New Item & New Concept Tools

Aqua EX Flat Drill

50 years in America

NACHI AMERICA INC.
Aqua EX Flat Drill

**Completely Flat Point Angle!**
(Point Angle 180°)

- Sharpness & Rigidity at the Same Time
- Excellent Chip Evacuation with the Flute Geometry
- Drilling on Either Inclined or Curved Surfaces
- Blind Tap Hole Done in One Go

【Condition】
Tool Dia.: φ10
Cutting Speed: 75m/min (2400min⁻¹)
Material: S50C
Cutting Depth: 15mm,
Coolant: Water Soluble

【Cutting Force Comparison (45° Drilling)】

<table>
<thead>
<tr>
<th>Feed</th>
<th>Conventional 2F EM</th>
<th>Aqua EX Flat Drill</th>
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</thead>
<tbody>
<tr>
<td>118mm/min (0.05mm/rev)</td>
<td><img src="image1" alt="Graph" /></td>
<td><img src="image2" alt="Graph" /></td>
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</table>

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
- Chip Pocket
- Large Chip Pockets
- Great Chip Ejection
- No Peck Drilling

Carbide End Mill 2Flute
- Chip Pocket
- Small Chip Pockets
- Difficult Chip Ejection
- Peck Drilling
Excellent Counter Bore Performance

Absolutely Flat Drill Point

Suitable for Accurate Counter Boring Surface one Operation

Flat Surface Makes a Stable Drilling Possible.

Flat Face

Convex Face Causes Hole Expansion Uneven Surface.

Convex Face

Vibration
Drilling Precision of Inclined Surface

Conventional Drill

Drilling

Drill

Breakage by Following the Point of Drill

End Mill 2 Flute

Drilling

Drill

Bend

Hole is Bending

Low Efficiency And Precision
Drilling Precision of Inclined Surface

Conventional Drill

Drilling

×

Drill

Breakage by Following the Point of Drill

Hole is Bending

Other

Aqua EX Flat Drill

Drilling

○

Aqua EX Flat Drill

Excellent Precision And Efficiency


Aqua EX Flat Drill  Multi-Purpose

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

Incline Face
Countersink

Countersink

Thin Plate

Blind Hole
for Tapping

Guide Hole
for Deep Drilling

Rectify
Eccentricity

Suitable for Cross-Hole!

Cross Hole

Excellent for Cross Holes
● Minimal burr.

Securing Effective Screw Length with Aqua EX Flat Drill

Guide Counter Boring

【Current: 3 Process】

Deep Drilling

【New: 2 Process】

Deep Drilling

Reduce Process from 3 to 2!
New Development Aqua EX Flat Series

<table>
<thead>
<tr>
<th>Dia. (φ)</th>
<th>φ1</th>
<th>φ2</th>
<th>φ3</th>
<th>φ6</th>
<th>φ10</th>
<th>φ16</th>
<th>φ20</th>
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<td>AQDEXZLS</td>
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Various Electrical Parts
Heat-Exchange Plate
Cylinder Block
Gear

Case of Power Generator
Construction Machine
Flame
Reduce Operation Time with Combined Process

Processes
Before Aqua EX Flat

1st End Mill
2nd Drill
3rd Remove Burr

Combined Process with Aqua EX Flat

Flat Drill
Effect of Improvement

Combine Functions and Achieve High Production Efficiency, Before/After Aqua EX Flat
AQDEXZ (L9610) has an Optimal Geometry for Counter Bores, and up to 1.6 Times Longer Tool Life than Competitor.

Drilling for Piston Holes of Cylinder Barrels (9 Holes/Work Piece)

- Tools:
  - Aqua EX Flat Drill (NACHI)
    - L9610 φ12.5x57x100x φ12
  - Carbide 2 Flute End Mill for Counter Bores
    - φ12.5x26x100x φ12

- Cutting Condition:
  - V65m/min (S1,650min⁻¹)
  - 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)

Competitor Carbide End Mill and Drill

Aqua EX Flat Drill

Tool
Aqua EX Flat Drill, L9610
AQDEXZ0400  φ 4.0x18x50x φ 6
Competitor φ 4.0mm
Carbide Coating End Mill and Drill

(Condition)
V 23m/min (S1,860min⁻¹)
F 70mm/min (f0.04mm/rev)
Hole Depth 7mm, Water Soluble
Carbon Steel S45C (Hydraulics Valve Parts)

Movie

2 Processes and a Burr Inside of the Hole to Remove

Improvement

Thickness 7mm

1mm (F40) = 1.5sec
6mm (F60) = 6 sec
Total 7.5 sec/Hole

420 Holes/regulated

Reduced one Process and Controlled Burr

7mm (F70) = 6 sec
Total 6.0 sec/Hole
Application Examples

--- Cycle Time Reduction ---

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

<table>
<thead>
<tr>
<th>Powder Material HSS End Mill</th>
<th>Aqua EX Flat Drill</th>
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</thead>
<tbody>
<tr>
<td>Speed</td>
<td>V20m/min (S350min(^{-1}))</td>
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<tr>
<td>Feed</td>
<td>F30mm/min (f0.09mm/rev)</td>
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<tr>
<td>Process</td>
<td>Drilling → Contouring x 2passes</td>
</tr>
<tr>
<td>Cycle Time</td>
<td><strong>258 sec/Hole</strong></td>
</tr>
</tbody>
</table>

(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)

(Tools)
Aqua EX Flat Drill (NACHI)
L9610  φ φ18x81x125x φ16
Carbide End Mill + Drill (Competitor)
φ18.0mm Powder Material HSS End Mill
2 Flute
**Application Examples**

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

3 Processes by Competitor. Carbide End Mill + Drill + De-Burring

- De-Burring Required Separately.
- Thickness 4.5mm

1 Process with Aqua EX Flat Drill

- Improved
- Thickness 4.5mm

Process Integration; From 3 to 1 Process Including Debuting with the Same Tool Life

(Tools)
- Aqua EX Flat Drill (NACHI)
- L9610 φ 2.5x11x50x φ 4
- Carbide End Mill + Drill (Competitor)
- φ 4.0mm

(Cutting Condition)
- V45m/min (S5,800min⁻¹)
- F210mm/min (f0.036mm/rev)
- Hole Depth 4.5mm, Wet
- Alloy Steels (Injection Parts for Construction Machinery)
Burr Progression

Standard Drill

Plasticity Deformity

Bending

Flat Drill

Shear
Application Examples

Comparison of Burrs at the Exit Hole

Conventional Carbide Drill
(Aqua EX Flat Drill (NACHI)
L9610 φ10.0x45x80x φ10
Conventional Drill φ10.0mm Carbide Coated Drill)

AQDEXZ(L9610)

(Cutting Condition)
V60m/min (S1,920min⁻¹)
F250mm/min (f0.13mm/rev)
Hole Depth 3mm, Carbon Steel S45C

Burr
0.278mm

Burr Generated

Less Burr
0.065mm
Successful Example from End User
--- Fuel Pump Parts Drilling on the Inclined Surface ---

Current

① Counter Boring with End Mill
② Drilling

Issues
・High Tool Cost with Two Process
・Bending at Hole Exit (Max. 60μm)
・Big Burrs at Hole Exit

Tool Cost
End Mill = 60pcs/Month = ¥180,000/Month
Drill = 120pcs/Month = ¥700,000/Month
Total Cost ¥880,000/Month

NACHI’s VA Suggestion

◎ Replaced by Two in One Tool
Aqua EX Flat Drill

Result

Tool Cost
End Mill → Zero
Drill 100pcs/Month = ¥430,000/Month

Cost Save △ ¥450,000/Month

• Bending at Hole Exit (Max. 45μm)
• Drastically Reduce Burr

Small Bending at Hole Exit = Less Consumption

Φ4.5mm

Successful Example from End User
Application Success Data

---Reduction Process for Drilling Oil Hole of Gear---
(Application Construction Parts)

**Competition 2 Processes**
Carbide End Mill and Drill

**Aqua EX Flat Drill**

Reduction Processes from 3 to 1 Process!
which Includes Burr Removal Process

**Improvement**

Process Needed for Burr Removal

Small Burr

(Tools)
Aqua EX Flat Drill  L9610
AQDEXZ1200  φ12x54x90xφ12
Competitor  φ12mm Carbide Coated End Mill and Drill

(Conditions)
V64m/min (S1,700min⁻¹)
F360mm/min (f0.21mm/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

**Condition**
- Size φ5mm
- 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)

**Exit Holes**
- Exit Hole with Aqua EX Flat Drill
  - 0.07mm
- Exit Hole with Competitor 135° Point Angle Drill
  - 0.14mm
- 1/2!
  - Half Amount of Burr Height Compared to A 135° Point Angle Drill
Application Examples

**Tool: φ15 (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
- RPM: 1,400min⁻¹
- Feed: 250mm/min
- Wet, BT40 Vertical M/C

**Tool: φ3 (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⁻¹
- Feed: 88mm/min
- Wet, BT40 Vertical M/C

**Tool: φ16 (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

- Counter Boring on Curved Surface R20
- RPM: 1,200min⁻¹
- Feed: 200mm/min
- Wet, BT50 Vertical M/C

**Tool: φ6 (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⁻¹
- 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

L9610
L9812
L6502
L6504

Inclined Surface

L9610
L9812

Recommendation
Aqua EX Flat Drill 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 : $\varphi 3 \sim \varphi 20$
Features of Aqua EX Flat Drill Oil Hole 3D/5D

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

**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 φ3 ~ φ16  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

AQDEXZOH3D

AQDEXZOH5D

Movie
Aqua EX Flat Drill Long Shank

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 φ3 ~ φ20

Best Balanced Flute Shape for More Rigidity and Better Chip Removal!
- Enhanced Chip Breakage and Ejection Performance

Negatives Angled Teeth and Double Margin Prevent Hole Expansion

Long Shank
Thank You