AXILE
agile smart machining

DC4i

DOUBLE-COLUMN TYPE 5-AXIS VERTICAL MACHINING CENTER

www.axilemachine.com

WE ARE AXILE

AXILE designs and builds agile smart 5-axis VMCs with leading automation solutions for manufacturers of complex parts and components.

“ We believe manufacturers shouldn’t have to choose between high-speed and high-performance 5-axis machines. ”

By combining sheer agility, digitalized intelligent automation, and a new standard of 5-axis machining, we’ve created an all-new approach:

Agile Smart Machining.

In short, our dedicated team of industry experts brings together ultra-high removal rates, pinpoint precision, and 24/7 automation and reliability within each and every AXILE 5-axis machine.

Our breakthrough design concepts and advanced proprietary technologies serve highly sophisticated manufacturers of complex parts and components for applications in aerospace, die and mold, medical, and general job shop, among others.

The AXILE service and support network spans nearly 50 countries, with more than 70 distributors across Asia, Europe, and the Americas, and a service center in Croatia, Canada, Germany, USA.

CONTENTS

DC4i DOUBLE-COLUMN TYPE VMC

The DC4i is a 5 axis masterpiece from AXILE with a 400 mm size table and a machine structure which results in the combination of speed, rigidity and accuracy.

The Double Column design is comparable to a Bridge type construction with the table assembly moving along the X axis.

DC4i design places the spindle nearer to the center of mass of the machine, increasing rigidity and offering superior stability. It reduces vibrations and maintains a high level of precision even during high-speed machining or when dealing with hard materials. This platform is perfect for application in aerospace, medical as well as die and mold industry.

DESIGN CONCEPT

THE STRUCTURE

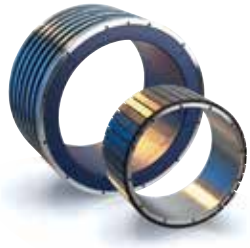
Bridge design	Same stability in all travels of X and Y axes Excellent accessibility to working area
All body made of high-quality casting	Homogeneous thermal behaviour Optimal damping of machining vibrations
Massive bridge supported on a one-piece base	Best linear-axis geometry and long-term stability
Integrated chip disposal channel directly under the table	Quick evacuation of chips for high chip volume machining

AGILITY

LINEAR AXES

Direct driven servomotors (no belts/gears)	Best dynamic and minimal elasticity in the driving system
Linear scales with 0,1 µm resolution in X, Y and Z axes	Ensures best accuracy for ALL axes
Roller type linear guideways	Best high-feed movement and vibration damping
Pre-loaded double-nut ballscrews	Minimized backlash allowing high-feed movements

SWIVELLING-ROTARY AXES

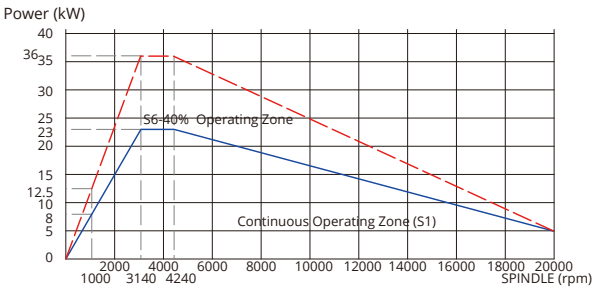


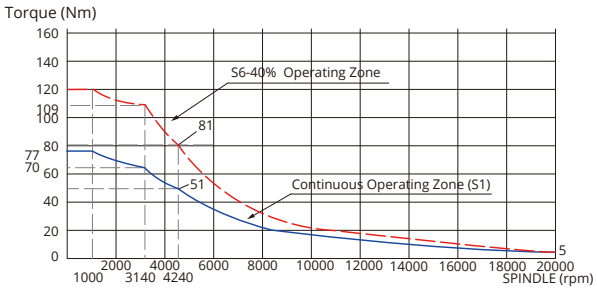
Integrated and ready-to-use hydraulic and pneumatic ports for the rotary C-axis table	Simplifying parts clamping process
Table: Torque motor-driven rotary axis (A/C)	Highest dynamics Highest accuracy
Hydraulic brake	High-stability in 4+1x operation when using the brakes
High-resolution, direct absolute rotary measuring system	Zero-backlash and high accuracy

SPINDLE

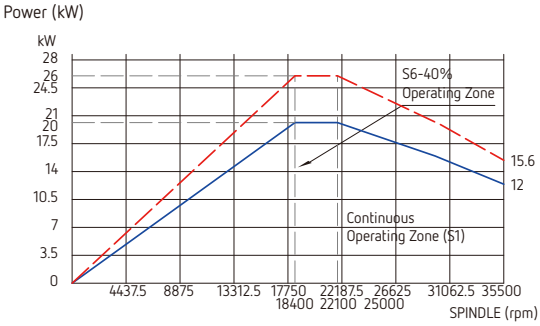
HIGH-PERFORMANCE BUILT-IN SPINDLE SELECTION

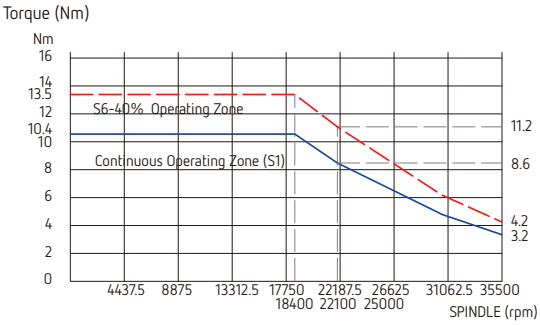
> 20.000 rpm (Reference: S brand)
> HSK A63
> 77/120 Nm S1/S6-40%
> Double coil asynchronous motor
> 23/36 kW S1/S6-40%





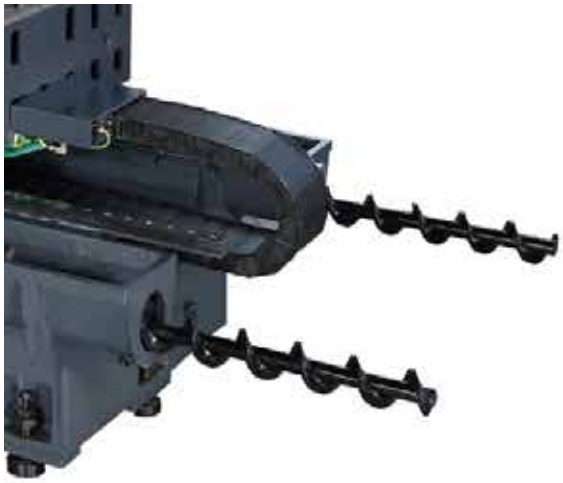
> 36.000 rpm (Reference: I brand)
> HSK E40
> 10.4/13.5 Nm S1/S6-40%
> Double coil asynchronous motor
> 20/26 kW S1/S6-40%





CHIP MANAGEMENT

EFFICIENT CHIP MANAGEMENT



There are two screw-type chip augers provided at both sides of the base

During cutting, the chips are delivered through chip augers to a chip conveyor for easy chip removal

Chip auger

Chip conveyor

4x coolant at spindle nose

Coolant through spindle

Air flushing

Chip wash down

TOOL MANAGEMENT

TOOL MAGAZINE SELECTION FOR EVERY APPLICATION

Chain type ATC HSK-A63 tool shank: 80 & 120 tools	Sister tools, complex parts and unmanned operation can be executed with no worries on the tool magazine capacity.
User-friendly tool accessibility	Tools can be easily changed during automatic operation in the same area for machining supervision, CNC panel and workpiece loading and unloading.
Smart tool: interface panel is used to select the tool. When finished, the system checks whether all tool HSK-A63 holders are in the right position	Avoid human failures when manually change tool to spindle, protecting spindle and reducing down-time.

ACCURACY

THE CORNERSTONE OF 5-AXIS MACHINING

Linear axes accuracy

Ballscrew's thermal growth	0.1µm resolution absolute linear scales in ALL axes

Rotary axes accuracy

Elasticity and backlash of driving system	Direct-driven torque motors with no backlash
Angular error is multiplied by the distance from rotary axis to machining point	+/- 4" 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

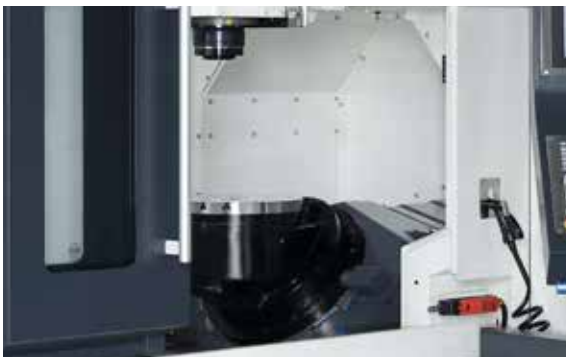
The swivelling-rotary table might shift its relative position to the 3 linear axes by many reasons generating an increasing error in the part	CNC embedded compensating functions like Kinematics (Heidenhain), Kinematic chain (Siemens) and Tilted working plane indexing (Fanuc)

ERGONOMICS

ACCESSIBILITY TO WORKING AREA

Integrated roof for overhead crane loading and unloading

Large front door opening	Comfortable access to working area for workpiece preparation and supervision
Integrated roof to open ceiling working area	Easy loading and unloading of heavy and bulky workpieces by over head crane



EASIER TOOLING MANAGEMENT AND MAINTENANCE

User-friendly tool accessibility	Tools can be easily changed during automatic operation in the same area for machining supervision, CNC panel and workpiece loading and unloading.
All necessary consumables are located together in the front of the machine	Easier routine maintenance for operator
Smart tool panel is used to select the tool and to check if all tool holders are in the right position when job is finished	Avoid human failures when manually change tool to spindle, protecting spindle and reducing down-time

EQUIPMENT

Details of a premium machine

High efficiency air conditioner

Electrical cabinet is maintained at stable temperature by using an air conditioner

Dual chip augers and chain type chip conveyor with coolant tank

U-type embedded in the table (for highest accuracy)

Tools are measured by an additional laser tool measurement, in different angles.

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

Automatic compensation of the 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.

Customize the machine to your needs

Cooling unit:
> CTS with 40 bar pump, paper filter and oil skimmert
> CTS with 70 bar pump, paper filter, oil skimmer and coolant chiller
> CTS with 70 bar pump, paper filter, oil skimmer, coolant chiller and programmable valve

Recommended for high aluminum or cast iron material

Spin window

Allows workers to easily check the working area

CONTROL UNIT

VARIOUS CHOICES FOR EVERY USER

Siemens SINUMERIK ONE

> Kinematics chain
> Collision Avoidance
> 5-axis transformation with tool orientation
> Swivel the Coordinate System

Fanuc 31i-B5 plus

> 3D Interference Check
> High Speed Smooth TCP
> Tilted Working Plane indexing

Siemens SINUMERIK ONE

Fanuc 31i-B5 plus

Heidenhain TNC 640 / TNC7

> Kinematics
> Dynamic Collision Monitoring
> Tool Center Point Management
> Tilted the Working Plane

Heidenhain TNC 640

Heidenhain TNC7

TECHNOLOGIES

SMT™

SMART MACHINING TECHNOLOGY

As pioneers of advanced mechatronic systems with decades of R&D expertise, AXILE has taken 5-axis CNC machining to the next level. Our patented SMT™ (Smart Machining Technology) delivers groundbreaking compensation and calibration functionality for unrivaled cutting speeds and industry-leading accuracy, and more importantly, resolves the aforementioned issues created by thermal expansion.

With AXILE's SMT™ manufacturers can have it all. There's no longer the need to choose between speed and precision, meaning manufacturers can produce superior parts rapidly, while also securing total process reliability and long-term machining performance.

Axial Accuracy Control

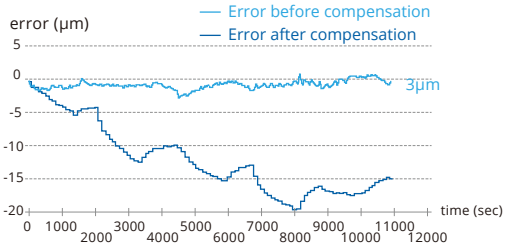
TEMPERATURE SENSORS → MULTIPLEXER /AMPLIFIER → MPU → CNC

compensation command

> **AXIAL THERMO MONITORING**
Integration of temperature sensors and thermal error model

> **HIGH PRECISION**
Thermal induced positioning error compensation

Thermal Error Before and After Compensation



With thermal compensation system, the thermal error van be reduced from 20μm to 3μm.

Tool-tip Positioning Control

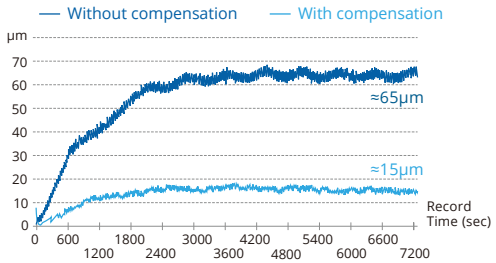
DISPLACEMENT METER → AMPLIFIER → MPU → CNC

compensation command

> **HIGH ACCURACY**
Directly measuring expansion

> **BETTER SURFACE FINISH**
5~6 times accuracy improved

> **REAL-TIME COMPENSATION**
Electrical type sensor



With compensation, the displacement of tool tip is reduced from 65μm to 15μm.

ACCURACY IMPROVED **5~6 TIMES!**

Spindle Vibration Supervision

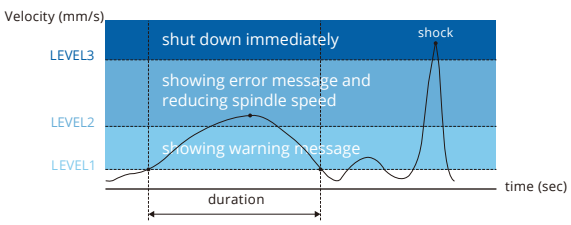
VIBRATION SENSOR → AMPLIFIER → MPU → CNC

compensation command

MPU ↕ MEMORY

> **HIGH FINISH QUALITY**
Spindle Life Time

Three Levels for Spindle Vibration Monitoring



> **LONGER LIFE TIME**
Wear reduction on spindle bearings and tools

> **EASY FOR MAINTENANCE**
Up to 12000 abnormal vibration data recording

ART™

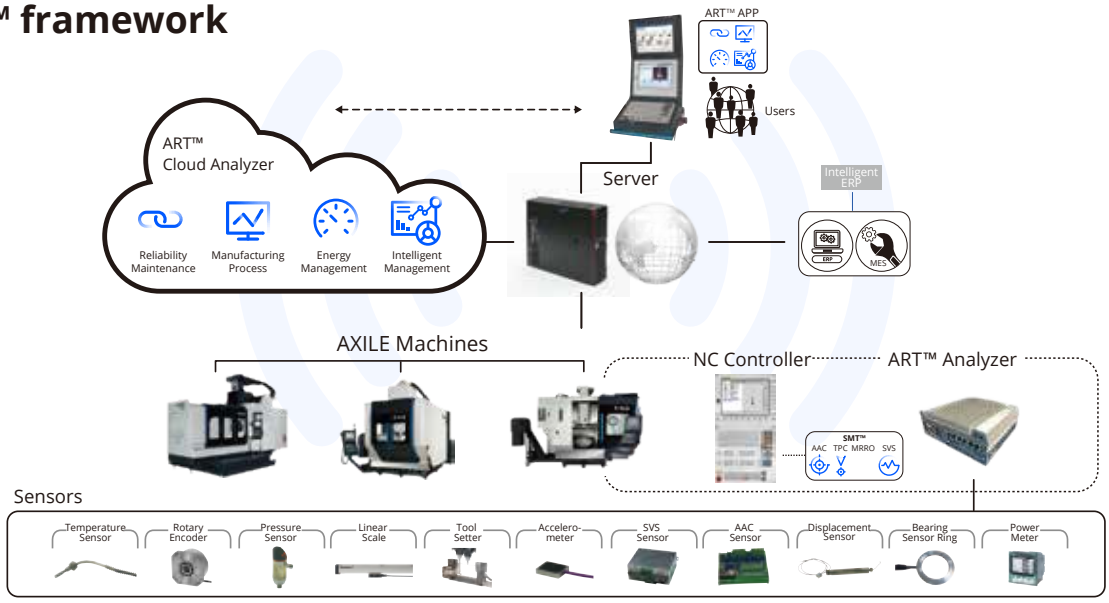
INTELLIGENT MONITORING SYSTEM

The future of manufacturing depends on intelligent automation. To gain an edge on the competition in the race to upgrade production, embracing and sustaining smart manufacturing is the best way to stay ahead of the curve.

To deliver agile smart machining and that all-important competitive edge, we have created an ART™ system that enables 24/7 automated production and allows operators to manage digitally, enabling them to plan and strategize through data analysis.

ART™ monitors all the wearing components, energy consumption, and fluids such as lubricant and coolant to supply real-time status updates on the machine and its components and to pre-empt future issues. AXILE's ART™ empowers manufacturers to make informed decisions, optimizing operations and greatly improving production efficiency. Now, that's how AXILE sees smart manufacturing in meeting the needs of sustainable business operations.

ART™ framework



The Core Functions to Boost Productivity & Profitability

Manufacturing Process (MP)

Unexpected downtime is the enemy of profitability. ART™ delivers machine components diagnosis, machine lifetime estimation, and consumable supplies monitoring to prevent machine failure and eliminate unplanned downtime.

Reliability Maintenance (RM)

Knowledge is power. ART™ achieves superior data collection and analytics on machine status and utilization rates, to deliver real-time information for optimized production strategies.

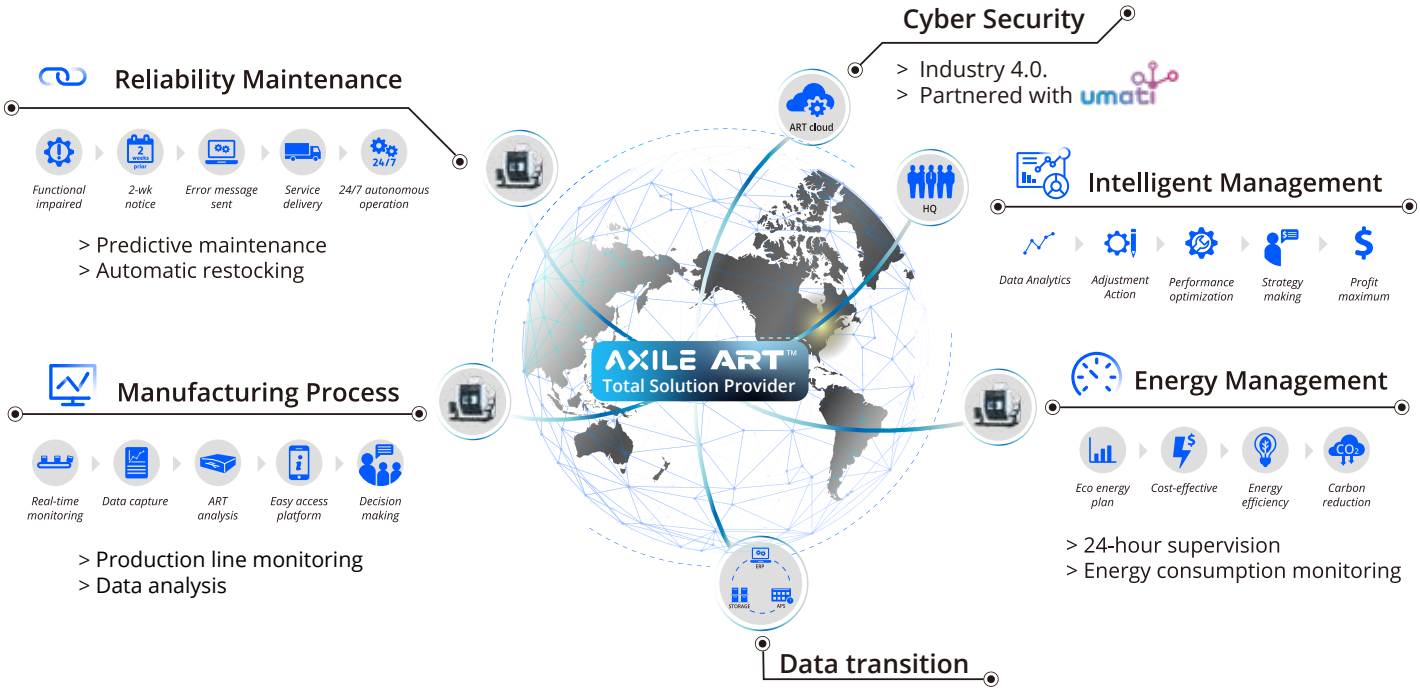
Energy Management (EM)

Every penny counts. ART™ enables manufacturers to monitor their power consumption, to identify ways to maximize energy efficiency and reduce expenditure.

Intelligent Management (IM)

ART™ provides analytic information for managers to understand the machine performance and take the immediate actions to optimize the machine capability.

Industry 4.0 Solutions to Intelligent Machine

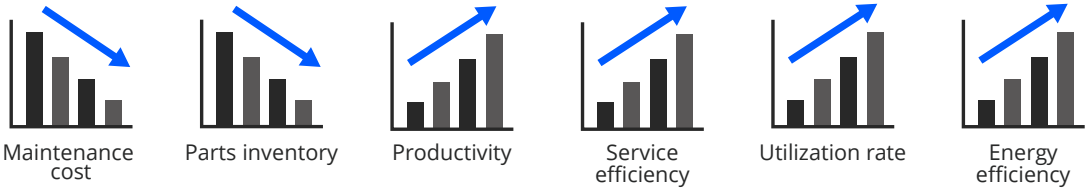


How ART™ Brings Production Benefits

> Clearly displays machine status, for quick decision-making
> Maximizes machine accessibility and utilization, for optimized production
> Optimizes machine performance, for high removal rates and longer machine lifetime
> Provides real-time notification of abnormal conditions, for swift intervention

How ART™ Brings Maintenance & Service Benefits

> Delivers pre-emptive error messages prior to breakdown, to eliminate unexpected downtime
> Decreases service expenses, by precisely identifying the issue
> Enhances service efficiency, by recommending appropriate action
> Reduces spare parts inventory, by highlighting exactly what is needed and when
> Automatically orders new parts, by linking to online purchasing system
> Allows machines and equipment to remain on stand-by, always ready to work



DC4i FLEX

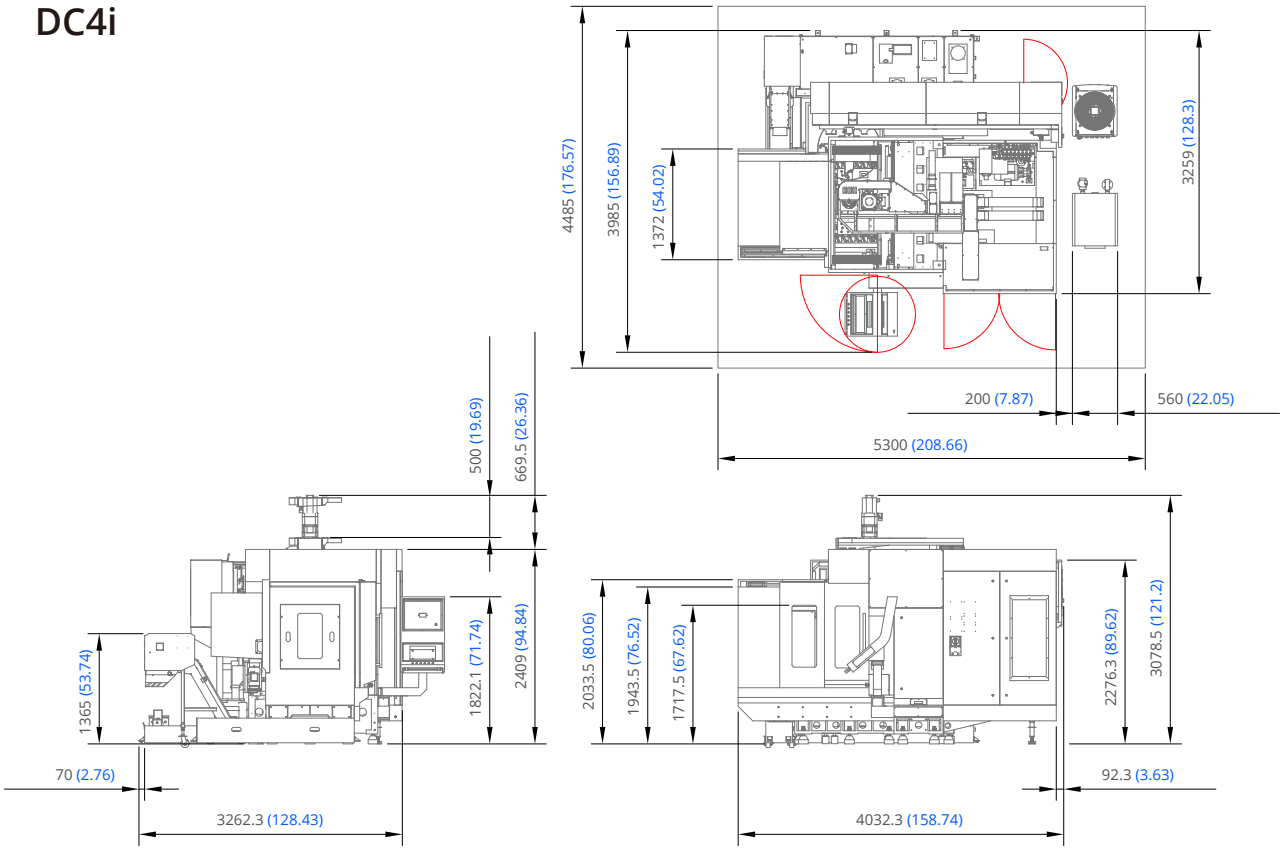
FLEX increases autonomy and flexibility

With DC4i FLEX, our customers can store up to 24 pallets while keeping operator access to machining area completely free to perform any type of settings.

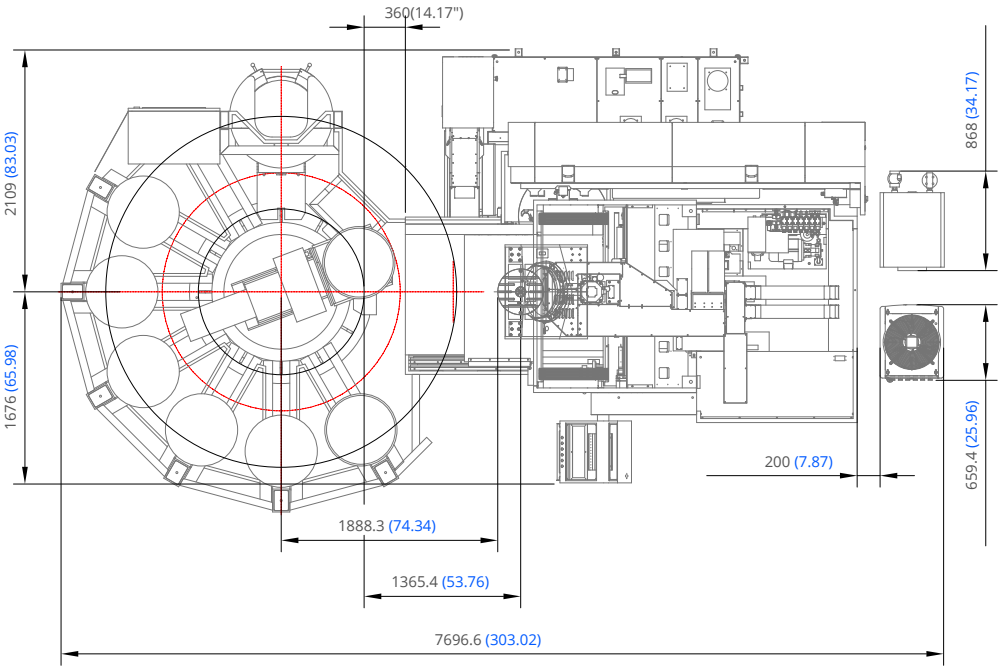
LAYOUT AND WORKSPACE

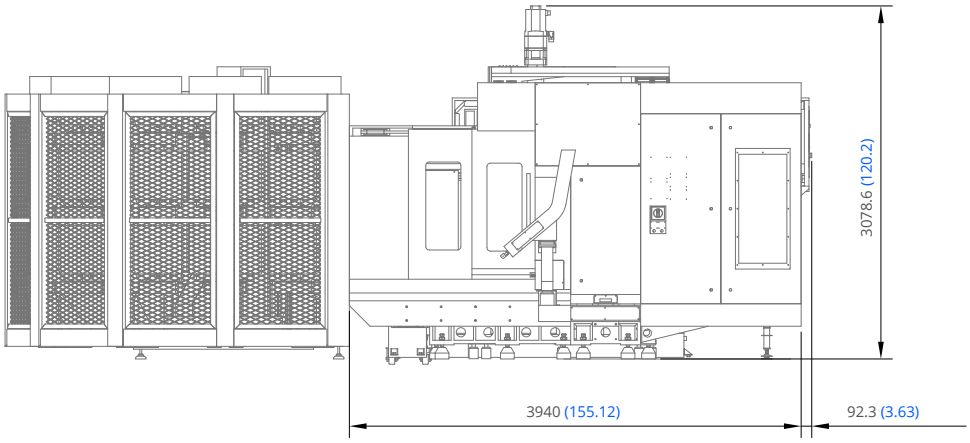
Metric
Inch

DC4i

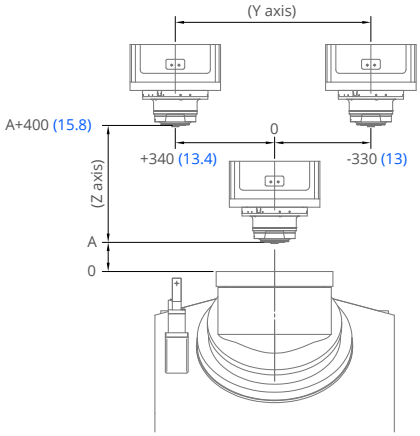


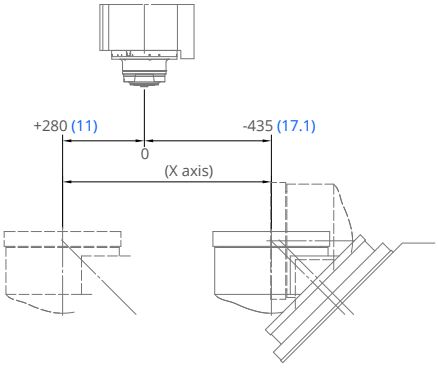
DC4i FLEX

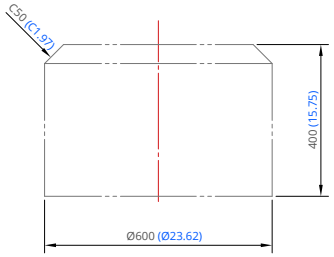




Interference







TECHNICAL DATA

COMMON DATA FOR DC4i

TABLE		
Table size	Ø400 mm	Ø 15.75 in
Maximun table load	300 kg	661.4 lb
Total number of hydraulic and pneumatic ports	4	
LINEAR AXES		
X travel	715 mm	28.15 in
Y travel	670 mm	26.38 in
Z travel	400 mm	15.75 in
Max feedrate X/Y/Z	36 m/min	1417 in/min
Guideways type	Roller	
Guideways size X/Y/Z	45 mm	1.77 in
ROTARY AXES		
Swiveling A axis-table	±180 deg	
Rotary axis C - Table	360 deg	
Max speed axis A	100 rpm	
Max speed axis C	200 rpm	
SPINDLE		
Spindle speed	20000 rpm	
Tool shank	HSK-A63	
Power S1/S6-40%	23/36 kW	31/48 hp
Torque S1/S6-40%	77/120Nm	56.8/88.5 Ft/lbs
MEASURING FEEDBACK		
Linear axes type	Linear scale on XYZ	
Linear axes resolution	0.1 µm	
Rotary axes type	Rotary	
Rotary axis accuracy	A axis: ±4" / C axis: ±8"	
ATC		
Tool shank	HSK-A63	
ATC type	Arm type	
Magazine positions	80T	
Maximum tool length	250 mm	9.84 in
Maximum tool diameter	Ø75 mm	Ø2.95 in
Maximum tool diameter (with adjacent pot empty)	Ø130 mm	Ø5.12 in
Maximum tool weight	8 kg	17.64 lb
Maximum loading weight	640 kg	1410.96 lb
ACCURACY (VDI/DGQ 3441)		
Positionning	0.005 mm	0.0002 in
Repeatability	0.005 mm	0.0002 in
AVAILABLE COOLANT THROUGH SPINDLE		
High pressure pump	40 / 70 bar	580.1 / 1015.2 psi
CONTROL UNIT		
Heidenhain	TNC 640 / TNC 7	
Siemens	Sinumerik one	
Fanuc	31i-B5 Plus	
DIMEMSION		
Length	4040 mm	159.06 in
Width	3300 mm	129.92 in
Height	3100 mm	122.05 in
Weight	12000 kg	26,455.47 lb
Floor Space	4040 x 3300 mm	159.06 x 129.92 in

** Specifications are subject to change without notice.*

AXILE MACHINE

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