-Shot Drilling with AQDEXZ

Cycle Time 1/4 with One-Shot Drilling



High Efficiency

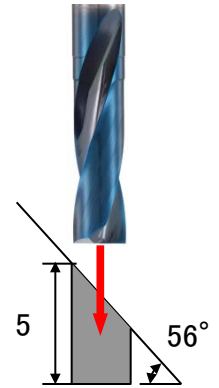
Contouring with Carbide End Mill

RPM: 1,400min<sup>-1</sup>  
 Feed: 250mm/min  
 Wet, BT40 Vertical M/C

**Tool:  $\phi 3$  (AQDEXZ0300)**  
**Work: FCD450 (Steeling Parts)**

Conventional: HSS End Mill  
 + Carbide Drill  
 Problem: No Process Integration

One-Shot Drilling on Inclined Surface with AQDEXZ; Reduced Tool Cost

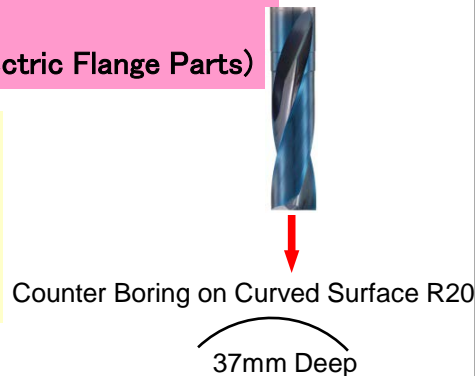


RPM: 5,000min<sup>-1</sup>  
 Feed: 88mm/min  
 Wet, BT40 Vertical M/C

**Tool:  $\phi 16$  (AQDEXZ1600)**  
**Work: Bronze Casting CAC (Electric Flange Parts)**

Conventional: HSS End Mill  
 + Carbide Drill  
 + HSS End Mill  
 Problem: Longer Cycle Time

AQDEXZ is Effective in Bronze Casting Process Integration



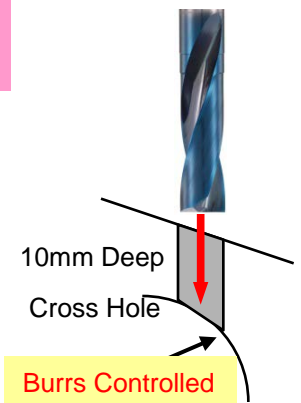
RPM: 1,200min<sup>-1</sup>  
 Feed: 200mm/min  
 Wet, BT50 Vertical M/C

**Tool:  $\phi 6$  (AQDEXZ0600)**  
**Work: S45C (Hydraulic Pump Parts)**

Conventional: HSS End Mill  
 + Carbide Drill

Problem: Removal of Burrs at the Exit Hole is Difficult.

Burrs on the Cross Hole Can be Controlled Also, Process Integration



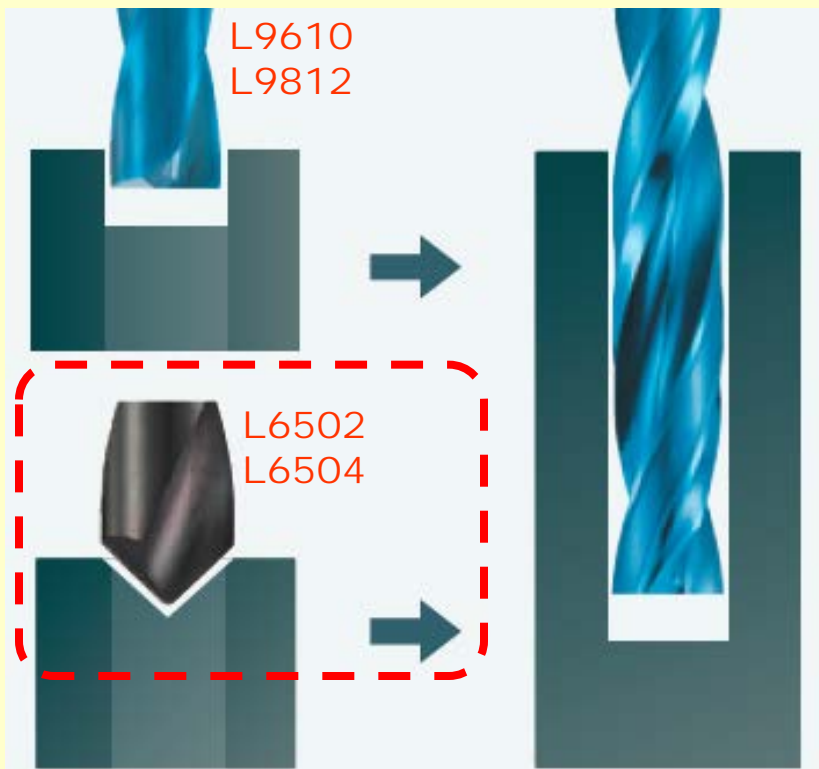
RPM: 3,600min<sup>-1</sup>  
 Feed: 250mm/min  
 Wet, BT40 Vertical M/C

# Precautions Using Flat Drills

※ Recommended Pilot Drills:

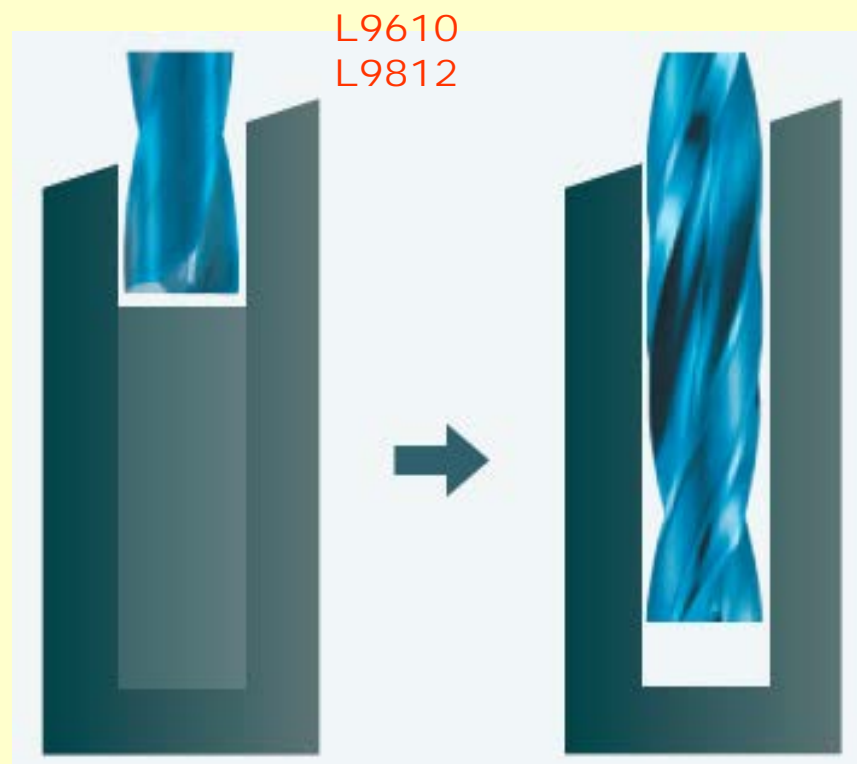
Oil Hole 5D (L9814), Regular (L9610), Long Shank (L9816)

Flat Surface



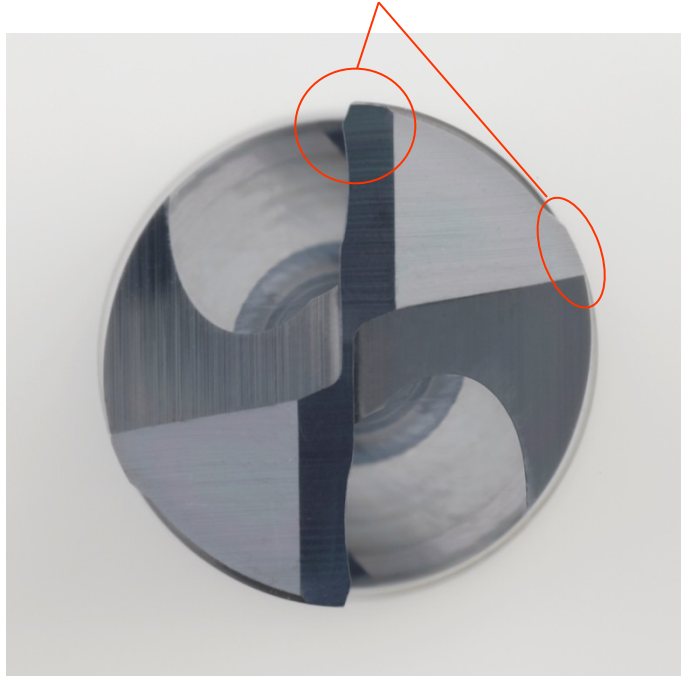
**Recommendation**

Inclined Surface



# Aqua EX Flat Drill Regular Length

**Negative Angled Teeth and Double Margin Prevent Hole Expansion**



***Regular Length***

***Industry's First!  
Solid Carbide Drill for 4XD Flat  
Holes!***

***Best Balanced Flute Shape for  
More Rigidity and Better Chip  
Removal!***

- **Enhanced Performance on chip Breakage and Ejection**
- **Intermediate Double Margin Control of Hole Expansion for High Accuracy Drilling**

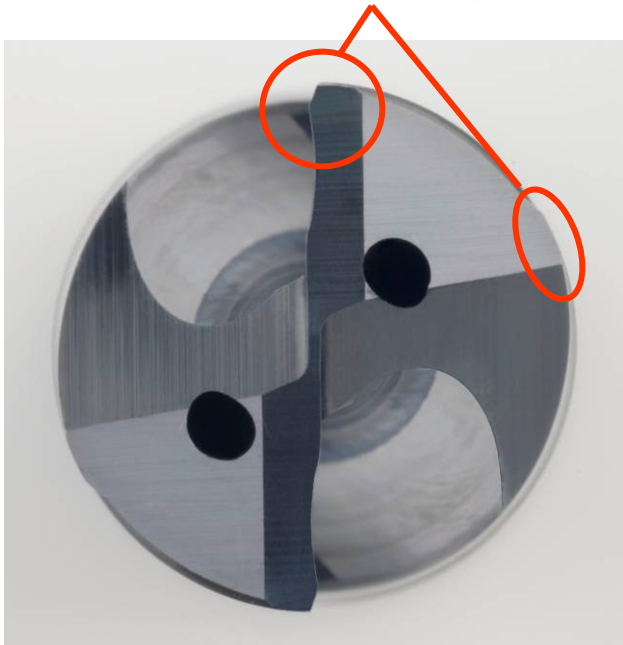
***Product Range***

- **Diameter :  $\varnothing 3 \sim \varnothing 20$**



# Features of Aqua EX Flat Drill Oil Hole 3D/5D

Prevent Oversize with “Negative Rake” and “Double Margin”



AQDEXZOH3D



AQDEXZOH5D



## *Added Oil Hole Flat Drill for Deep Drilling*

- Realize 5D Drilling with High Efficiency

## *Wide Application of Materials*

- Applicable from Carbon Steel, Alloy Steel and Cast Iron to **Stainless Steel**
- Size Range  $\phi 3 \sim \phi 16$  98 Sizes

## *Well Balanced Flute Geometry*

## *Realizing Both Rigidity and Excellent Ejection*

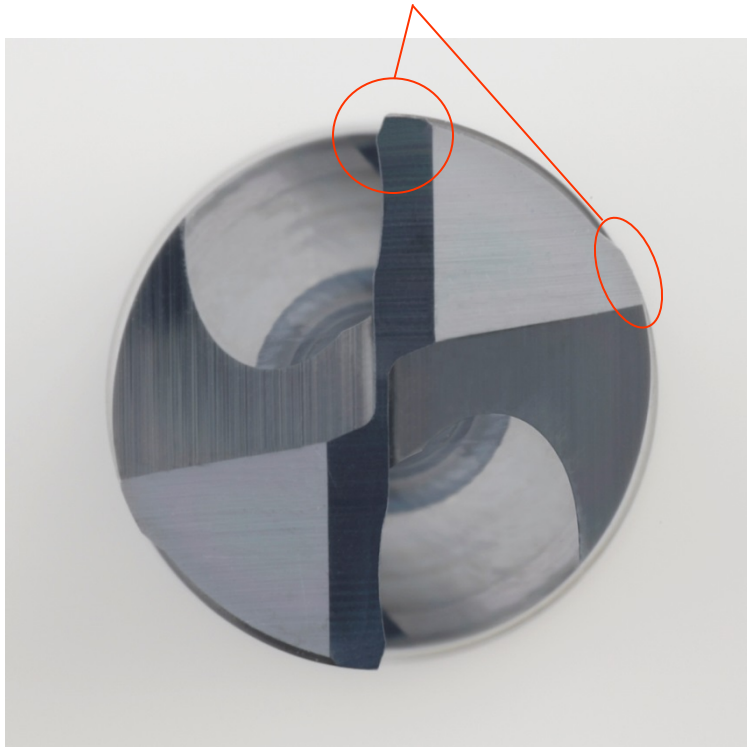
- Improved Chip Separation and Evacuation
- Intermediate Double Margin Realizes Highly Accurate Boring and Oversize Control

**Movie**



# Aqua EX Flat Drill Long Shank

**Negative Angled Teeth and Double Margin Prevent Hole Expansion**



***Developed Long Shank Drill Type for Flat Drill Series!***

▪ **2D Flat Hole Drilling with 10D Extension Length (Industry's Longest!) Applicable for Cutting Wide Range of Materials**

▪ From Carbon Steel to Alloy Steel, Cast Iron → Very Wide!

▪ Product Range : Diameter  $\phi 3 \sim \phi 20$

***Best Balanced Flute Shape for More Rigidity and Better Chip Removal!***

▪ Enhanced Chip Breakage and Ejection Performance

***Long Shank***





**Thank You**