

AMADA MACHINERY AMERICA, INC.



THE VISION OF PRECISION

# Optical Profile Grinders



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# Amada Machinery America



With more than 70 years of industry experience, Amada Machinery America is committed to helping our customers deliver dependable service and top-quality work with exceptional grinding solutions.

Whether you need profile, forming, surface, or rotary grinding, we have the right solution for your specific needs.

**Market-Leading Quality**—We believe quality work begins with quality tools designed and built from the ground up to deliver outstanding performance, time after time.

**Customer-Driven Innovation**—Every feature, function and configuration we offer has been developed to address the needs of our customers.

**Proven Accuracy**—We help you take your work to the next level and exceed your customers' expectations.

**Reliable Productivity**—We understand productivity is the heart of your business, and we can help you optimize it in multiple ways.

## A History of Cutting-Edge Manufacturing

Since we began building profile grinders back in the 1940s, our goals have always been to provide our customers with increased accuracy and productivity. Throughout our history, we've maintained our time-honored tradition of hand-fitting our grinders to deliver the ultimate in quality and precision.

And, as technology has evolved, we've embraced CNC automation as a core strength, improving throughput and helping new operators become productive more quickly.

Today, we are uniquely positioned to help you expand your capabilities and grow your business.

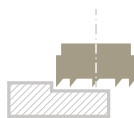
## Solutions Designed Around Customer Needs

No two manufacturing needs are exactly alike. Finding the right solution means thoroughly understanding your objectives and configuring a solution to match them precisely. Our engineers bring decades of industry experience to help you achieve your specified goals with a process that fits—and enhances—your workflow.

### TECHNOLOGIES OF AMADA



GRINDING



MILLING



SAWING

# Amada Grinding Technology



When the tightest tolerances and accurate repeatability matter, Amada is a world leader in optical profile grinding and high-precision surface and profile work. Suppliers to high-tech electronics and semiconductor manufacturers have trusted Amada grinders for years to deliver the flexibility, precision and productivity they need to stay ahead in a rapidly changing industry.

- Integrated measuring technology
- Award-winning innovation
- Maximum accuracy optimized through use of the most modern construction/design
- High speed for increased efficiency
- Integrated automation for higher efficiency
- Automatic swiveling grinding head during the grinding cycle
- External programming software to optimize part production
- Modular construction for versatile and economic specification

## Engineered to Perform

**Optimum Balance Supports High-Reciprocating Grinding**—As a pioneer in high-reciprocating grinding and processing, we have achieved a superb, dynamic balance between the machine and the grindstone to deliver superior performance with the widest range of work materials.

**High-Quality Grinding that Exceeds Specifications**—The accuracy of our grinding and processing work goes beyond simply measuring RZ to deliver mark-less and sharp-edge mirror finishes.

**Reliable, High-Rigidity Structure**—The form of the machine has been developed by advanced three-dimensional design and finalized through a comprehensive series of demonstration tests to create high-dimensional rigidity.

**Consistent Repeatability**—Through superior design and meticulous assembly practices, Amada grinders are engineered to account for thermal displacement, ensuring maximum accuracy throughout the working process.

**Advanced, Easy-to-Use CNC Software**—Every Amada grinder has dedicated software to allow your operators to take full advantage of each machine's capabilities.

**From Surface Grinding to Molding to Profile**—Amada's exclusive WAPS platform gives you complete control of all forming processes—rough, semi-finish, and finish processing. It also prepares charts for optical profile grinding and data for profile dressing.

**Original Measurement Technology on Equipment**—Save time and steps while ensuring maximum accuracy with built-in measurement technology.



#### GRINDING TECHNOLOGY

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## Optical Grinders

Amada's optical grinders have set new standards in machining high-precision components for tool and die, mold shops, and the industry in general. With an uncompromising approach to manufacturing standards and extensive engineering expertise, we have helped our customers expand their capabilities and improve their productivity.

# DV1

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## DV1 Digital Profile Grinder

Take your optical profile grinding to the next level with a compact, chartless, and fully automated third-generation profile grinder. Available with five-axis control (for superior surface finishing), the DV1 can also be specified with 16 pallet stations for automatically changing out workpieces and grinding wheels, giving you the ultimate in truly “hands-off” productivity in one compact, user-friendly package.



Ultra-Precision Shoulder Punches



CCD Camera System

## DV1 Features

**Compact, Fully Enclosed Design**—A full cover improves operational safety and environmental performance while still allowing easy access for operators.

**Four-Sided Grinding for Maximum Efficiency**—The CNC rotary table allows for full periphery processing with one chucking.

**Automatic Measurement and Compensation Processing**—The fully automated DV1 incorporates a state-of-the-art CCD camera system for automatic, on-machine measurement and compensation. That means improved precision and consistency on every job.

**Process Stability**—Through completely unmanned and chartless finish processing, variations in processing standards are remarkably reduced.

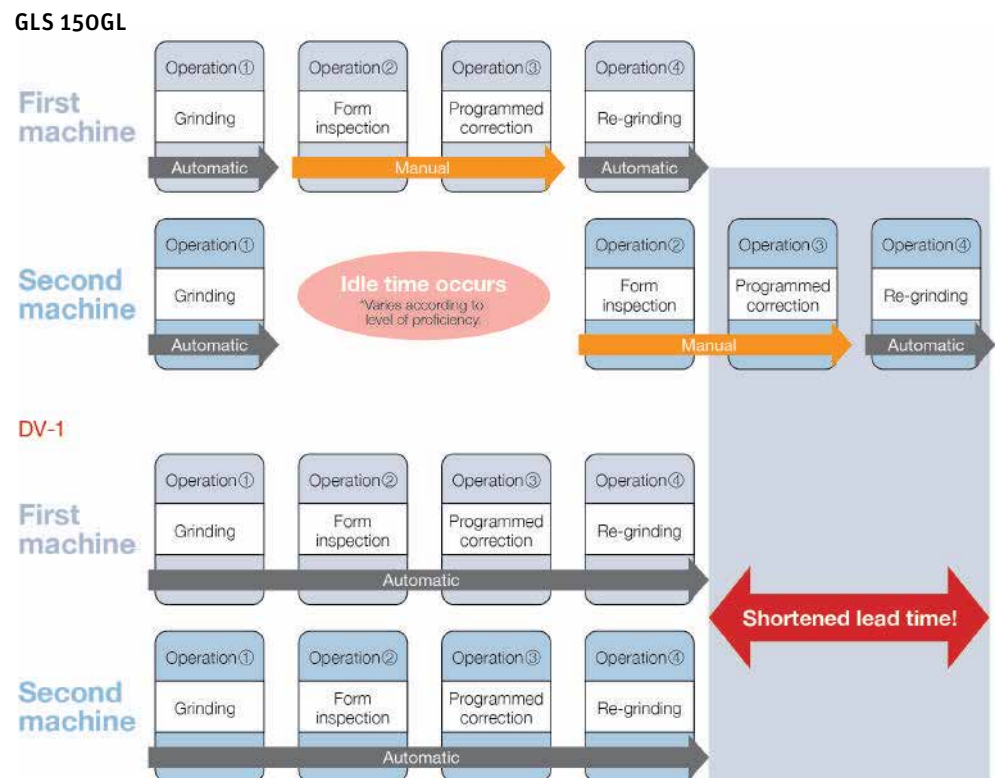
**Verify Very Small, Fine Shapes**—The automatic inspection system can qualify very small shapes of 1-degree angles or less, which cannot be easily measured with a projector.

**Ideally Suited for Precision Carbide Punch Grinding**—The DV1 can consistently deliver inside form tolerances of 0.0001".

**CCD Camera Automatic Instrumentation and Automatic Compensation Grinding System**—Optical resolution of 10x and monitor resolution of 350x is standard equipment on the DV1. With the proven CCD camera image processing technology, full automation is achieved throughout measurement and automatic program editing.

## Comparing Optical Grinding to Digital Grinding

If you use two machines for one worker, our optical profile grinder GLS 150GL requires manual form measurement and program correction, resulting in idle time for a machine. In contrast, the DV1 can perform this task automatically, resulting in shorter lead times and improved productivity.







## The Leader in Profile Grinding Goes Digital

Structural analysis, including 3D design, provides rigidity and compact design for the DV1. LCD displays and CCD cameras have replaced the traditional projection systems, and Mylar charts are replaced by CAD-based digital profiles. The net result is that program creation can now be based on actual digital data. Also, because the system is chartless, there's no need for a plotter. In addition, the original image teaching program function uses the CCD camera without a projector (as standard equipment), allowing for chartless instrumentation. This also allows the use of full-enclosure guards for high-performance design characteristics without any compromise in basic work efficiency.



CNC Rotary Table



Optional Full Automation Available



Operation Panel Screen

## Productivity Made Easy

### CNC Rotary Table Allows Four-Sided Grinding for Maximum Efficiency

—With a CNC rotary table as standard equipment, the DV1 is capable of full periphery processing with one chucking. Multiple wheel operations for roughing all sides of the workpiece can be completed—completely unattended—before changing the wheel for finishing.

**Easy-to-Use PC NC Interface**—The PC NC operation software, accessed through a 12-inch color touch panel, significantly improves operability. The new layout of the operation panel organizes the function for both ease of use and clarity. Optimum usability makes this powerful grinder technology a pleasure to operate.

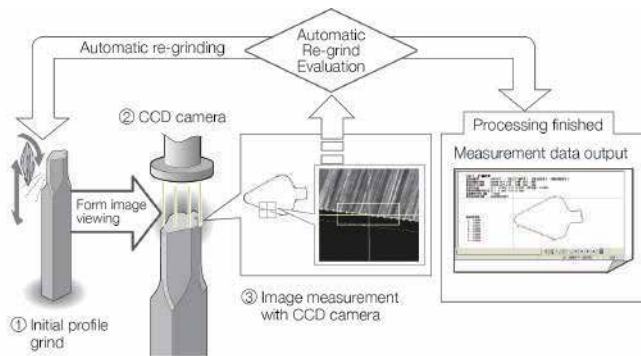
### Optional Full Automation Available—

With the addition of articulated robots for automated workpiece exchanges and wheel changes on the ATC spindle, the DV1 is capable of running completely unattended.

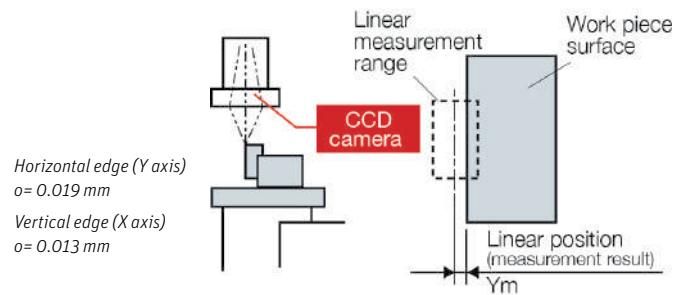
## Automation that Drives Accuracy

The implementation of CCD camera systems puts the DV1 in a new class of grinding technology.

- 1 Automatic measurement of workpiece form with automatic re-grinding ensures repeatable precision.

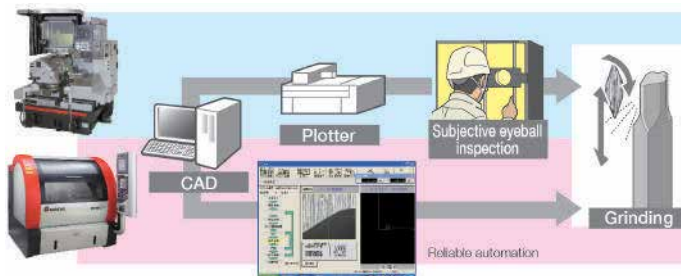


- 2 The DV1 can process ultra-small workpieces below an angle of 0.04" (1 mm), which is difficult to measure with a projector. In addition, the edge compensation function ensures consistency of inspection.

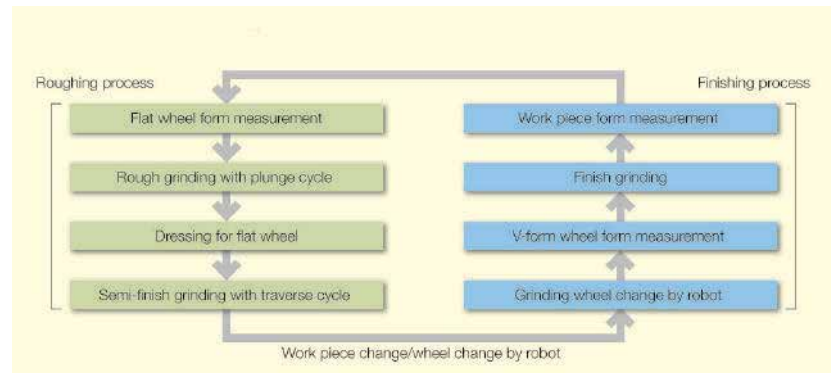


- 3 Automated CCD camera measurement eliminates subjective manual inspection, dramatically reducing variations in processing quality.

- 4 Measurement data can be output, providing documented part qualification.



- 5 Grinding wheel form measurement can be performed.



Full Automation for Roughing and Finishing Operations

## Fully Automated Part Production with Articulated Robot and Stocker

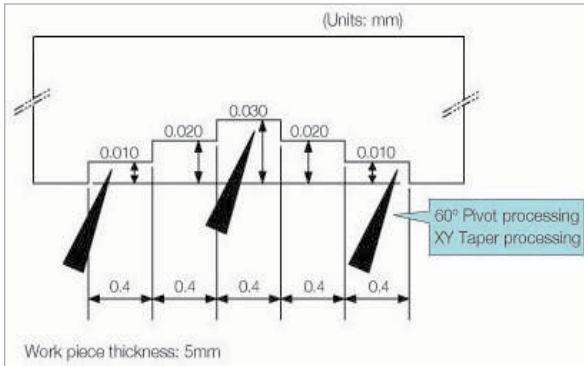
Through automatic wheel changing, rough and finish operations are seamless and can be conducted completely unattended. The ATC spindle automatically clamps the necessary wheels to fully process workpieces, unattended. Measurement software for flat (1A1) grinding wheels automatically qualifies the wheel width/position, and an integrated rotary dresser provides peripheral, side, and corner radius dressing in flat wheels for semi-finish operations. Rough plunge cycles speed throughput.



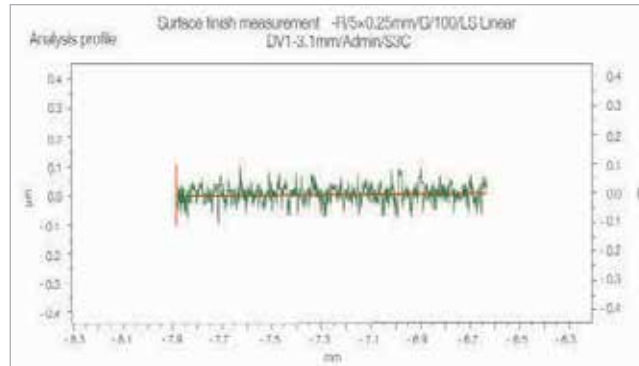
Five-Axis Controls For High-Quality Surface Finish

## Uncompromising Machine Design for High-Precision Form Processing

**Five-Axis Controls for High-Quality Surface Finish**—The DV1 employs a crank-motion elevating stand to achieve superior surface finish. The TC-20 spindle (developed by Amada for 20,000 RPM performance) supports high precision and high speed when creating small and medium shoulders. Integrated front and side clearance ensures angles that satisfy die specifications.



Grinding Step Profile



Surface Finish Measurement Data

## Precision in Part Processing

An ultra-hard workpiece 0.1" (2.5 mm) thick is precision-ground to within 1µm. Test piece is five steps of 10µm, as pictured, with grinding, measurement and compensated re-grind. A work surface finish of Rz0.16µm is achieved, showcasing the DV1's ability to produce "light" surface finishes.

### 10µm step grinding (5 steps) with automatic compensated re-grind

- Processing material: ultra-hard (G5 equivalent)
- Main spindle rotation speed: 12,000 RPM
- Reciprocation speed: 120 RPM
- Grinding wheel: TWD700R2
- Grindstone size: Ø3" x Ø0.87" (Ø75 x Ø22.23)
- Single V15°: R0.05

### Straight processing (X-axis shift)

- Processing material: ultra-hard (G5 equivalent)
- Main spindle rotation speed: 12,000 RPM
- Reciprocation speed: 100 RPM
- Depth of cut: 0.0002" (0.005 mm)
- Feed speed: 0.04"/min. (1.0 mm/min.)
- Measuring machine: surface finish measuring instrument (Taylor Hobson)
- Grinding wheel: TWD700R2
- Grindstone size: Ø3" x Ø0.87" (Ø75 x Ø22.23)
- Single V15°: R0.05
- Wheel dressing device: MRD-180 dress after ~10 min. grinding time
- Dressing time: 5 min. (finish only)

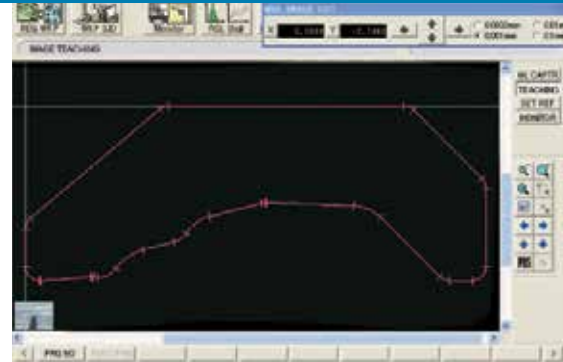


Image-Based Teach and Playback

## Custom Software and Craftsmanship in a Digital World

The new operation panel is designed for ease of use, and the control system allows intuitive navigation through all the powerful functions.

**FANUC Series 32i-B**—Five-axis control specification:

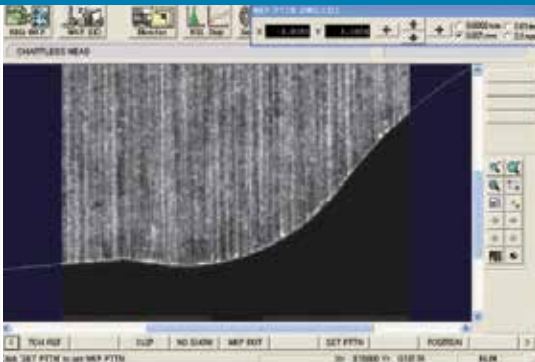
- Table X, Y
- Headstock up/down (W)
- Table up/down (Z)
- Workpiece pivot (B)



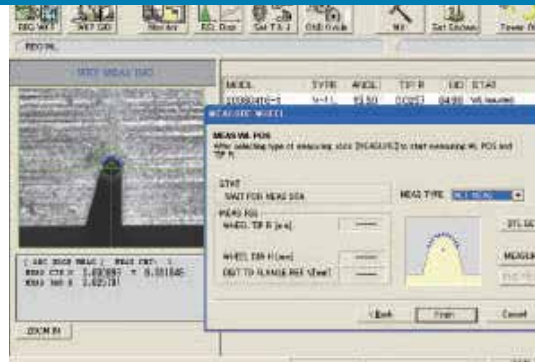
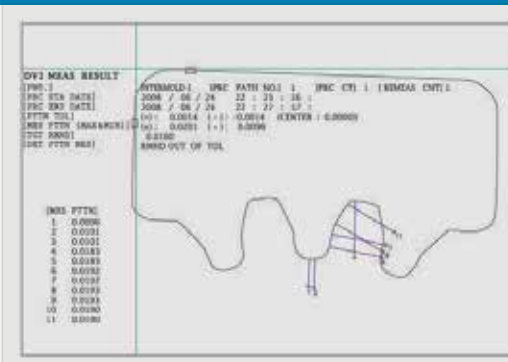
12-inch Color LCD Touch Panel (top)  
USB Port (above)  
Operation Panel (right)







Chartless Measurement

Automatic Workpiece Form Measurement/  
Compensation Processing

Grinding Wheel Position and Shape Measurement

## Software

The custom software on the DV1 is designed for maximum productivity.

### Image-Based Teach and Playback—

Image-based teach and playback software can create programs visually using monitor images of digital profiles, providing digital accuracy instead of projector-and-chart methods. Additionally, using digital profiles enables automatic measurement of the workpiece profile by measuring the CCD camera image of the workpiece against the actual digital image.

Image teaching provides an actual, wheel-based profile by capturing digital images of the wheel profile. Then the wheel image is used to “teach” the wheel path against the digital workpiece profile. Actual teaching is done by manipulating the handle.

### Chartless Measurement—CAD data (DXF)

is loaded and, based on the processing data, the position of the workpiece image is set. When the manual handle is turned, the workpiece image moves. Similarly, by moving the cursor on the NC screen, the workpiece image moves, and the software can determine the difference.

### Automatic Workpiece Form Measurement/Compensation Processing—

After the grind operation is finished, the standard position is confirmed and measurements are made to determine the deviation from the standard. This is done automatically—no operator intervention or programming is required.

At the time of measurement, multiple points are simultaneously inspected and large deviations from the standard are disregarded. The measured image area is as small as 0.019" (0.5 mm). In order to measure areas less than 1μm, the number of pixels and dots is set.

### Grinding Wheel Position and Shape Measurement—

The on-board dresser unit re-trues the leading edge radius of the grinding wheel. The shape of the grinding wheel is plunged into the dummy workpiece fixtured to the table. Through the dummy, the profile of the grindstone radius is measured at multiple points, and determined by CCM calculations. Taking measurements at multiple points minimizes errors. This procedure automatically qualifies both the wheel radius and wheel position, greatly facilitating the setup process.

## Machine Specifications

PROJECTOR	Screen size		12" LCD (CCD view range 0.5 x 0.4 mm)	
	Magnification		Optical magnification x10/monitor magnification x350	
	Lighting		Tapering lighting 150 W	
TABLE	Working surface		4.5" (Ø115 mm) (round table)	
	Distance from the table top to focus point		7.8" (200 mm)	
	Maximum loading weight		44 lb. (20 kg) (workpiece + fixture + chuck)	
	Linear axis	Travel	Traverse feed (X axis)	11.8" (300 mm)
			Cross feed (Y axis)	9.8" (250 mm)
			Vertical feed (Z axis)	3.1" (80 mm)
		Feedrate	Rapid traverse (G00)	XY: 78"/min, Z: 19.6"/min (XY: 2000 mm/min, Z: 500 mm/min)
			Linear interpolation (G01)	XY: 0.0004~39"/min (XY: 0.1~1000 mm/min, Z: 500 mm/min)
		Jog feed		XY: 78"/min (2000 mm/min), Z: 19.6"/min (500 mm/min)
		Minimum input increment		0.000010" (0.0001 mm)
		Position detection/ scale resolution	X and Y axes	Full-closed/0.05 µm
			Z axis	Semi-closed
	Rotary axis B	Travel		360°
		Feedrate	Rapid traverse (G00)	1000°/min
			Linear interpolation (G01)	0.1~1000°/min
		Jog feed		1000°/min
		Minimum input increment		(0.0001°)
		Position detection/scale resolution		Full-closed/±5°
WHEEL SPINDLE	Wheel size (outer diameter x width x hole diameter)		Ø2.5"~3.9" x 0.15"~0.25" x 0.875" (Ø65-100 x 4~6 x Ø22.23 mm)	
	Spindle nose		Ø1.0" (Ø25.4 mm) 1/4 taper	
	Spindle speed		2000~20000 min <sup>-1</sup> (TC-20)	
WHEEL HEAD	Reciprocating axis	Reciprocating slide stroke (W axis)		0 – 3.14" (0~80*1 mm)
		Drive system		Crank
		Reciprocation speed		1.18"~15.7" (30~400 mm) (in case of 10st)* <sup>2</sup>
	Relief angle	Travel	Radial relief angle (V axis)	-1~2° (manual operation)
			Axial relief angle (A axis)	±3° (manual operation)



<b>MOTOR</b>	Wheel spindle	2 HP~4P (1.5~4 kW·P) (TC-20)
	X/Y axes	1 HP (0.75 kW)
	Z axis	.67 HP (0.5 kW)
	B axis	.06 HP (0.05 kW)
	Reciprocating axis (W axis)	2.5 HP (1.8 kW)
	Automatic lubrication	4 W
<b>POWER CAPACITY</b>		13 kVA
<b>MACHINE SIZE (WIDTH X DEPTH X HEIGHT)</b>		64" x 93" x 67" (1630 x 2370 x 1717 mm)
<b>MACHINE WEIGHT</b>		8800 lb (4000 kg)

\*1 Length that can be processed will vary depending on the setting of relief angle.

\*2 There is limitation depending on the reciprocation stroke.

## NC Control Specifications

<b>CONTROL UNIT MODEL</b>		<b>FANUC SERIES 180i-MB</b>
<b>NUMBER OF CONTROL AXES</b>	5-axis control specification	Table X, Y; table vertical Z; reciprocation W; workpiece rotary B
<b>STANDARD FUNCTIONS</b>	12" color LCD (touch panel)	Manual reference return
	PC NC (O/S Windows XP)	Memory-type pitch error compensation
	CNC screen display function	Feedrate override 0 to 200%
	Wheel spindle infinitely variable-speed drive (inverter control)	Tape memory 40m (16kB)
	Simple S command (7-speed)	Registerable programs 63
	Reciprocation 20-speed (servo control)	Total tool offset pairs 32
	Circuit breaker (30mA)	Tool length compensation
	Auto power off	Rapid speed override
	AC100V outlet (2P-1 outlet)	Warm-up timer (daily timer)
	3 manual handles (5-spindle control specification: common to X axis, Y axis, Z/B axis)	Memory card I/O
<b>OPTIONAL FUNCTIONS</b>	Handle magnification ratio Off, x1, x10, x100	Table setup function
	Additional memory (80, 160, 320, 640, 1280m)	Run hour and parts count display
	Additional registerable programs (125, 200, 400)	Cycle time stamp function
	Additional tool offset pairs (64, 99, 200, 400)	Automatic corner override
	Weekly timer	
	I/O interface	
	LAN connection (additional Ethernet function/connector for the PC part) *3	

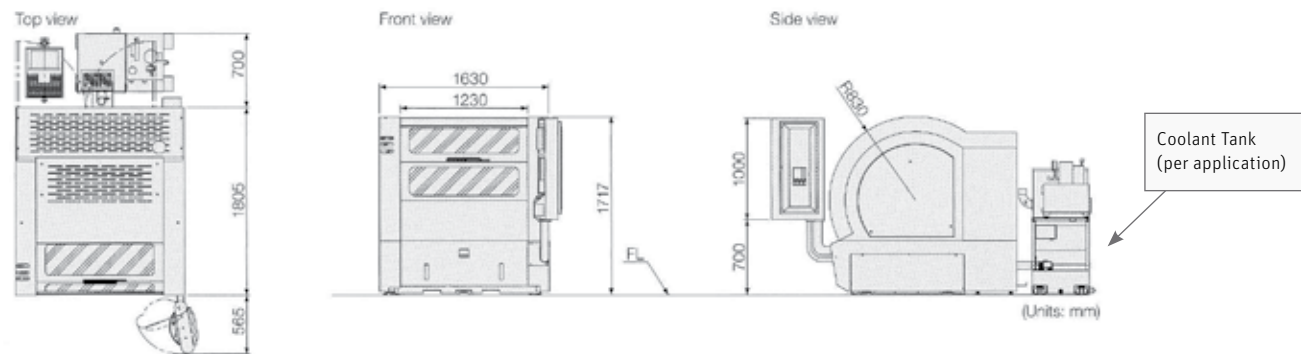
\*3 Device for LAN connection is added. The network connection for the PC part should be set by customer.

## Software

DV1 SOFTWARE (APPLICATION FOR PC)		CONVERSATIONAL MICROSOFTWARE, ETC.
STANDARD FUNCTIONS	Image teaching playback	Wheel data recording function
	Chartless measurement	Fixture recording function
	Processing simulation display	Simple S command (7-speed)
	Workpiece standard measurement	Warm-up setting
	Processing actual performance display	
	Wheel position measurement (wheel transcription form measurement)	
	Automatic workpiece form measurement/correction processing software	
OPTIONAL FUNCTIONS	Rough grinding cycle	Taper interpolation
	R-forming dress software	Simple circular interpolation
	Outside auto programming software ASSIST DV*4	Repeat cycle
		Run hour display function

\*4 Not compatible with WAPS WIN.

## Floor Layout DV1 Stand-Alone Specification



## Multi-Axis Robot Stoker Specification

ROBOT	Robot	Manufacturer: FANUC	
	Number of controlled axes	6 axes	
	Maximum travel	35" (892 mm)	
	Maximum delivery weight	11 lb (5 kg)	Including robot hand
	Machine weight	63 lb (29 kg)	
STOCKER	Maximum number of stocked pallets	12 pieces	4 pallet x 3
	Maximum number of stocked wheel flanges	4 pieces	4 tools x 1
	Maximum workpiece size	4.5" x 3.5" (Ø115 mm x 90 mm) from pallet top surface	Pallet diameter 3.14" (Ø80 mm) is available
	Maximum wheel size	Ø2.9"~3.3" x 0.15"~0.23" (Ø75 mm~85 mm x 4 mm to 6 mm)	