Gantry type
5-Axis Vertical
Machining Center
AXILE /ˈæksəl/, stands for “agile”

Agility is the best word to define the identity of AXILE. Motor agility is the ability to move quickly and precisely, which is the essence of high-speed machining. Mental agility is the ability to think and understand quickly, to be smart in other words.

AXILE provides agile smart machining.

Highly sophisticated part manufacturers face the same problems everywhere: lower selling prices every day, higher costs and a shortage of specialized labour. AXILE propose highly productive machines based on high-speed and 5-axis technologies at very competitive prices.

The new AXILE line is built with standard high-tech design and components from world-class suppliers to ensure the best quality and reliability. AXILE patented SMT technology attains reaching high levels of accuracy and embraces Industry 4.0 technologies, reliability is upgraded, maintenance costs minimized and downtime avoided.

AXILE products are proudly designed and manufactured at Buffalo’s facilities, one of the leading technology manufacturers in Taichung (Taiwan). Taichung is the world’s biggest cluster of machine-tool builders, thanks to abundant specialized workforce and a component supply chain far more efficient than in any other country. The rationalized range of 3X and 5X high-speed VMC’s covers only the most requested sizes to reach economies of scale to maintain reasonable market prices.

AXILE is conceived to conquer the premium market of 3X and 5X high-speed vertical machining centers. Such markets will grow and AXILE will be the real Asian big player amongst its European competitors.

AXILE, motor and mental agility at a competitive price.
Design concept

The structure

1. Spindle moved by 3 linear axes
   - No rotary axis between the tool and the machine body, for better machining rigidity.

2. Perfect U-shape closed-gantry design
   - Same stability in all travels of X and Y axes
   - Excellent accessibility to working area

3. 3-guided headstock
   - Highest rigidity in roughing processes with high torque in spindle

4. Table moved by swivelling-rotary axes
   - Best accuracy with fixed relative position between 2 rotary axes.

5. Massive gantry sliding on 2 symmetric synchronized axes
   - Best servo response to any milling forces

6. All body made of high-quality casting
   - Optimal damping of machining vibrations
   - Homogeneous thermal behaviour

7. Integrated chip disposal channel directly under the table
   - Quick evacuation of chips for high chip volume machining

“Gantry: best dynamics, accuracy and ergonomics for 5X machines”
### Agility

#### Linear axes

<table>
<thead>
<tr>
<th>Feature/Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct driven servomotors (no belts/gears)</td>
<td>Best dynamic and minimal elasticity in the driving system</td>
</tr>
<tr>
<td>Double symmetric and synchronized axes (Y1, Y2)</td>
<td>Best dynamic for the gantry no matter the position of the machining force</td>
</tr>
<tr>
<td>Linear scales with 0.001 µm resolution in X, Y1, Y2 and Z axes</td>
<td>Ensures optimal synchronization in Y1 and Y2 axes, and best accuracy for ALL axes</td>
</tr>
<tr>
<td>Double roller type linear guideways</td>
<td>Best high-feed movement and vibration damping</td>
</tr>
<tr>
<td>Double pre-loaded double-nut ball screws</td>
<td>Minimized back-lash allowing high-feed movements</td>
</tr>
</tbody>
</table>

#### Swivelling-rotary axes

<table>
<thead>
<tr>
<th>Feature/Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated and ready-to-use hydraulic and pneumatic ports</td>
<td>Simplifying parts clamping process</td>
</tr>
<tr>
<td>Torque motor-driven rotary axis (C)</td>
<td>Highest dynamics</td>
</tr>
<tr>
<td>Dual torque motor-driven swivelling axis (A)</td>
<td>Highest accuracy</td>
</tr>
<tr>
<td>Brakes in every shaft</td>
<td>High-repeatability in 4+1x operation when using the brakes</td>
</tr>
<tr>
<td>High-resolution, direct absolute rotary measuring system</td>
<td>Zero-backlash and high accuracy</td>
</tr>
</tbody>
</table>
Smart Technology

**Smart Machining Technology (SMT)**
High-speed and 5-axis technologies pursue lower manufacturing costs for complex products, but they also represent some serious challenges for accuracy and reliability. This is why Buffalo dedicated almost a decade to research the necessary knowledge to dominate such technologies. We call them SMT.

- **Tool-tip Positioning Control (TPC)**
  Direct displacement measure and real-time monitoring and compensation technology

- **Metal Removal Rate Optimization (MRRO)**
  Maximal metal removal rate, cutting force and chatter-free machining

- **Axial Accuracy Control (AAC)**
  A machine thermo monitoring and compensation technology

- **Spindle Vibration Supervision (SVS)**
  Spindle vibration monitoring and real-time control technology

**Axile Reliability Technology (ART)**
Axile also embraces Industrie 4.0 and is developing its own patented technologies called ART. The main components of the machine will be equipped with sensors that collect relevant data like vibration, acceleration or temperature, to monitor working conditions in real-time.

- **Reliability Maintenance (RM)**
  Predictive maintenance

- **Energy Management (EM)**
  ISO14955 (Eco-friendly)

- **Manufacturing Process (MP)**
  Process & production planning

Reliability

**SMT and ART technologies are applied to predict Mean Time Between Failure (MTBF)**

- **How to real-time monitor the spindle vibration to maintain the machining accuracy under long time operation?**

  **THREE LEVELS FOR SPINDLE VIBRATION MONITORING**
  - **LEVEL 1**
    - Shows the warning message to notify the operator
  - **LEVEL 2**
    - Shows the error message and reduces spindle speed and feed rate
  - **LEVEL 3**
    - Instantly shuts down the machine to prevent crash

  **HIGH FINISH QUALITY**
  - Longer life time
  - Longer life time
  - Easy for maintenance
  - Easier for maintenance
  - Flexible vibration analysis and vibration analysis
  - Flexible vibration analysis and vibration analysis

**Spindle Lifetime**
- Longer life time
- Wear reduction on spindle bearings and tooling
- Easy for maintenance
- Abnormal vibration data recording

**Velocity (mm/s)**
- **LEVEL 1**
  - Starting time
  - Ending time
- **LEVEL 2**
- **LEVEL 3**

**AMPLIFIER VIBRATION SENSOR MPU MEMORY CNC compensation command**

**Field Data Acquire**
- Machine
- Database
- Analysis
- Application

**Reliability Maintenance**
**Accuracy**

**Linear axes accuracy**

- **Ballscrew’s thermal growth**: 0.001µm resolution absolute linear scales in ALL axes

**Rotary axes accuracy**

- **Elasticity and backlash**: Direct-driven torque motors with no back-lash
- **Angular error**: +/- 5° accuracy absolute rotary scale feedback

**Thermal control**

- **Heat generated by spindle and torque motors**: Spindle and torque motors are cooled with a water chiller close-circuit and a cooling unit

**Linear-rotary axes relative positioning**

- **Angular error**: Angular error is multiplied by the distance from rotary axis to machining point
- **Thermal induced positioning error compensation**: Calculation with deformation model, temperature sensors, and MPU/CNC/MULTIPLEXER/AMPLIFIER

**Angular deformation in machine body causing linear errors**

**Axial Accuracy Control**

- **Spindle thermal growth at high-speed**: TPC

**Angular deformation in spindle causing linear errors**

**Axial Accuracy Control**

**Rotary accuracy**

- **Elasticity and backlash of driving system**: Direct-driven torque motors with no back-lash
- **Angular error**: +/- 5° accuracy absolute rotary scale feedback

**Thermal control**

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Spindle

High-performance built-in spindle selection

- 15,000 rpm
- Double coil synchronous motor
- 130/187 Nm S1/S6-40%
- 27/39 kW S1/S6-40%
- HSK A63

- 20,000 rpm
- Double coil synchronous motor
- 86/130 Nm S1/S6-40%
- 25/35 kW S1/S6-40%
- HSK A63

Chip management

Flushing chips away

- Chip wash down
- Chip conveyor
- 4x coolant at spindle nose
- Coolant through spindle
- 2x air flushing
- 2x-2 coolant flushing

High-quality stainless steel work area
Long-lasting clean operation

Sharp walls and no-corner design
Easier to flush away chips by shower

1. Chip wash down
2. Chip conveyor
3. 4x coolant at spindle nose
4. Coolant through spindle
5. 2x air flushing
6. 2x-2 coolant flushing
Ergonomics

Accessibility to work area

- Large front door opening
- Comfortable access to work area for workpiece preparation and supervision
- Short distance from operator to table
- Ergonomic loading and unloading of small parts
- Automatic roof to open ceiling working area
- Easy loading and unloading of heavy and bulky workpieces by overhead crane

Easier tooling management and maintenance

- Tools are accessible from back of the machine and stored vertically
- All necessary consumables are located together in the back of the machine
- Tools can be changed into the magazine while automatic operation of machine.
- Easy maintenance routine for operator
- Smart tool: interface panel is used to select the tool. When finished, the system checks whether all tool HSK-A-63 holders are in the right position
- Avoid human failures when automatically change tool to spindle, protecting spindle and reducing down-time
- Comfortable pending panel can be selected in either sides of machine
- Layout is optimized and operator ergonomics customized

Automatic roof
for overhead crane loading and unloading

- Roof closed
- Automatic sliding of roof
- Fold-up the roof
- Easy access to table center

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- Layout is optimized and operator ergonomics customized
Tool management

Flexible capacity for every application

Single or twin carousels of 32, 48 or 60 tools can be selected and capacity doubled to 64, 96 or 120 tools. Up to 96 tools machine layout is not modified.

Sister tools, complex parts and unmanned operation can be executed with no worries on the tool magazine capacity.

“Carrousel-type magazine with 32 to 120 tools capacity”

Control unit

A controller for every user

Heidenhain iTNC530 HSCI
- Kinematics
- Dynamic Collision Monitoring
- Tool Center Point Management
- Tilted the Working Plane

Heidenhain TNC640
- Kinematics
- Dynamic Collision Monitoring
- Tool Center Point Management
- Tilted the Working Plane

Siemens 840D sl
- Kinematic chain
- Collision Avoidance
- 5-axis transformation with tool orientation
- Swivel the Coordinate System

Fanuc 31iMB5
- 3D Interference Check
- High Speed Smooth TCP
- Tilted Working Plane indexing

Heidenhain TNC640

Siemens 840D sl
Major heat-generating electrical components like transformer and line filters are kept in a separate cabinet for easier temperature control. Electrical cabinet is maintained at stable temperature using an air conditioner.

Chain-type chip conveyor with chip bucket, oil skimmer and built-in 20 bar through spindle coolant pump are standard equipments. They can be positioned either side of the machine for layout customization.

Optional design and organization of electrical connectors and cables

Easier maintenance

High-speed and twisting stress cycles

Integrating and ready-to-use 3 hydraulic and 1 pneumatic port. Clamping and unclamping functions by softkeys in the control panel and/or by M-function.

Simplifies 5X workpiece clamping.

Automatic workpiece measurement (with probe, receiver and reference ball)

Automatic compensation of the linear-rotary axis relative positioning: Kinematics (Heidenhain), Kinematic chain (Siemens) and Tilted working plane indexing (Fanuc)

For accurate workpiece positioning or in-process measuring of some machining features.

2 versions: U-type embedded in the table (for highest accuracy) or wall-to-wall type with protection gate (for best protection). Laser tool measurement. This option is used for:

For accurate tool measurement in length, radius and shape

For in-process tool measurement at working conditions (spindle running at thermal stable conditions)

Separate type cooling unit including:

- Cartridge filter
- Paper filter
- Through spindle 20 bar centrifugal pump or...
- Through spindle 70 bar screw type pump with stepless programmable pressure
- Oil skimmer
- Coolant chiller

Recommended for high aluminum or cast iron material cutting

Spin window

For easier view of working area when huge amount of coolant and chips are produced

Customize the machine to your needs
Layout and workspace

Interference
### Technical data

#### Basic parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LINEAR AXES</strong></td>
<td></td>
</tr>
<tr>
<td>X travel (carriage left and right) mm</td>
<td>670</td>
</tr>
<tr>
<td>Y travel (gantry back and forth) mm</td>
<td>820</td>
</tr>
<tr>
<td>Z travel (headstock up and down) mm</td>
<td>600</td>
</tr>
<tr>
<td>Max feedrate X/Y/Z m/min</td>
<td>60</td>
</tr>
<tr>
<td><strong>WORKPIECE AND TABLE</strong></td>
<td></td>
</tr>
<tr>
<td>Max workpiece dia/height mm</td>
<td>920/500</td>
</tr>
<tr>
<td>Table size (diameter) mm</td>
<td>800</td>
</tr>
<tr>
<td>Maximum table load kg</td>
<td>1300</td>
</tr>
<tr>
<td><strong>ROTARY AXES</strong></td>
<td></td>
</tr>
<tr>
<td>A range (swivelling) deg</td>
<td>+/- 120</td>
</tr>
<tr>
<td>C (rotary) deg</td>
<td>360 (unlimited)</td>
</tr>
<tr>
<td>Maximum swivelling (A) speed rpm</td>
<td>80</td>
</tr>
<tr>
<td>Maximum rotary (C) speed rpm</td>
<td>100</td>
</tr>
<tr>
<td><strong>SPINDLE 15,000rpm</strong></td>
<td></td>
</tr>
<tr>
<td>Spindle taper:</td>
<td>HSK A63</td>
</tr>
<tr>
<td>Max Speed rpm</td>
<td>15000</td>
</tr>
<tr>
<td>Power S1/36-40% kW</td>
<td>27/39</td>
</tr>
<tr>
<td>Torque S1/36-40% Nm</td>
<td>130/187</td>
</tr>
<tr>
<td><strong>SPINDLE 20,000rpm</strong></td>
<td></td>
</tr>
<tr>
<td>Spindle taper:</td>
<td>HSK A63</td>
</tr>
<tr>
<td>Max Speed rpm</td>
<td>20000</td>
</tr>
<tr>
<td>Power S1/36-40% kW</td>
<td>25/35</td>
</tr>
<tr>
<td>Torque S1/36-40% Nm</td>
<td>86/130</td>
</tr>
<tr>
<td><strong>TOOL CHANGER</strong></td>
<td></td>
</tr>
<tr>
<td>Magazine positions</td>
<td>32/64</td>
</tr>
<tr>
<td>Maximum length mm</td>
<td>300</td>
</tr>
<tr>
<td>Maximum tool diameter (with adjacent pot empty) mm</td>
<td>75 (120)</td>
</tr>
<tr>
<td>Maximum tool weight kg</td>
<td>7</td>
</tr>
</tbody>
</table>

#### Construction details

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LINEAR AXES</strong></td>
<td></td>
</tr>
<tr>
<td>Linear guideways type</td>
<td>Roller type</td>
</tr>
<tr>
<td>Linear guideways size X/Y/Z</td>
<td>mm 55/45/45</td>
</tr>
<tr>
<td>Distance between X/Y/Z axis guides mm</td>
<td>598/1472</td>
</tr>
<tr>
<td>Ballscrew type</td>
<td>Double nut</td>
</tr>
<tr>
<td>Ballscrew diameter/pitch mm</td>
<td>45/20</td>
</tr>
<tr>
<td>X axis motor power/Torque kW/Nm</td>
<td>6/19.2</td>
</tr>
<tr>
<td>Y axis motor power/Torque (x2) kW/Nm</td>
<td>6/19.2 (x2)</td>
</tr>
<tr>
<td>Z axis motor power/Torque kW/Nm</td>
<td>9.9/31.5</td>
</tr>
<tr>
<td><strong>WORKPIECE AND TABLE</strong></td>
<td></td>
</tr>
<tr>
<td>Number of hydraulic ports</td>
<td>3</td>
</tr>
<tr>
<td>Working pressure of hydraulic ports bar</td>
<td>80</td>
</tr>
<tr>
<td>Number of pneumatic ports</td>
<td>3</td>
</tr>
<tr>
<td>Working pressure of pneumatic port bar</td>
<td>6</td>
</tr>
<tr>
<td><strong>ROTARY AXES</strong></td>
<td></td>
</tr>
<tr>
<td>Driving system in swivelling (A) axis</td>
<td>Dual torque motor</td>
</tr>
<tr>
<td>Power and torque of swivelling (A) axis kW/Nm</td>
<td>15.7/1870 x2</td>
</tr>
<tr>
<td>Power and torque of rotary (C) axis kW/Nm</td>
<td>15.7/1870</td>
</tr>
<tr>
<td>Brake type of swivelling (A) axis</td>
<td>Dual hydraulic</td>
</tr>
<tr>
<td>Braking torque of swivelling (A) axis Nm</td>
<td>3500 x2</td>
</tr>
<tr>
<td>Brake type of rotary (C) axis</td>
<td>kW</td>
</tr>
<tr>
<td>Braking torque of rotary (C) axis Nm</td>
<td>2500</td>
</tr>
<tr>
<td><strong>SPINDLE 15,000rpm</strong></td>
<td></td>
</tr>
<tr>
<td>Motor type</td>
<td>Synchronous</td>
</tr>
<tr>
<td>Bearing type front/rear</td>
<td>Angular ball</td>
</tr>
<tr>
<td>Bearing cooling and lubrication</td>
<td>Oil/Air</td>
</tr>
<tr>
<td><strong>SPINDLE 20,000rpm</strong></td>
<td></td>
</tr>
<tr>
<td>Motor type</td>
<td>Synchronous</td>
</tr>
<tr>
<td>Bearing type front/rear</td>
<td>Angular ball</td>
</tr>
<tr>
<td>Bearing cooling and lubrication</td>
<td>Oil/Air</td>
</tr>
<tr>
<td><strong>TOOL CHANGER</strong></td>
<td></td>
</tr>
<tr>
<td>Change type</td>
<td>Pick-up</td>
</tr>
<tr>
<td>Magazine type</td>
<td>Carrousel (x2)</td>
</tr>
<tr>
<td>Carrousel driving system</td>
<td>(2x) Servomotor and gearbox</td>
</tr>
<tr>
<td><strong>MEASURING FEEDBACK</strong></td>
<td></td>
</tr>
<tr>
<td>Linear axes type</td>
<td>Linear scales</td>
</tr>
<tr>
<td>Linear axes resolution</td>
<td>µm 0.001</td>
</tr>
<tr>
<td>Rotary axes type</td>
<td>Rotary scale</td>
</tr>
<tr>
<td>Rotary axes accuracy</td>
<td>+/- 5”</td>
</tr>
<tr>
<td><strong>EXTERNAL COOLANT SUPPLY</strong></td>
<td></td>
</tr>
<tr>
<td>External nozzles coolant supply (number) pressure bar 4x</td>
<td>3</td>
</tr>
<tr>
<td>External nozzles air supply (number) pressure bar 2x</td>
<td>6</td>
</tr>
<tr>
<td>Tank capacity l</td>
<td>425</td>
</tr>
<tr>
<td><strong>SPINDLE THROUGH COOLANT SUPPLY (STANDARD)</strong></td>
<td></td>
</tr>
<tr>
<td>High pressure pump</td>
<td>bar 20</td>
</tr>
<tr>
<td>Filter type</td>
<td>Cartridge</td>
</tr>
<tr>
<td><strong>SPINDLE THROUGH COOLANT SUPPLY WITH SEPARATE TANK (OPTIONAL)</strong></td>
<td></td>
</tr>
<tr>
<td>High pressure pump</td>
<td>bar 20</td>
</tr>
<tr>
<td>High pressure pump</td>
<td>bar 70</td>
</tr>
<tr>
<td>High pressure pump with stainless programmable pressure bar</td>
<td>0 - 70 stainless</td>
</tr>
<tr>
<td>Filter type</td>
<td>Cartridge and paper band</td>
</tr>
<tr>
<td>Additional tank capacity l</td>
<td>700</td>
</tr>
</tbody>
</table>