DETAIL SPECIFICATIONS

for

VERTICAL CENTER NEXUS

(VCN) Compact 12k/20k

NC: MATRIX NEXUS

(VCN) Compact 5X

NC: MATRIX (ONLY 5X)

Specifications No. : C591DA0010E

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◆ Original version

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		Manager		Group leader	
				Team leader	
		Team leader		Prepared by	

◆ Version history

Revised month	Specification No.	Revised page(s)	Prepared by

CONTENTS

1 INTRODUCTION

Mazak VERTICAL CENTER NEXUS Compact Series is a C frame type vertical machining center for both economical and quality machining, developed to achieve higher productivity and meet diversified products.

1. Features of VCN Compact Series

(1) The spindle motor for each of VCN Compact employs a high-power AC motor having output of 18.5 kW (5-min. rating). The standard spindle speed range is 40 to 12000 min^{-1}. A variety of materials such as aluminum, cast iron and steel can be handled, allowing high-speed precision machining and heavy-duty cutting.

(2) The rapid traverse rate for each of the X-, Y- and Z-axes of VCN Compact is as high as 36 m/min (1417 IPM).

(3) The standard magazine can store up to 20 tools. The ATC unit driven by a high-performance servomotor and equipped with roller gear cams facilitates smooth tool change. Tools are selected in the MAZATROL Memory Random mode.

(4) The valves and lubrication ports are centralized and arranged at one place to improve the maintainability.

(5) The NC unit, power control cabinet and the like are integrated into the machine body to save a space.

(6) In order to have high universality, the VCN Compact 5x has a high-accuracy tilting rotary table and a 6th generation CNC device MAZATROL MATRIX to have a standard function of simultaneously controlled 5-axis machining. As the tilting rotary table is removable, the machine can also be used as a normal 3-axis vertical machining center.

(7) With the VCN Compact 5x, excellent high-accuracy machining functions including the intelligent functions that are highly acclaimed on the current models have been improved in the following respects to give a high-accuracy machine with high cost performance.

- Compared to the MAZAK standard accuracy (1/2 x ISO specified tolerance), the VCN Compact 5x guarantees an accuracy of 1/4 x ISO specified tolerance.

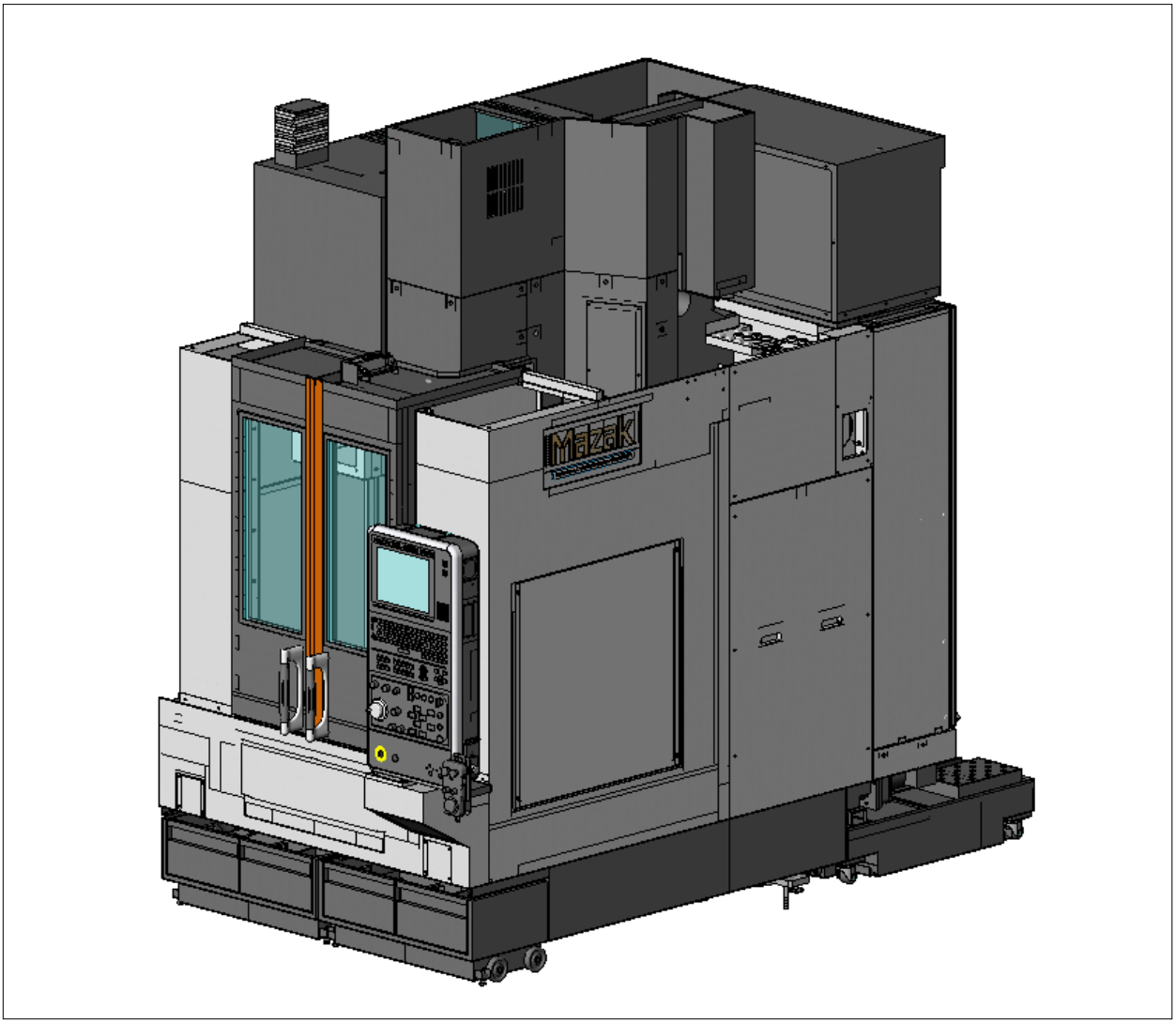
(8) The use of the setup mode makes setting up work easier. (Refer to 9-2-4.)

(9) The Z-axis pull-up function available as a standard function with the VCN series notifies the servo amplifier of the power failure signal immediately on occurrence of a power failure and raises the spindle above the face being machined to protect the workpiece from damage due to falling of the spindle.

(10) Since the absolute position detection function is adopted, zero-point return operation is not required after turning the power on.

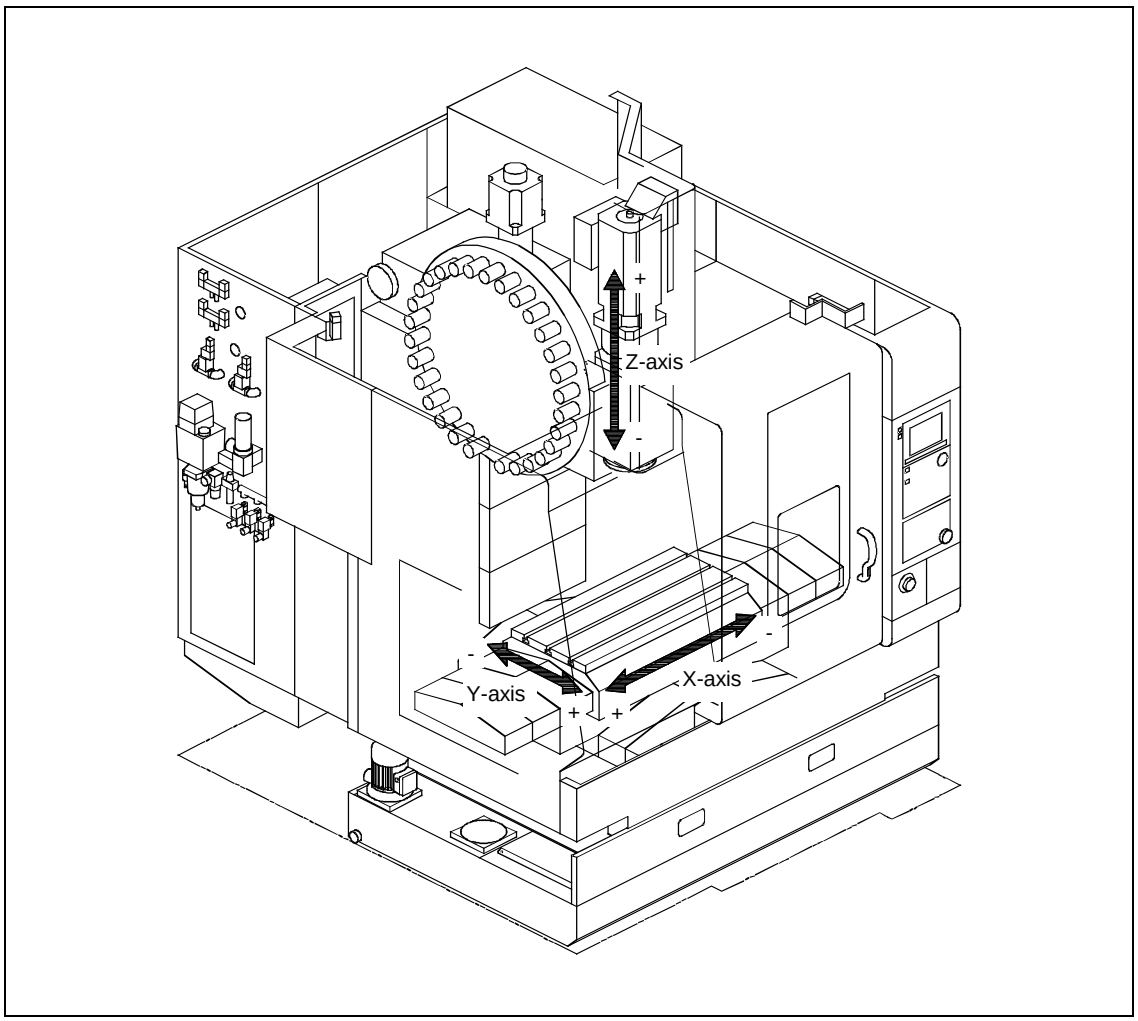
2 CONFIGURATION

2-1 Machine View

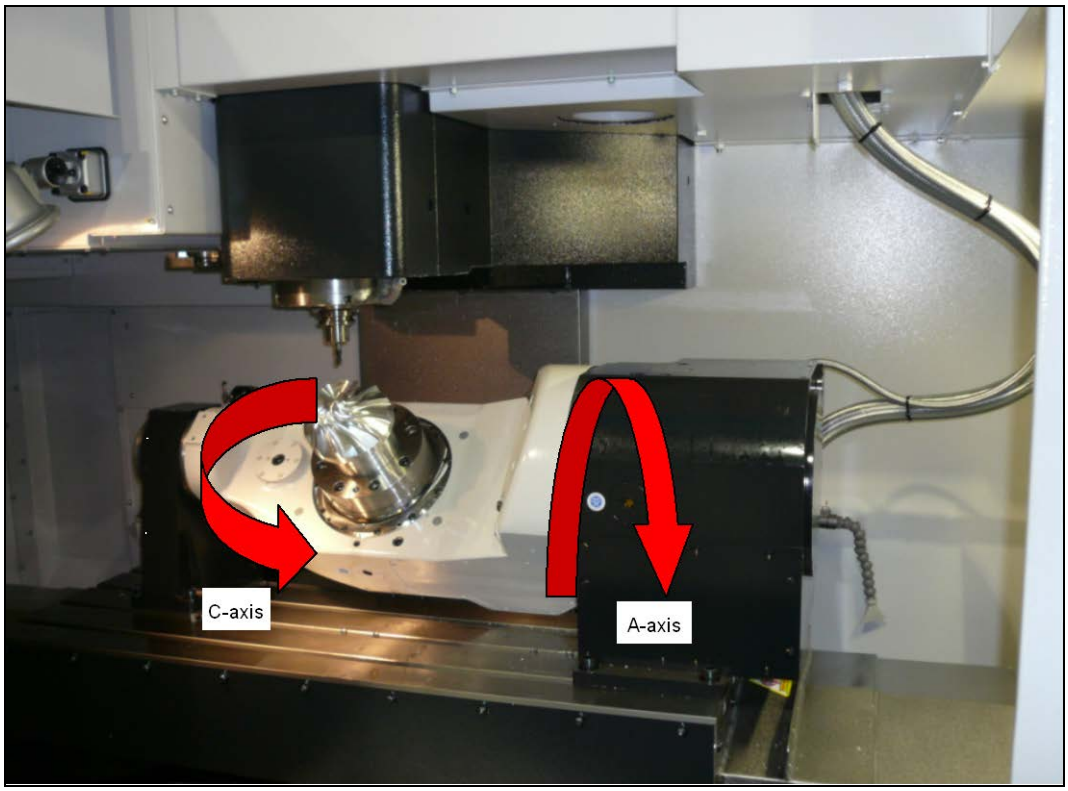


2-2 Axis Coordinate Systems

1. VCN Compact



2. VCN Compact 5x



3 SPECIFICATIONS

3-1 Mechanical Systems

3-1-1 Standard machine

1. VCN Compact

Item				Unit	VCN Compact (12000 rpm)
Ability, capacity	Machine table size		Right/left	mm (in)	650 (25.59)
			Longitudinal	mm (in)	400 (15.75)
	Table: Right/left travel amount		X-axis	mm (in)	500 (19.69)
	Saddle: Back/forth travel amount		Y-axis	mm (in)	430 (16.93)
	Spindlehead: Up & down travel amount		Z-axis	mm (in)	510 (20.08)
	From spindle end to tabletop		Min.	mm (in)	150 (5.91)
			Max.	mm (in)	660 (25.98)
	From spindle center to column front			mm (in)	450 (17.72)
	Max. load on table (equally distributed)			kg (lbs)	300 (661)
Spindle	Spindle taper bore			-	7/24 taper No. 40
	Standard	Spindle speed		min^{-1}	40-12000 (Electrically shifted in two)
		Main motor (AC inverter motor)	5 min. rating	kW	18.5
			10 min. rating	kW	15
			30 min. rating	kW	11
			Cont. rating	kW	7.5
Feed rate	Rapid traverse rate			mm/min (IPM)	36000 (1417)
	Cutting feed rate			mm/min (IPM)	1-8000 (0.039-315)
					1-3600 (0.039-141.73) (for MAZACC-2D and 3D)
Table	Machine table size		Right/left	mm (in)	650 (25.59)
			Depth	mm (in)	400 (15.75)
	T-slot	Nominal size (ISO R299)		mm (in)	18 (0.71)
		No. of slots		slots	3
		Slot pitch		mm (in)	125 (4.92)
	Max. load on table			kg (lbs)	300 (661)
	From machine underside to tabletop			mm (in)	780 (30.71)
ATC & tool magazine	Magazine capacity		Standard	tools	20
	Tool selection method			-	Automatic random access to the magazine pocket numbers in the shortest pass
	Tool shank			-	MAS BT-40
	Max. tool diameter	When adjacent tool exists		mm (in)	ϕ80 (3.15)
		When no adjacent tool exists		mm (in)	ϕ125 (4.92)
	Max. tool mass (Tool shank & pull stud included)			kg (lbs)	8 (17.64)
	Max. storable mass in whole magazine		Standard	kg (lbs)	120 (264.55)
	Max. tool length (from gauge line)			mm (in)	190.5 (7.5)
	Tool change time (chip to chip)			s	2.9 (1000 min^{-1})
				s	5.8 (12000 min^{-1})

Item				Unit	VCN Compact (12000 rpm)
Accuracy	Positioning accuracy in both directions		X, Y, Z	mm (in)	0.012 (0.00047)
	Repeatability in both directions		X, Y, Z	mm (in)	0.008 (0.00031)
Tank capacity	Spindle lubrication tank capacity			L (ft^3)	1.8 (0.06)
	Feed system lubrication grease tank capacity			cm^3 (in^3)	260 (15.87)
	Spindle cooling oil tank capacity			L (ft^3)	16 (0.57)
	Hydraulic unit tank capacity			cm^3 (in^3)	460 (28.07)
	Coolant tank capacity (Standard spec.)			L (ft^3)	200 (7.06)
Machine size	Machine dimensions (Standard spec.)	Height from floor level		mm (in)	2550 (107.09)
		Width		mm (in)	1500(59.06)
		Depth		mm (in)	2580 (101.57)
	Mass of machine without coolant tank (Standard specification)			kg (lbs)	4800 (10580)
Power	Voltage (3-phase)			V	AC 200/220/230/240 ±10% AC 380/400/415/440 ±10% AC 460/480 ±10%
	Frequency			Hz	50/60 ± 1
	Power capacity (Standard spec.)	5 min. rating		kVA	38.07
		10 min. rating		kVA	33.09
		30 min. rating		kVA	27.39
		Cont. rating		kVA	22.41
Air source	Pressure			MPa (psi)	Over 0.5 (70) and under 0.9 (130)
	Capacity (Standard spec.)			L (ft^3)/min (ANR) [ft^3/min (ANR)]	200 (7.06)

Noise level during operation (at operator's position) 76 dBA

Machine operation conditions

Cutting tool	Face mill (ϕ80 mm (3.15 in))	Spindle speed	: 1193 min^{-1}
Workpiece material	: S45C	Feedrate	: 2792 mm/min (109.92 IPM)
Coolant	: Without coolant	Width of cut	: 60 mm (2.36 in)
Spindle load	: 50%	Depth of cut	: 1.0 mm (0.039 in)

2. VCN Compact

Item				Unit	VCN Compact (20000 rpm)
Ability, capacity	Machine table size		Right/left	mm (in)	650 (25.59)
			Depth	mm (in)	400 (15.75)
	Table: Right/left travel amount		X-axis	mm (in)	500 (19.69)
	Saddle: Back/forth travel amount		Y-axis	mm (in)	430 (16.93)
	Spindlehead: Up & down travel amount		Z-axis	mm (in)	510 (20.08)
	From spindle end to tabletop		Min.	mm (in)	150 (5.91)
			Max.	mm (in)	660 (25.98)
	From spindle center to column front			mm (in)	450 (17.72)
	Max. load on table (equally distributed)			kg (lbs)	300 (661)
Spindle	Spindle taper bore			-	7/24 taper No. 40
	Standard	Spindle speed		min^{-1}	35-20000 (Electrically shifted in two)
		Main motor (AC inverter motor)	15 min. rating	kW	30
			Cont. rating	kW	22
Feedrate	Rapid traverse rate			mm/min (IPM)	52000 (2047)
	Cutting feed rate			mm/min (IPM)	1-52000 (0.039- 2047)
Table	Machine table size		Right/left	mm (in)	650 (25.59)
			Depth	mm (in)	400 (15.75)
	T-slot	Nominal size (ISO R299)		mm (in)	18 (0.71)
		No. of slots		slots	3
		Slot pitch		mm (in)	125 (4.92)
	Max. load on table			kg (lbs)	300 (661)
	From machine underside to tabletop			mm (in)	780 (30.71)
ATC & tool magazine	Magazine capacity		Standard	tools	20
	Tool selection method			-	Automatic random access to the magazine pocket numbers in the shortest pass
	Tool shank			-	MAS BT-40
	Max. tool diameter	When adjacent tool exists		mm (in)	ϕ80 (3.15)
		When no adjacent tool exists		mm (in)	ϕ125 (4.92)
	Max. tool mass (Tool shank + pull stud included)			kg (lbs)	8 (17.64)
	Max. storable mass in whole magazine		Standard	kg (lbs)	120 (264.55)
	Max. tool length (from gauge line)			mm (in)	190.5 (7.5)
	Tool change time (chip to chip)			s	4.5 ($15000\ min^{-1}$)
				s	5.2 ($20000\ min^{-1}$)
Accuracy	Positioning accuracy in both directions		X, Y, Z	mm (in)	0.012 (0.00047)
	Repeatability in both directions		X, Y, Z	mm (in)	0.008 (0.00031)
Tank capacity	Spindle lubrication tank capacity			L (ft^3)	1.8 (0.06)
	Feed system lubrication grease tank capacity			cm^3 (in^3)	260 (15.87)
	Spindle cooling oil tank capacity			L (ft^3)	72 (2.54)
	Hydraulic unit tank capacity			cm^3 (in^3)	460 (28.07)
	Coolant tank capacity (Standard spec.)			L (ft^3)	200 (7.06)

Item				Unit	VCN Compact (20000 rpm)
Machine size	Machine dimensions (Standard spec.)	Height from floor level		mm (in)	2550 (107.09)
		Width		mm (in)	1500(59.06)
		Depth		mm (in)	2580 (101.57)
	Mass of machine without coolant tank (Standard specification)			kg (lbs)	4800 (10580)
Power	Voltage (3-phase)			V	AC 200/220/230/240 ±10% AC 380/400/415/440 ±10% AC 460/480 ±10%
	Frequency			Hz	50/60 ± 1
	Power capacity (Standard spec.)		15 min. rating	kVA	57.6
			Cont. rating	kVA	46.4
Air source	Pressure			MPa (psi)	Over 0.5 (70) and under 0.9 (130)
	Capacity (Standard spec.)			L (ft^3)/min (ANR) [ft^3/min (ANR)]	300 (10.59)
Noise level during operation (at operator's position) 79.4 dBA					
Machine operation conditions					
Cutting tool	Face mill (ϕ80 mm (3.15 in))		Spindle speed	: 1500 min^{-1}	
Workpiece material	: S45C		Feedrate	: 2510 mm/min (98.82 IPM)	
Coolant	: Without coolant		Width of cut	: 60 mm (2.36 in)	
Spindle load	: 50%		Depth of cut	: 1.0 mm (0.039 in)	

3. VCN Compact 5x

Item				Unit	RT080	RT100
Ability, capacity	Tilting rotary table size		Pallet diameter	mm	ϕ80	ϕ100
	Machine table size		Right/left	mm (in)	403 (15.86)	475(18.70)
			Depth	mm (in)	215 (8.46)	257(10.12)
	Machine table: Right/left travel amount		X-axis	mm (in)	500 (19.69)	
	Saddle: Back/forth travel amount		Y-axis	mm (in)	430 (16.93)	
	Spindlehead: Up & down travel amount		Z-axis	mm (in)	510 (20.08)	
	Tilting rotary table travel amount		A-axis	°	+20~-120	
			C-axis	°	± 360	
	From spindle end to tabletop		Minimum	mm (in)	150 (5.91)	
			Maximum	mm (in)	660 (25.98)	
	From spindle center to column front			mm (in)	450 (17.72)	
	Maximum load on tilting rotary table (evenly distributed)			kg (lbs)	10 (22.03)	30(66.15)
	Maximum load on machine table (evenly distributed)			kg (lbs)	300 (661)	
Spindle	Spindle taper hole			-	7/24 taper No. 40	
	Standard	Spindle speed		min^{-1}	40-12000 (Electrically shifted in two)	
		Main motor (AC inverter motor)	5-min rating	kW	18.5	
			10-min rating	kW	15	
			30-min rating	kW	11	
			Cont. rating	kW	7.5	

Item				Unit	RT080	RT100
Feed rate	Rapid traverse rate		X, Y, Z	mm/min (IPM)	36000	
			A-axis	min^{-1}	40	
			C-axis	min^{-1}	50	
	Cutting feed rate			mm/min (IPM)	1-8000 (0.039-315)	
					1-3600 (0.039-141.73) (for MAZACC-2D and 3D)	
table	Machine table size		Right/left	mm (in)	650 (25.59)	
			Depth	mm (in)	400 (15.75)	
	T-slot	Nominal size (ISO R299)		mm (in)	18 (0.71)	
		No. of slots		slots	3	
		Slot pitch		mm (in)	125 (4.92)	
	Max. load on table			kg (lbs)	300 (661)	
	From machine underside to tabletop			mm (in)	780 (30.71)	
ATC & tool magazine	Magazine capacity		Standard	tools	20	
	Tool selection method			-	Automatic random access to the magazine pocket numbers in the shortest pass	
	Tool shank			-	MAS BT-40	
	Max. tool diameter	When adjacent tool exists		mm (in)	ϕ80 (3.15)	
		When no adjacent tool exists		mm (in)	ϕ125 (4.92)	
	Max. tool mass (Tool shank + pull stud included)			kg (lbs)	8 (17.64)	
	Max. storable mass in whole magazine		Standard	kg (lbs)	120 (264.6)	
	Max. tool length (from gauge line)			mm (in)	350 (13.78)	
	Tool change time (chip to chip)			s	2.9 (1000 min^{-1})	
				s	5.8 (12000 min^{-1})	
Accuracy	Positioning accuracy in both directions		X, Y, Z	mm (in)	0.012 (0.00047)	
	Repeatability in both directions		X, Y, Z	mm (in)	0.008 (0.0003)	
Tank capacity	Spindle lubrication tank capacity			L (ft^3)	1.8 (0.06)	
	Feed system lubrication grease tank capacity			cm^3 (in^3)	260 (15.87)	
	Spindle cooling oil tank capacity			L (ft^3)	16 (0.57)	
	Hydraulic unit tank capacity			cm^3 (in^3)	460 (28.07)	
	Coolant tank capacity (Standard spec.)			L (ft^3)	250 (8.83)	
Machine size	Machine dimensions (Standard spec.)	Height from floor level		mm (in)	2550 (107.09)	
		Width		mm (in)	1500(59.06)	
		Depth		mm (in)	2580 (101.57)	
	Mass of machine without coolant tank (Standard spec.)			kg (lbs)	4800 (10580)	
Power	Voltage (3-phase)			V	AC 200 / 220 / 230 / 240 ±10 % AC 380 / 400 / 415 / 440 ±10 % AC 460 / 480 ±10 %	
	Frequency			Hz	50 / 60 ± 1	
	Power capacity (Standard spec.)		5-min rating	kVA	41.6	
			10-min rating	kVA	36.6	
			30-min rating	kVA	30.9	
			Cont. rating	kVA	25.9	
Air source	Pressure			MPa (psi)	Over 0.5 (70) and under 0.9 (130)	
	Capacity (Standard spec.)			L (ft^3)/min (ANR) [ft^3/min (ANR)]	200 (7.06)	

Item			Unit	RT080	RT100
Noise level during operation (at operator's position)		76 dBA			
Machine operation conditions					
Cutting tool	Face mill (ϕ80 mm (3.15 in))		Spindle speed	: 1193 min^{-1}	
Workpiece material	: S45C		Feedrate	: 2792 mm/min (109.92 IPM)	
Coolant	: Without coolant		Width of cut	: 60 mm (2.36 in)	
Spindle load	: 50%		Depth of cut	: 1.0 mm (0.039 in)	

3-1-2 Standard accessories (mechanical)

1.	Coolant unit	Coolant tank capacity	200 L (7.06 ft^3) (Standard)
		Pump	MTH2-50/2A 230/365 W (50/60 Hz) (Standard)
2.	Coolant/chip cover		2080 mm (81.89 in) from floor level
3.	Tool kit		1 set
4.	Foundation supplies		Jack bolts, log nuts and bottom boards
5.	Manuals		OPERATING MANUALS for machine and NC MAINTENANCE MANUAL PARTS LIST ELECTRICAL CIRCUIT DIAGRAMS

3-1-3 Options (mechanical)

	Option
For FA	( ) Auto tool length measuring function
	( ) Monitoring system B: Tool Life Monitoring (TLM) and Spare Tool Change System Tool Breakage Detection & Recovery (TBR) System Adaptive Feedrate Control (AFC) System Automatic Alignment Function (AAF) (Touch sensor tool included.)
	( ) Preparation for mounting a monitoring system B: This is the Automatic Alignment Function (AAF) of the monitoring system B prepared for mounting, so only a touch sensor tool is not included.
	( ) Auto power off
	( ) 2-pallet changer
Coolant system	( ) Air blast
	( ) Through-spindle coolant
	( ) Chip conveyor (Hinge belt type) Chips are conveyed from the left side of VCN 410A-II/VCN 410B-II/VCN 510C-II.
	( ) Chip conveyor (ConSep2000II WS system) Chips are conveyed from the left side of VCN 410A-II/VCN 410B-II/VCN 510C-II.
	( ) Chip bucket (Fixed type)
	( ) Chip bucket (Swing type)
	( ) Oil hole
Tables and magazines	( ) Sub-table VCN 410A-II: 410 mm × 900 mm (16.14 in × 35.43 in)
	( ) For index table **(Note)** Note the model of the servomotor.
	( ) For NC rotary table **(Note)** Note the model of the servomotor.
Miscellaneous	( ) Operation finish light (yellow lamp)
	( ) Alarm light (red lamp)
	( ) 3-color (red, yellow and green) light
	( ) Work light
	( ) Earth leakage breaker (Only for Japan)
	( ) Customized color painting
	( ) Foundation parts (Anchor bolts)

3-2 Specifications of NC

For the specifications of NC unit, refer to the separately published volumes.

NC	Machine model
MAZATROL MATRIX NEXUS	VCN Compact
MAZATROL MATRIX	VCN Compact 5x

4 OVERALL VIEWS

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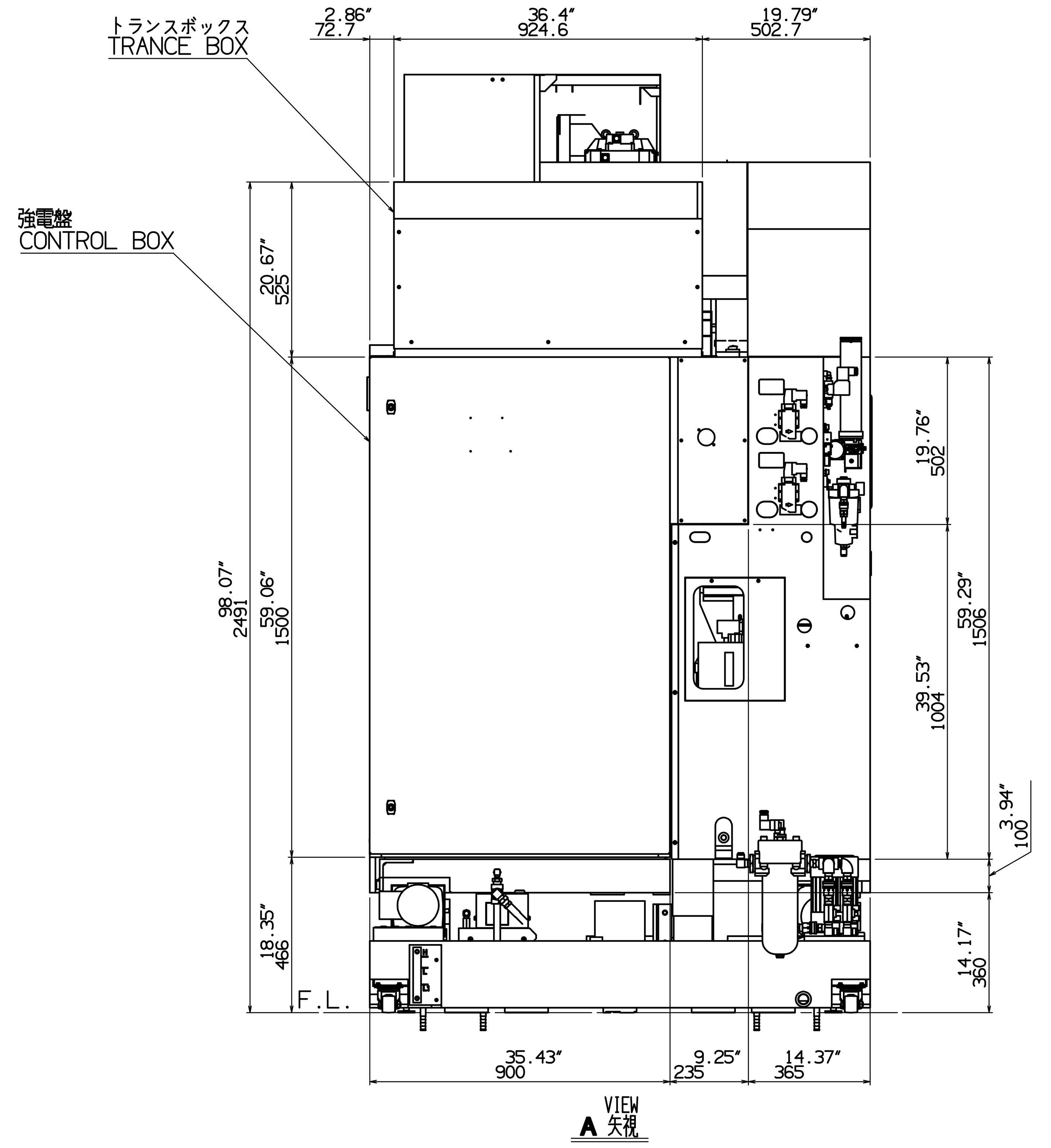
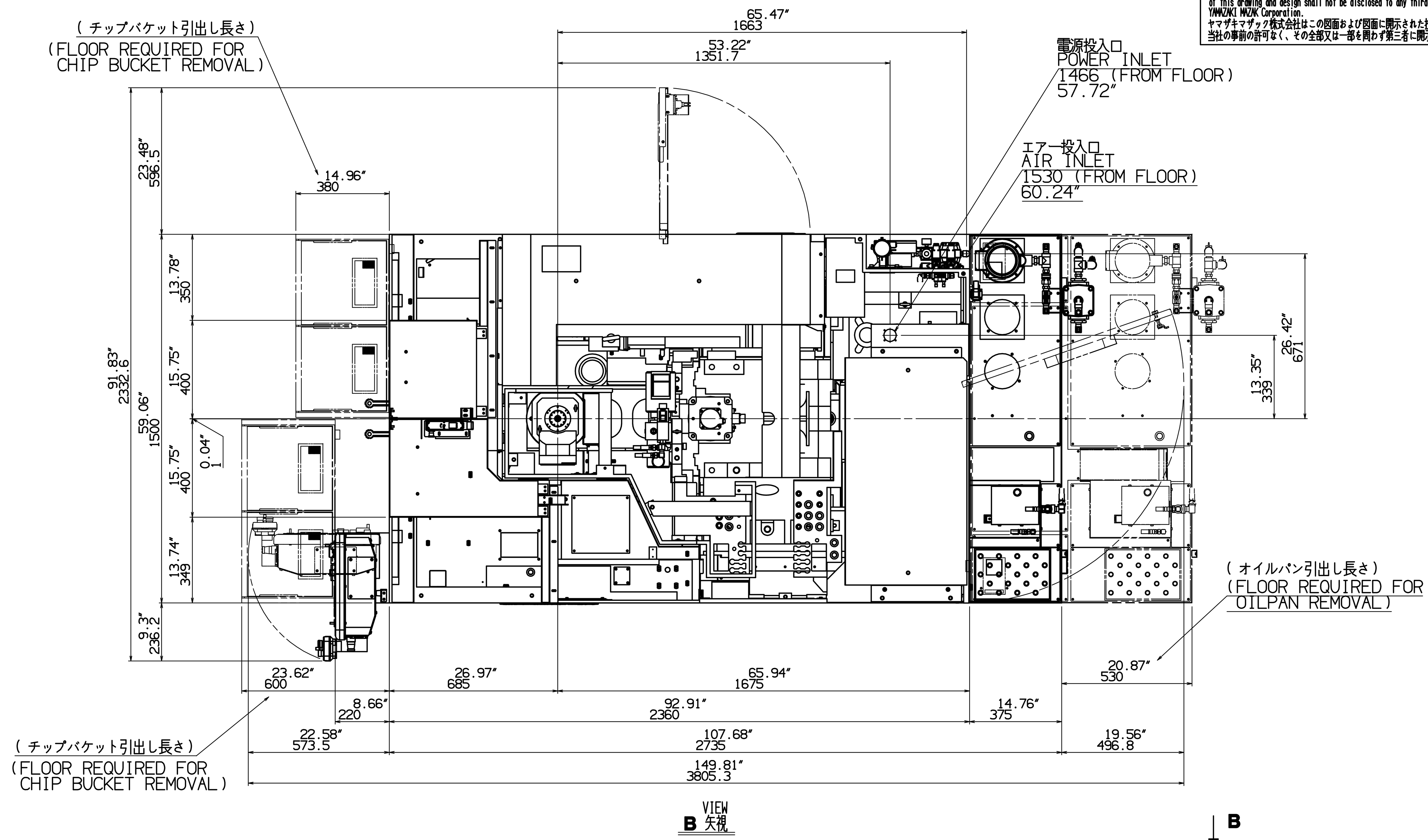
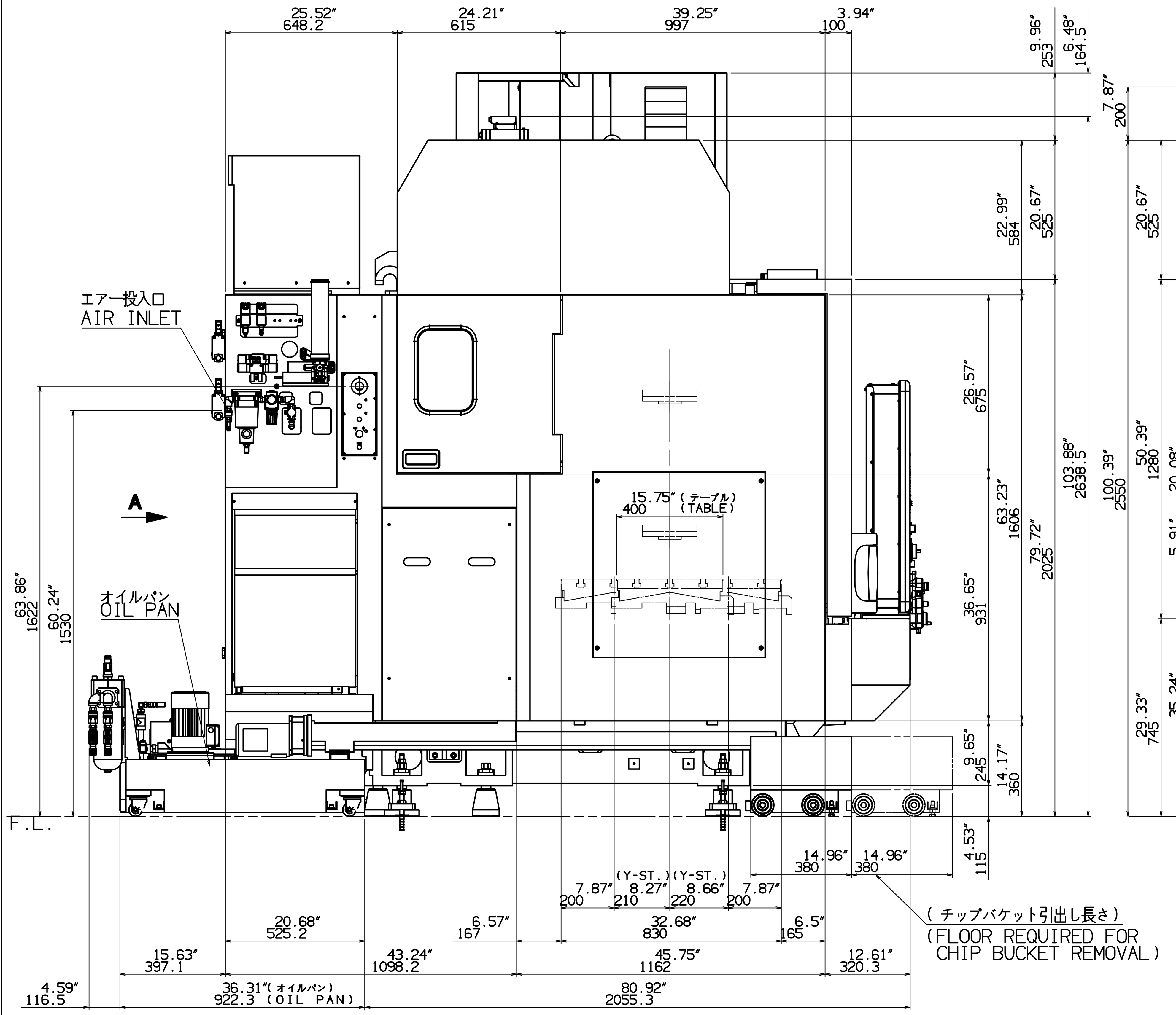
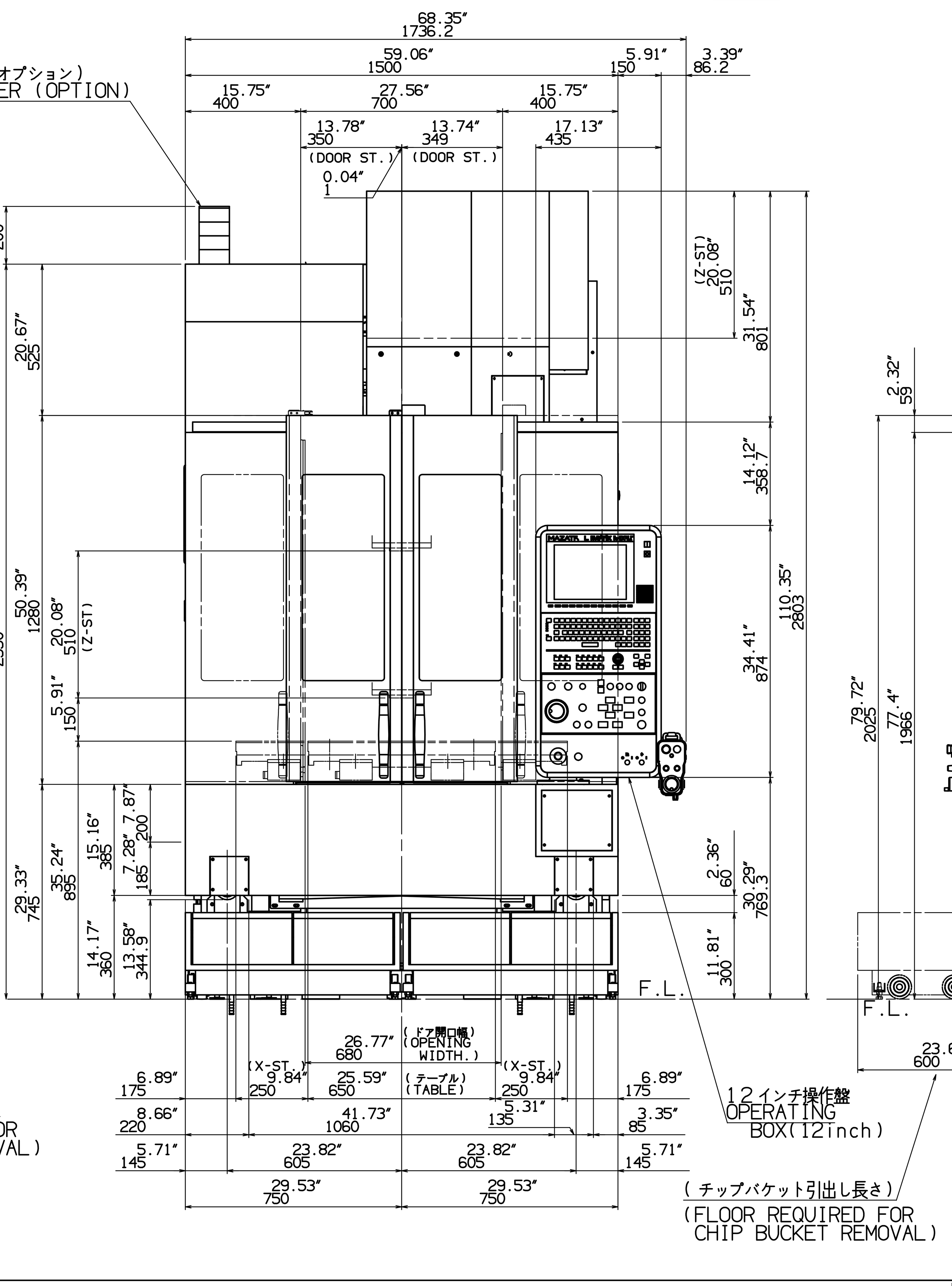
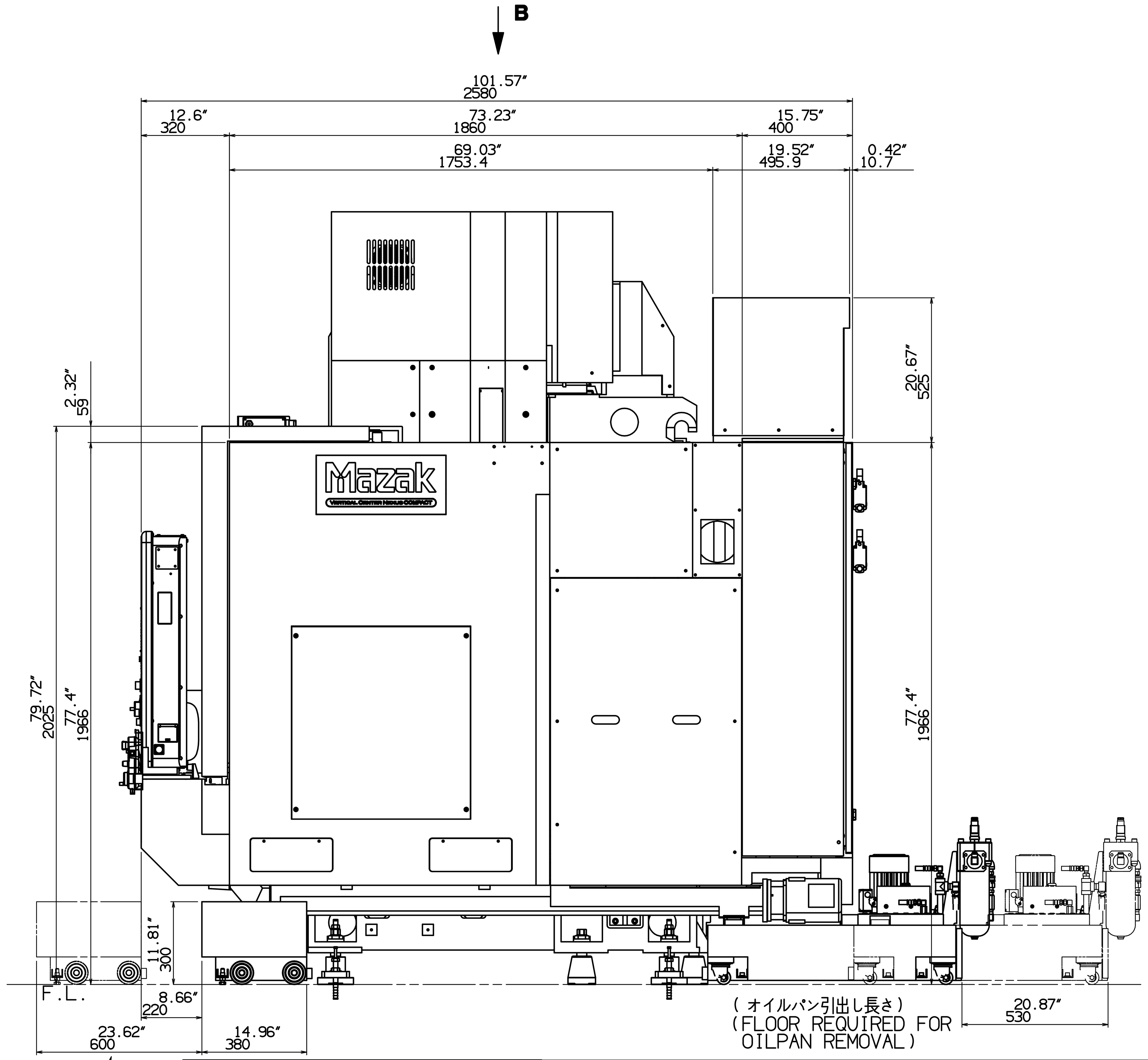








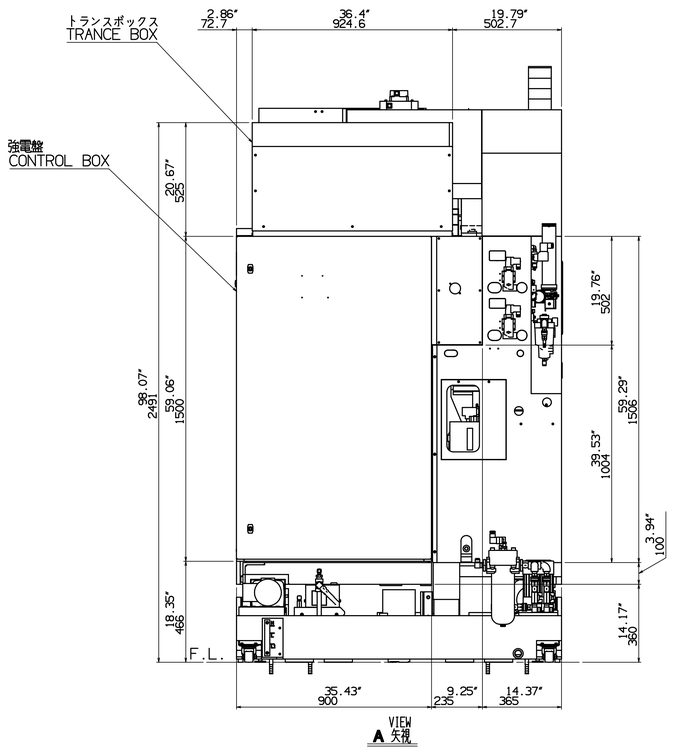


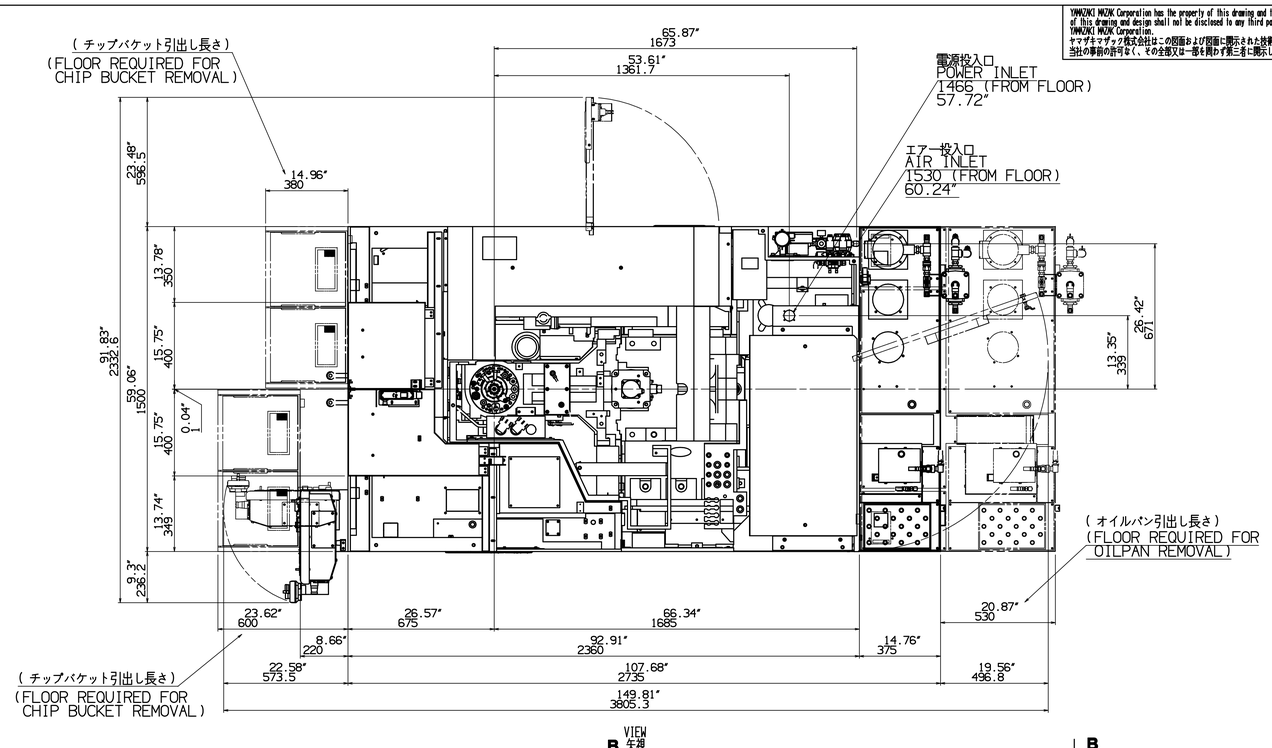
SPECIFICATION OF UNIT							
UNIT No.			9	–	. .	–	
SPEC.	VCN-COMPACT		8	–	. .	–	
	12000rpm		7	–	. .	–	
	NEXUS (12″)		6	–	. .	–	
			5	–	. .	–	
			4	–	. .	–	
			3	–	. .	–	
			2	–	. .	–	
			1	–	. .	–	
				QTY	DATE	DC NO.	SIGN

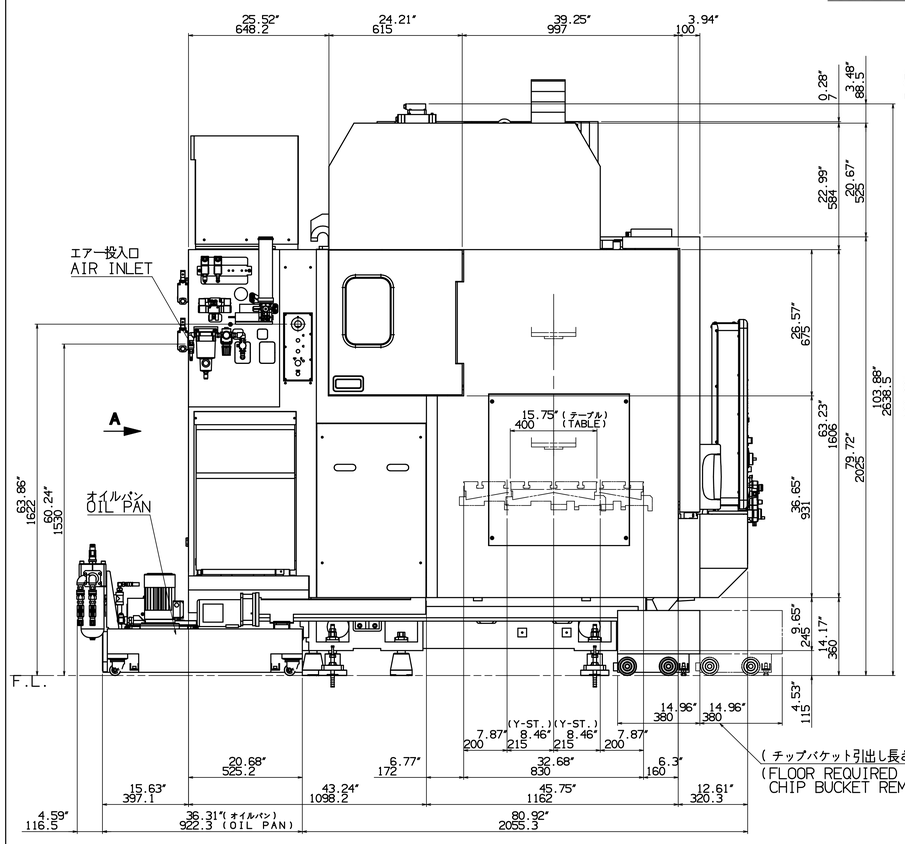
THIRD ANGLE PROJECTION					
APP'D	CHK'D	DSGN	DRAWING		
090811 H.N	090811 Y.S	090811 Y.S	090711 T-Y.Y		
SCALE	NAME				
1/10	VCN-COMPACT 全体図 VCN-COMPACT TOTAL VIEW DRAWING				
DRAWING NO.	0	590	TV	C001	0

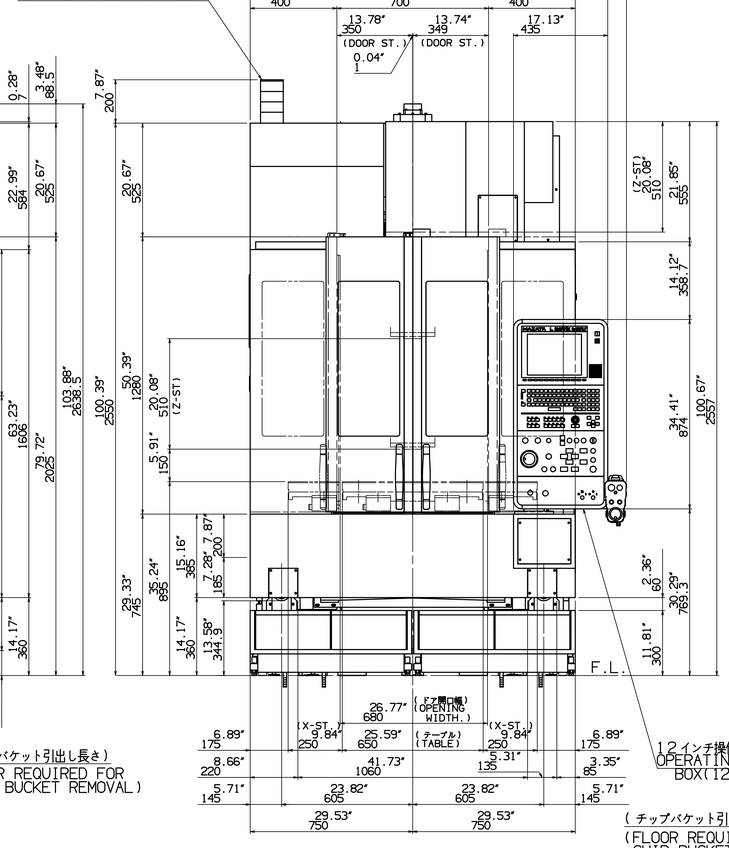
Mazak

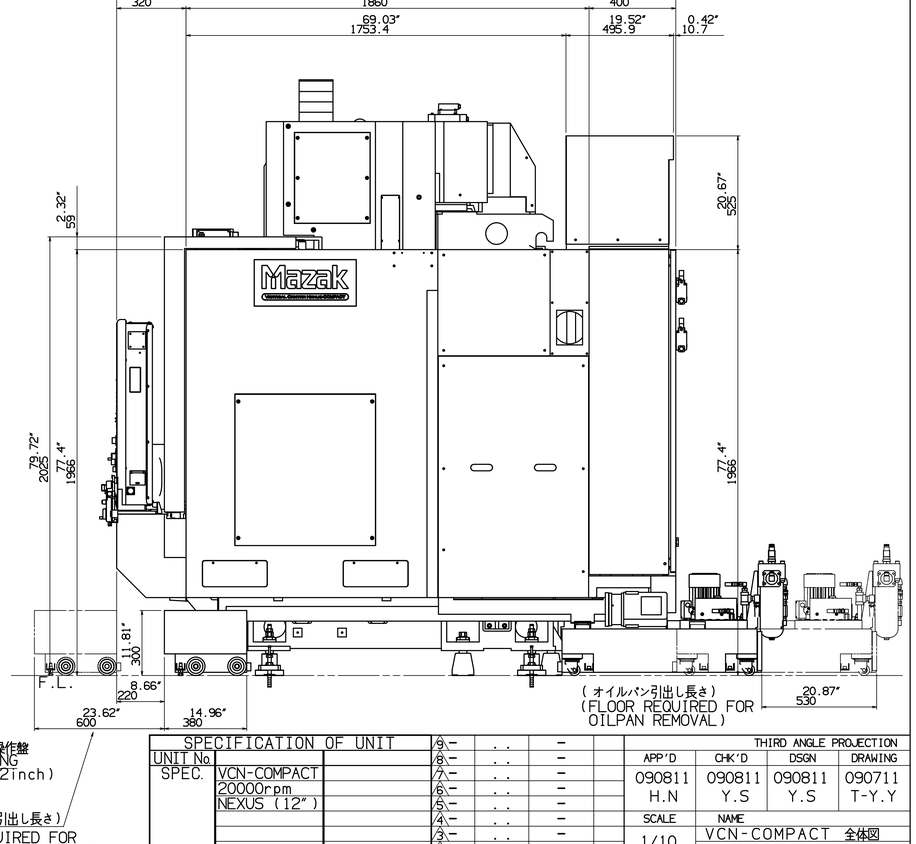
METRIC/INCH





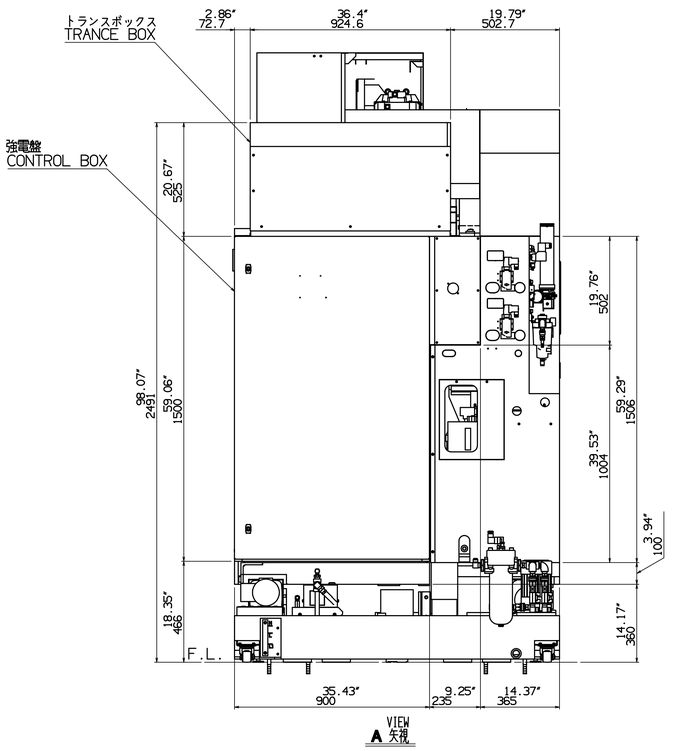


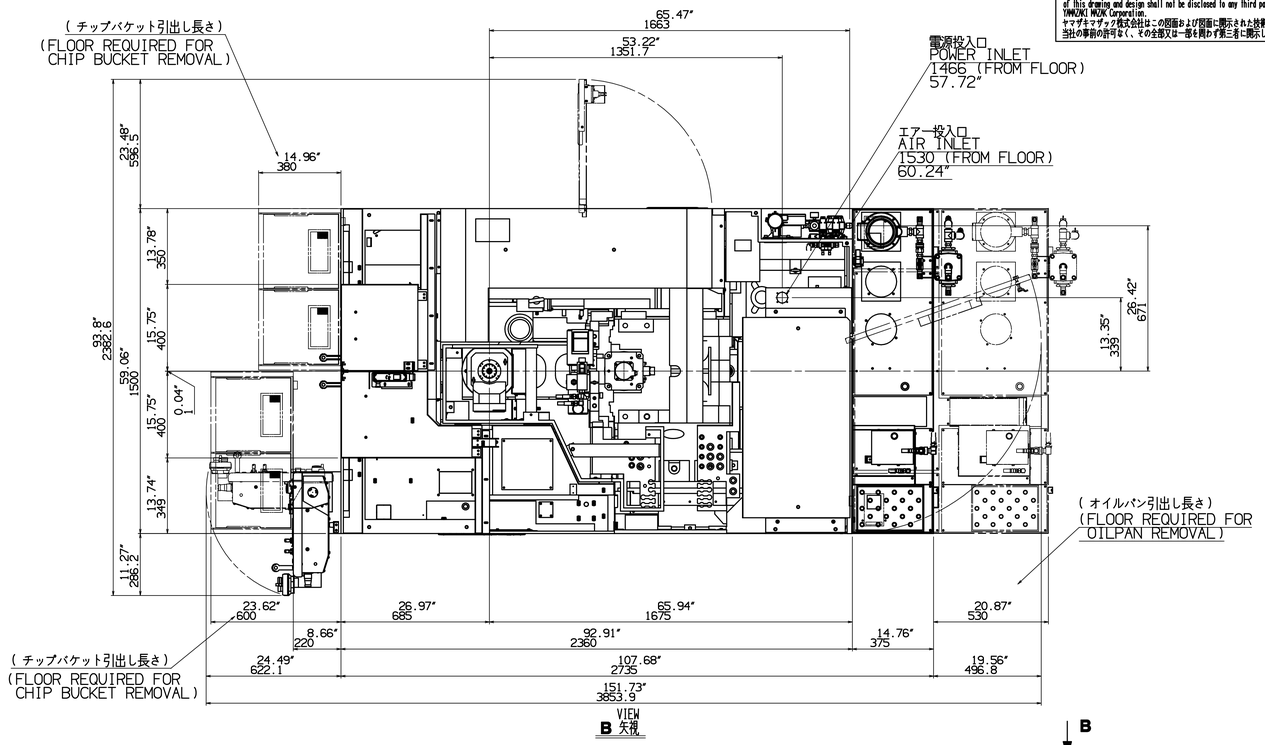


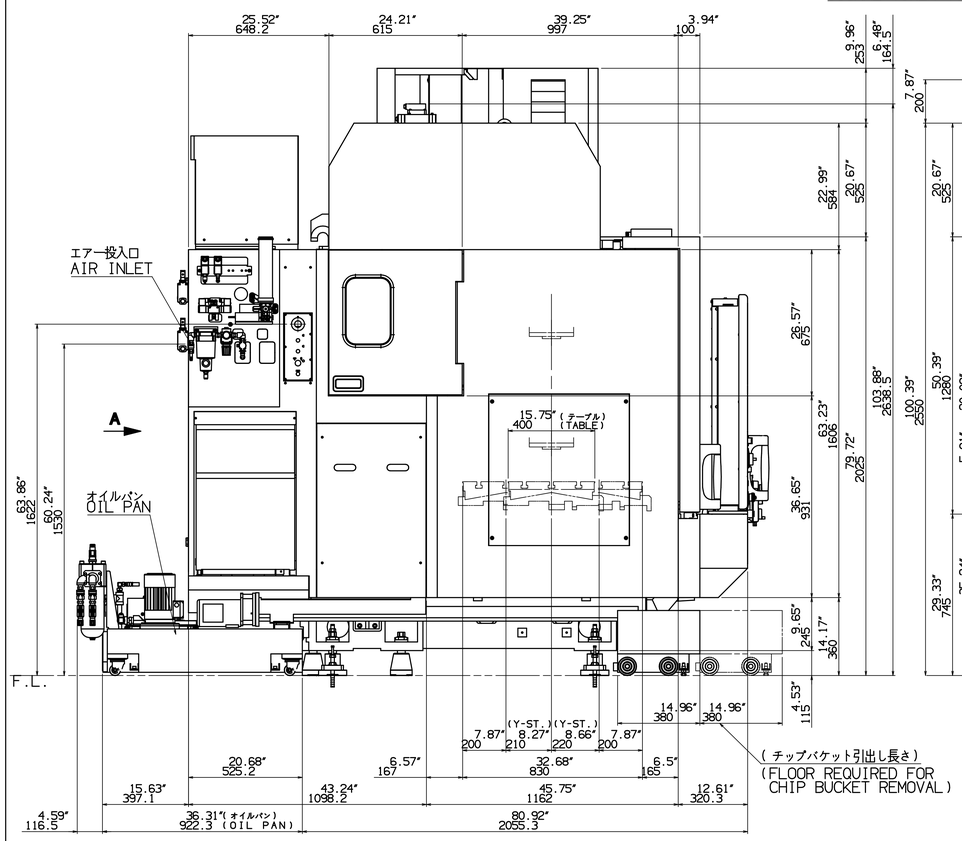


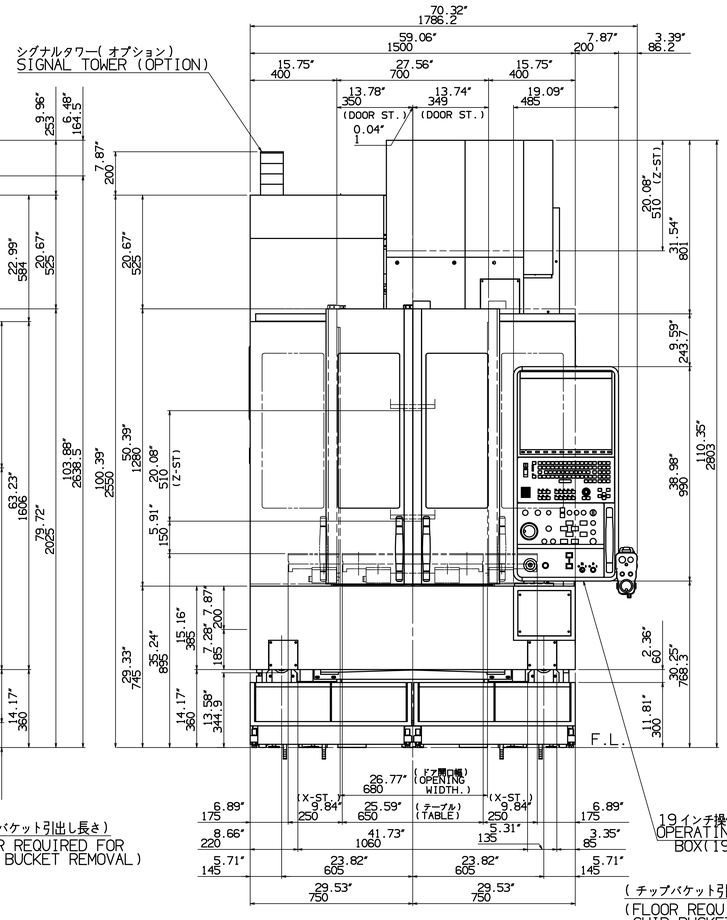
SPECIFICATION OF UNIT									THIRD ANGLE PROJECTION			
UNIT No.								APP'D	CHK'D	DSGN	DRAWING
SPEC.	VCN-COMPACT							090811 H.N	090811 Y.S	090811 Y.S	090711 T-Y.Y
	20000rpm										
	NEXUS (12")							SCALE	NAME		
								1/10	VCN-COMPACT 全体図		
									VCN-COMPACT TOTAL VIEW DRAWING		
								DRAWING NO.	0	590	TV	C002	0
								QTY	DATE	DC NO.	SIGN		

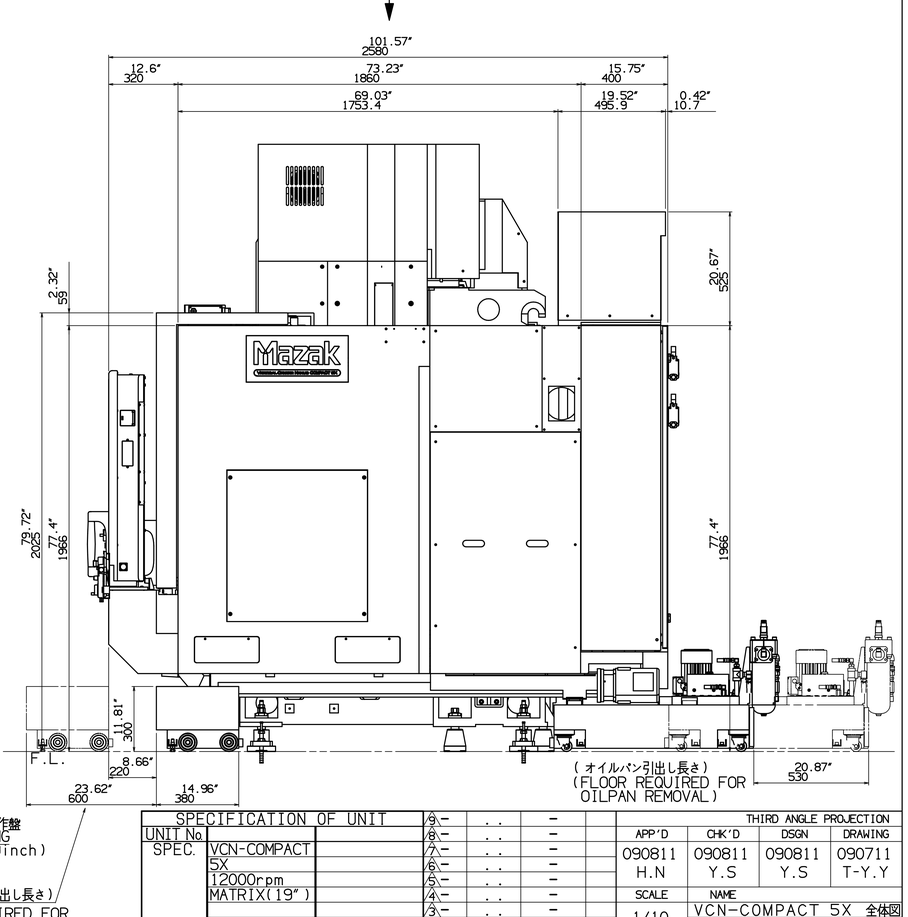
Mazak METRIC/INCH











SPECIFICATION OF UNIT									THIRD ANGLE PROJECTION			
UNIT No.								APP'D	CHK'D	DSGN	DRAWING
SPEC.	VCN-COMPACT 5X 12000rpm MATRIX(19")							090811 H.N	090811 Y.S	090811 Y.S	090711 T-Y.Y
								SCALE	NAME		
								1/10	VCN-COMPACT 5X 全体図		
									VCN-COMPACT TOTAL VIEW DRAWING		
								DRAWING NO.	0	591	TV	C001	0
								QTY	DATE	DC NO.	SIGN		

Mazak
METRIC/INCH

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SPECIFICATION OF UNIT	
UNIT No.	
SPEC.	VCN-COMPACT 5X 20000rpm MATRIX(19")

	QTY	DATE	DC NO.	SIGN
9	–	. .	–	
8	–	. .	–	
7	–	. .	–	
6	–	. .	–	
5	–	. .	–	
4	–	. .	–	
3	–	. .	–	
2	–	. .	–	
1	–	. .	–	

THIRD ANGLE PROJECTION

APP'D	CHK'D	DSGN	DRAWING
090811 H.N	090811 Y.S	090811 Y.S	090711 T-Y.Y

SCALE	NAME
1/10	VCN-COMPACT 全体図 VCN-COMPACT TOTAL VIEW DRAWING

DRAWING NO. 0 591 TV C002 0

Mazak

METRIC/INCH

5 FLOOR SPACE REQUIREMENTS AND FOUNDATION DRAWINGS

1. Note

The foundation drawings in this volume are for general reference only. The foundation should be constructed after consulting with MAZAK regarding concrete information, referring to the machine serial number.

2. Recommendations for foundation

(1) Pave gravel all over the foundation base to assure at least 49 kPa (7.11 psi) soil bearing power.

(2) The concrete compressive strength (σ) must be more than 17.6 MPa (2553 psi). The tensile strength must be more than 1.76 MPa (255 psi).

(3) Watch that the concrete is not cracked.

(4) Lay a vibration isolator like asphalt all around the machine in the foundation base.

(5) To reinforce the foundation base, lay grids of ϕ19 mm (0.75 in diameter) iron bars at every 150 mm (5.91 in) pitch all over the foundation base

(6) Jag the inner walls of the foundation bolt pits so that the secondary concrete fits well with the primary concrete when the machine is settled.

(7) Pour the primary concrete under the condition of the foundation bolt pits open. After the concrete has been sufficiently cured, lay anchor plates. Place the machine on them and take temporary leveling of the machine. After the foundation bolts, plants, and others are assembled, pour the secondary concrete into the foundation bolt pits and fix them.

(8) When pouring the secondary concrete, set the foundation plates the set-screws of the collars. After the concrete is cured, take the final level of the machine and secure the leveling blocks to the machine by tightening the nuts (M16). Here, sliding force is generated at the set-screws of the collars so that it is added to the foundation bolts.

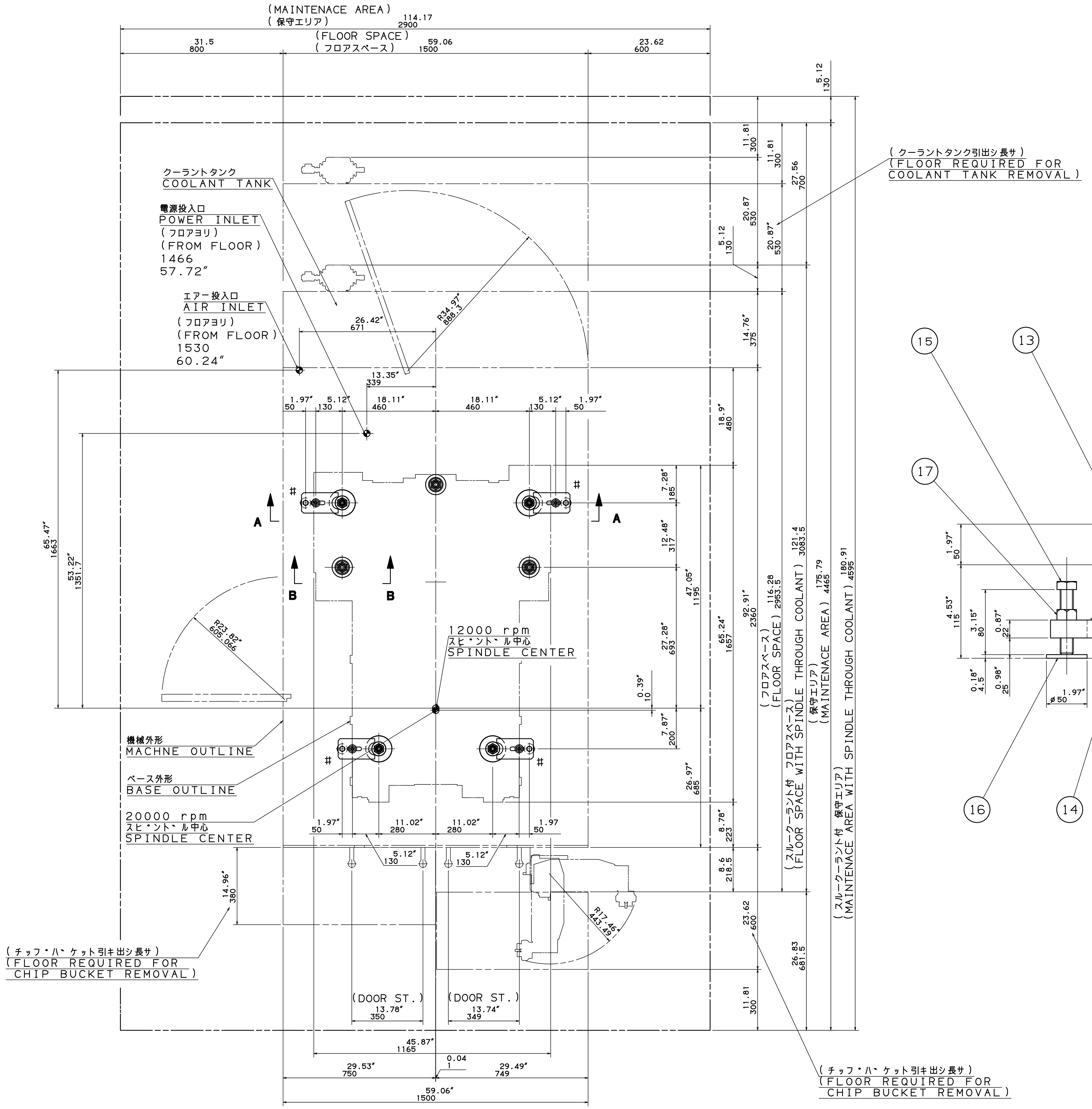
(9) Total volume of concrete

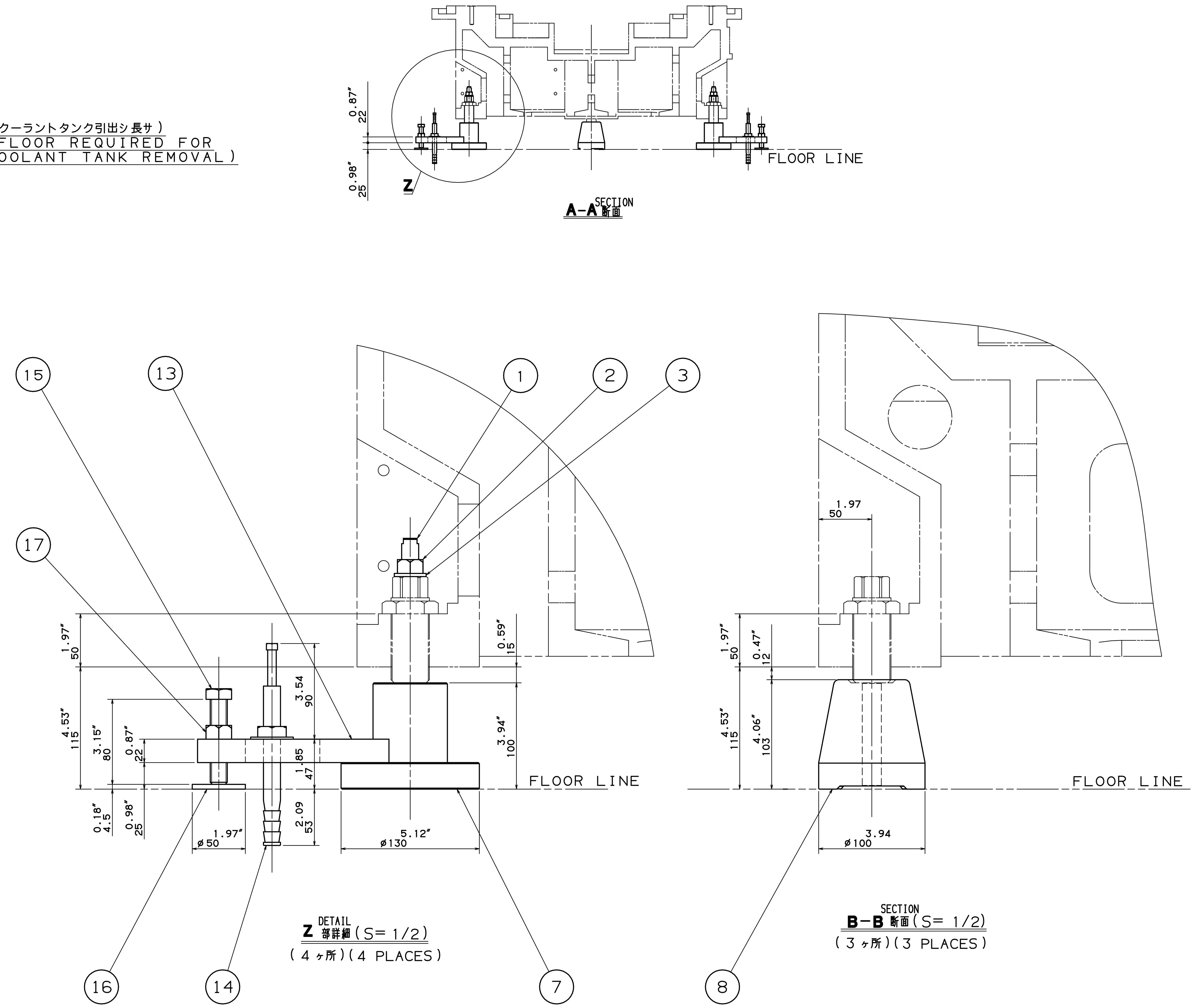
About 1.7 m^3 (60 ft^3)

Fill the foundation bolt pits with concrete. It is advisable to mix a proper inflating agent (such as Denka CSA) in the secondary concrete so that it does not contract after it is cured.

Foundation drawings

Machine model	Specifications	Drawing No.	Page
VCN Compact	Dry pit type	059116AC010	5-2





注記
1．グリ石層ナトニヨリ地耐力49kPa(5ton/㎡)以上ノ事
2．コンクリートノ圧縮強サσ=17.7MPa(180kg/c㎡)以上，引張リ強サ1.8MPa(18kg/c㎡)以上ノ事
3．コンクリートニ亀裂ヲ生シサナイヨウニスル事
4．機械設置前ニトリルニヨル穴開ケ作業及ビホールアンカー打設ノ事(#印4ヶ所)
5．表面ニハ防水モルタルヲ塗リナメラカニ仕上ゲル事
6．本図ハ、工場内配置図ト共ニ使用シ、保守スペースガ確保サレル様配置スル事

Suggestions for Floor Foundation Preparation
1) Use gravel stones to obtain a minimum soil bearing pressure of 49kPa (1022lbs/ft).
2) Use concrete with a minimum compressive strength of 17.7MPa (2561 PSI) and tensile strength of 1.8MPa (256 PSI).
3) Take precautions so that there are no cracks in the concrete.
4) 4 nos. whole anchors (marked #) should be positioned , drilled and set prior to set-up the machine.
5) It Paints The Waterroof Mortar On The Ground Level And Finish Smoothly.
6) As For This Drawing The Layout Drawing Of The Factory And In Order For The Maintenance Space To Be Guaranteed,Please Use Together,Arrange.

SPECIFICATION OF UNIT			
UNIT No	559161001C0		
SPEC.	VCN-COMPACT		
	ドライピット		
	VCN-COMPACT		
	DRY PIT		

	QTY	DATE	DC NO.	SIGN
9	−	. .	−	
8	−	. .	−	
7	−	. .	−	
6	−	. .	−	
5	−	. .	−	
4	−	. .	−	
3	−	. .	−	
2	−	. .	−	
1	−	. .	−	

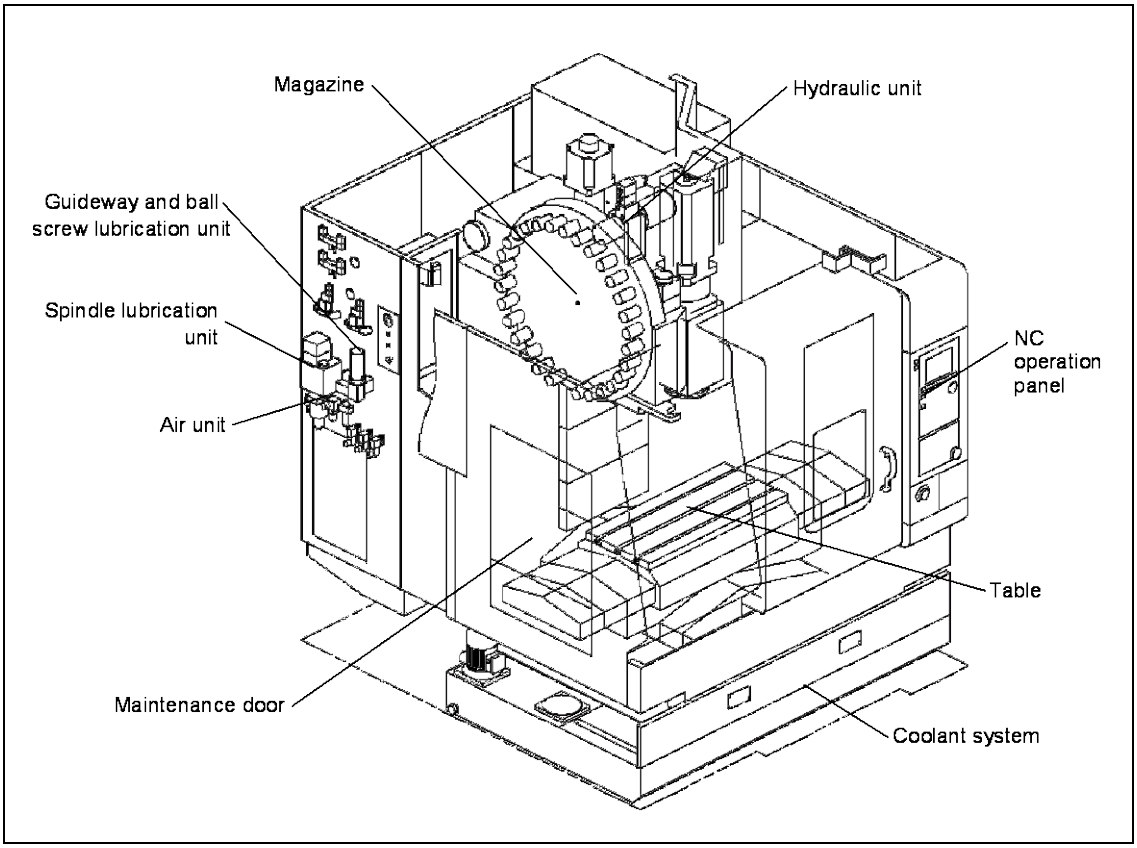
THIRD ANGLE PROJECTION

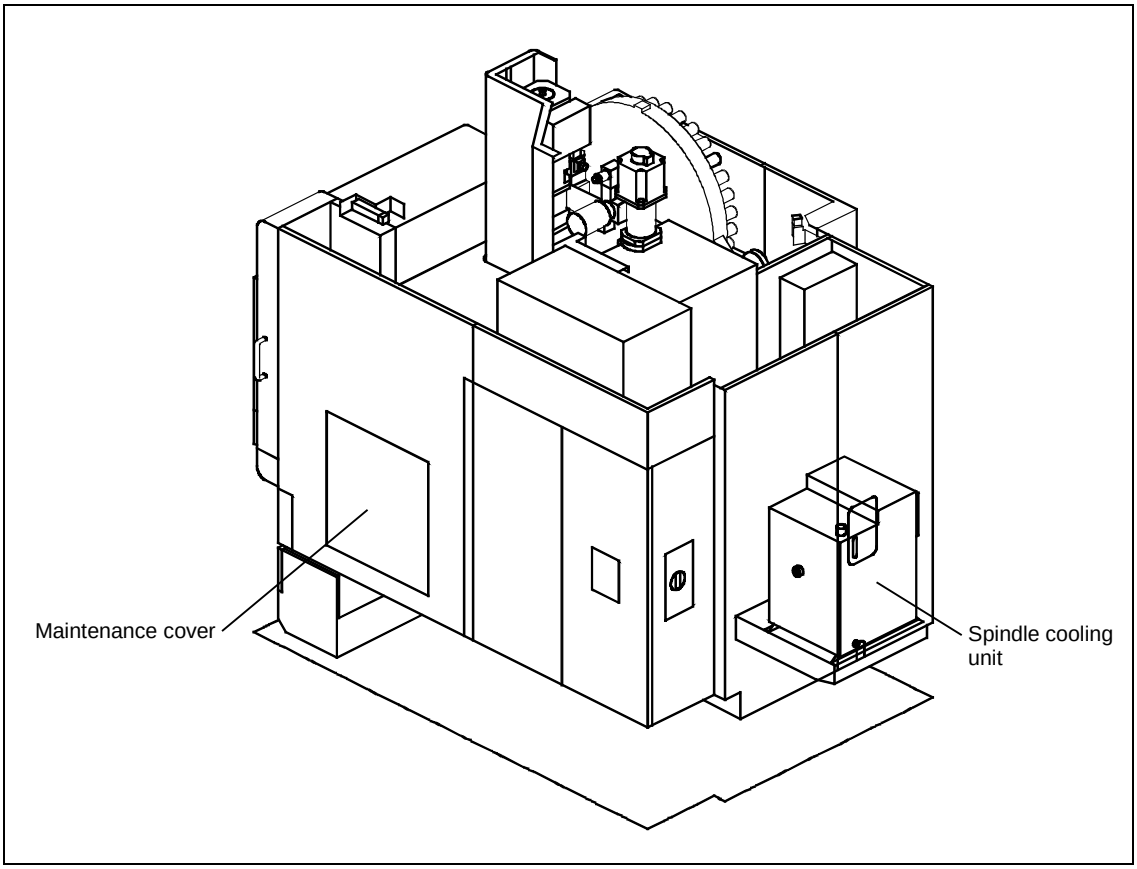
APP'D	CHK'D	DSGN	DRAWING
091311 H.N	091311 Y.S	091311 Y.S	091211 T-Y.Y

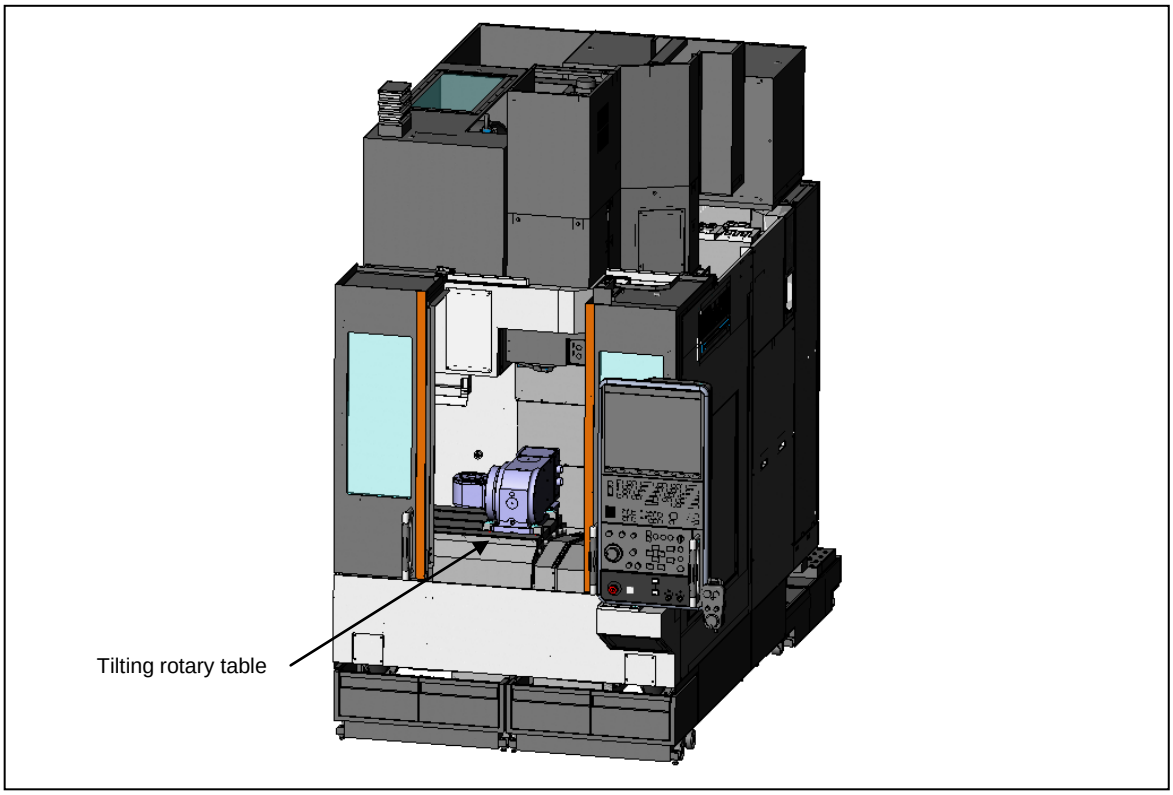
SCALE	NAME
1/8 (1/2)	VCN COMPACT 基礎図 VCN COMPACT FOUNDATION DRAWING
DRAWING NO.	0 591 61 AC01 0

Mazak METRIC/INCH

6 MACHINE LAYOUT







Note : Tilting rotary table is available only for VCN Compact 5x.

7 MODEL EXPANSION

Main spindle	Coolant	Chip disposal system
• 12000 min^{-1} specification • 20000 min^{-1} specification	• Without through-spindle coolant (Standard) • With through-spindle coolant (Option)	• With ConSep 2000II WS system (Applicable to iron, aluminum and casting chips, and their mixed chips) (Option)

8 DETAIL SPECIFICATIONS OF EACH UNIT

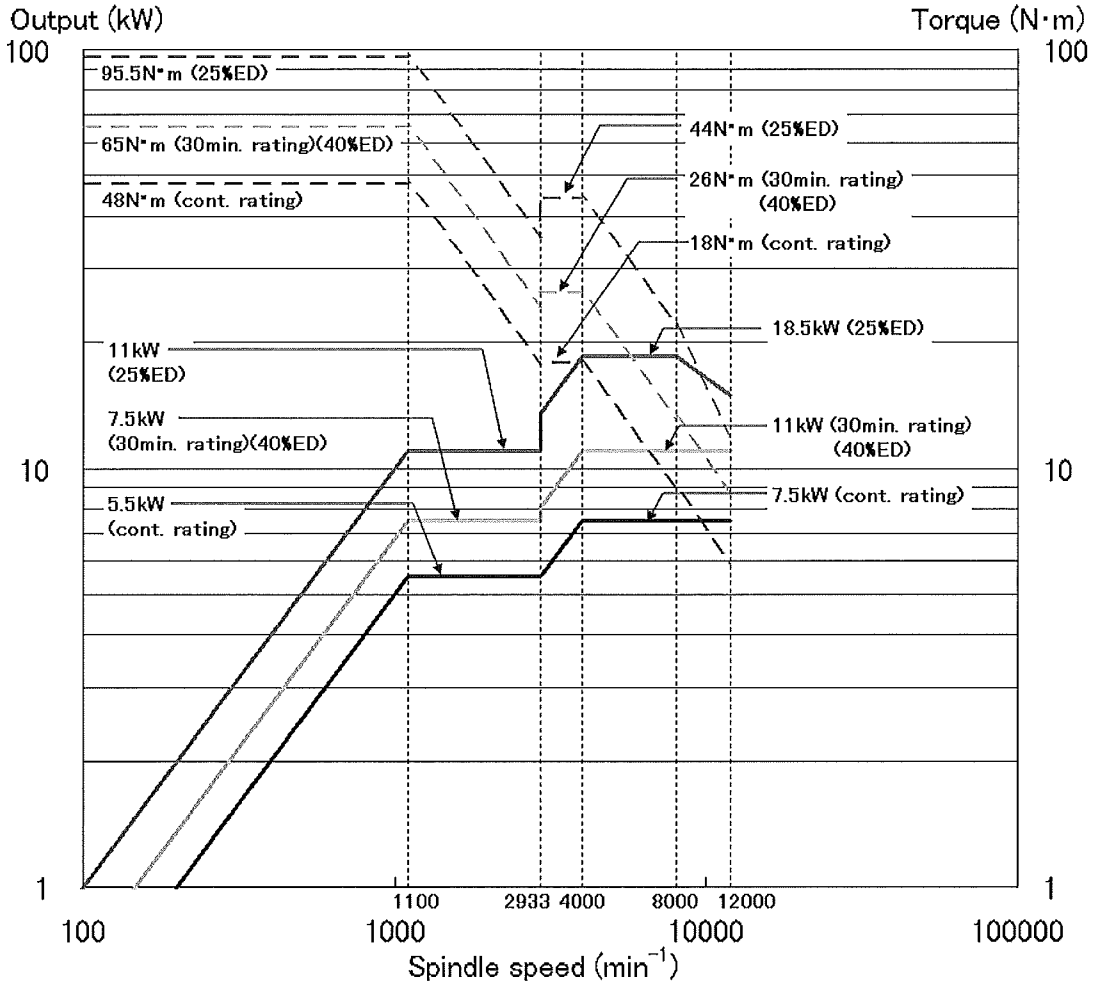
8-1 Main Spindle

8-1-1 Standard 12000 min^{-1} VCN Compact

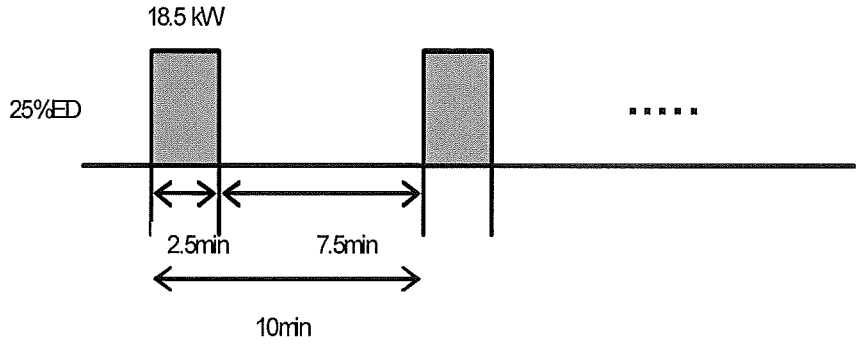
1. Specifications

Item		Specifications		
Spindle taper shape		7/24 taper No. 40		
Tool retention		Coned disc spring Clamping force 9.8 kN (2203 lbf)		
Spindle bearings		Angular contact ball bearings		
Bearing size		I.D.	ϕ70 mm (2.76 in)	
		O.D.	ϕ110 mm (4.33 in)	
		Width	20 mm × 4 (0.79 in × 4)	
		Model	ACH014CA-5DBBCS4	
		Max. dynamic rating load	75.6 kN (16996 lbf)	
		Max. static rating load	119 kN (26752 lbf)	
		Contact angle	20°	
Spindle speed range		40-12000 min^{-1}		
Bearing lubrication		Grease lubrication		
Number of speed ranges		Direct motor drive Direct speed command in 1 min^{-1} increments		
Spindle motor	Model	AC inverter motor SJ-4-VKS15-13ZT		
	Output		High-speed winding	Low-speed winding
		25%ED	18.5 kW (25 HP)	11 kW (15 HP)
		30min.rating	11 kW (15 HP)	7.5 kW (10 HP)
		40%ED	11 kW (15 HP)	7.5 kW (10 HP)
		Cont. rating:	7.5 kW	5.5 kW
Spindle cooling system		Circulation of coolant in spindle housing (Cooling unit: Chiller type)		
Spindle orientation		Electrical orientation (Built-in encoder orientation system)		
Spindle taper hole cleaning		Air blast (Pneumatic source to be prepared by user) Pneumatic source: 0.5-0.9 MPa (70-130 PSI)		

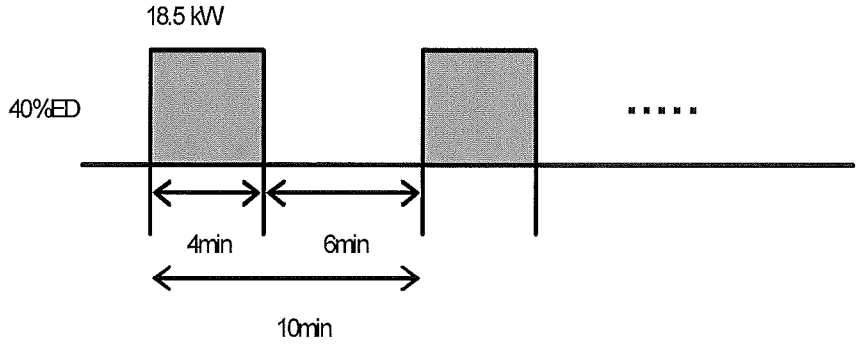
2. Output-torque diagram [40-12000 min^{-1}]



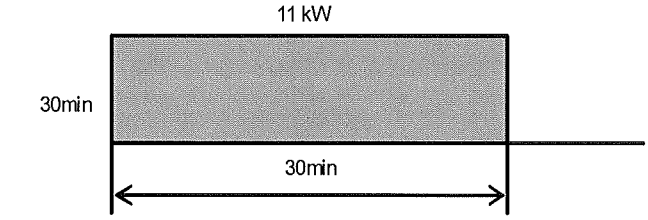
3. Definitions of spindle motor time and rating



Output of 25%ED. rating enables continuous operation for 5 minutes starting from the spindle motor cooled state (at the same temperature as the ambient temperature).



Output of 40%ED. rating enables continuous operation for 5 minutes starting from the spindle motor cooled state (at the same temperature as the ambient temperature).



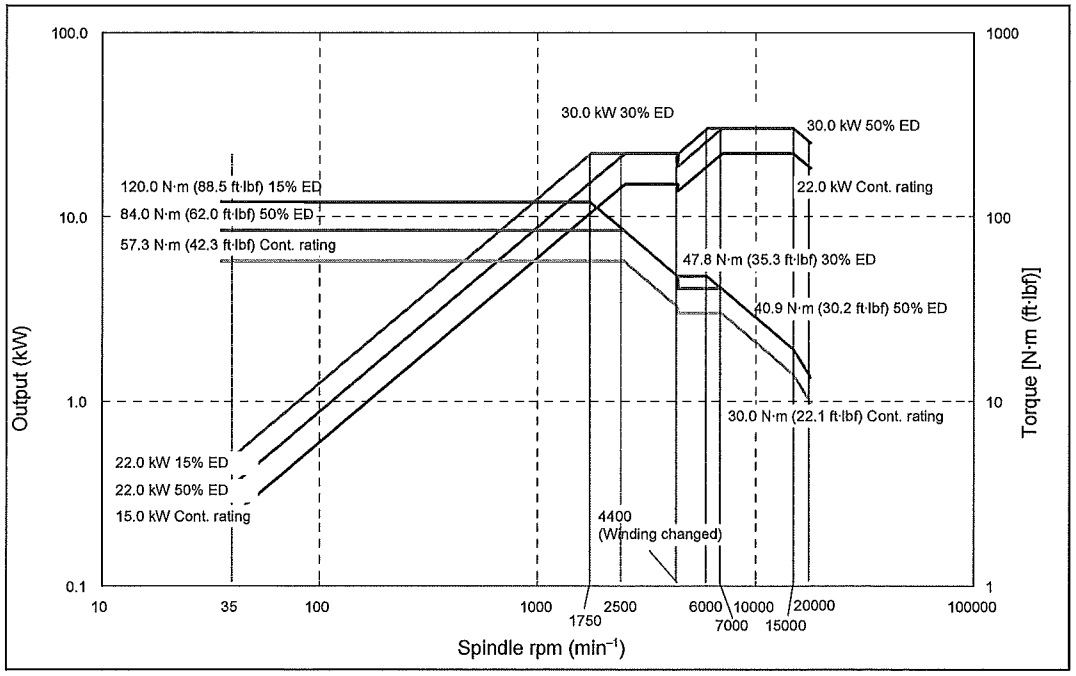
Output of 30min. rating enables continuous operation for 5 minutes starting from the spindle motor cooled state (at the same temperature as the ambient temperature).

8-1-2 Standard 20000 min^{-1} VCN Compact

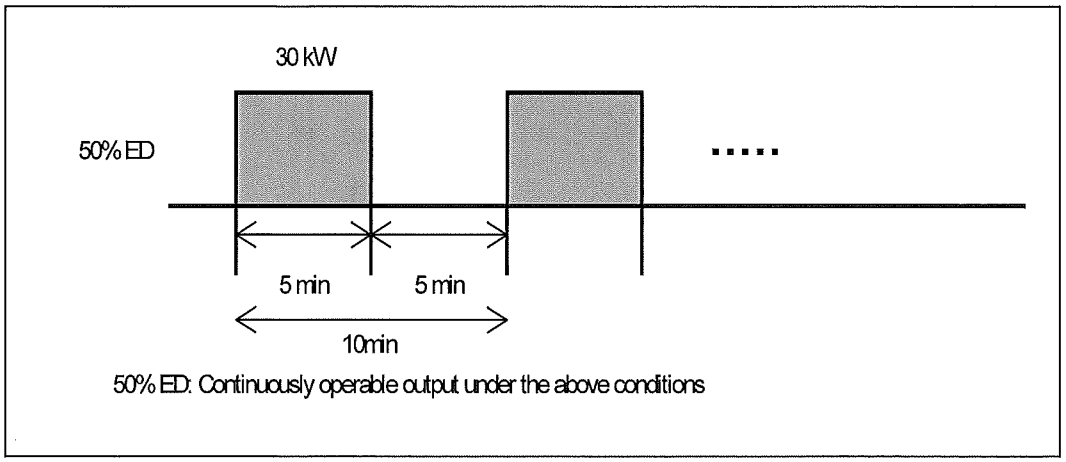
4. Specifications

Item		Specification		
Spindle taper shape		7/24 Taper No. 40		
Tool retention		Coned disc spring Clamping force 11.0 kN (2473 lbf)		
Spindle bearings		Angular contact ball bearings		
Bearing size		I.D.	ϕ70 mm (2.76 in)	
		O.D.	ϕ100 mm (3.94 in)	
		Width	16 mm × 4 (0.63 in × 4)	
		Model	EP70BER19HETDBBP4Y+3KLX32A/17D/17DCA24U17	
		Max. dynamic rating load	54.0 kN (12140 lbf)	
		Max. static rating load	69.5 kN (15624 lbf)	
		Contact angle	25°	
Spindle speed range		35-20000 min^{-1}		
Bearing lubrication		Oil & air lubrication		
Number of speed ranges		Directly connected to motor Direct speed command in 1 min^{-1} increments		
Spindle motor	Model	AC inverter motor SJ-4B4346TDH		
	Output		High-speed winding	Low-speed winding
		50%ED:	30 kW	22 .5W
		Cont. rating:	22 kW	16.5kW
Spindle cooling system		Circulation of coolant in spindle housing (Cooling unit: Chiller type)		
Spindle orientation		Electrical orientation (Built-in encoder orientation system)		
Spindle taper hole cleaning		Air blast (Pneumatic source to be prepared by user) Pneumatic source: 0.5-0.9 MPa (70-130 psi)		

5. Output-torque diagram [35-20000 min^{-1}]



6. Definitions of spindle motor time and rating



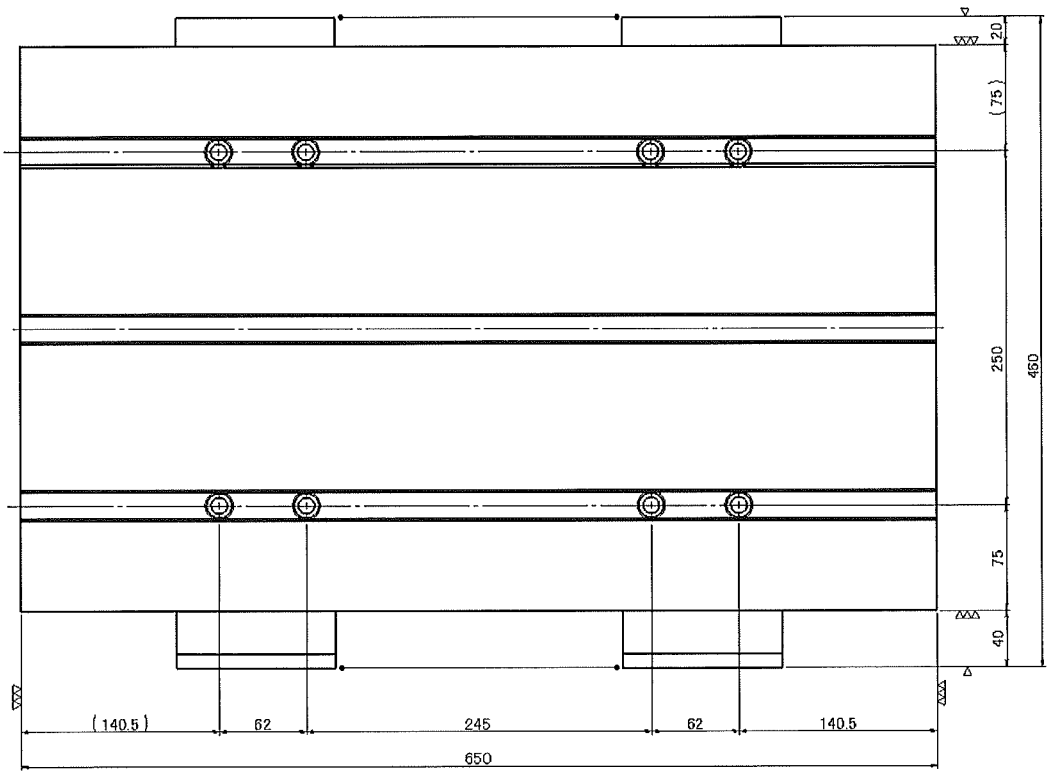
8-2 Table

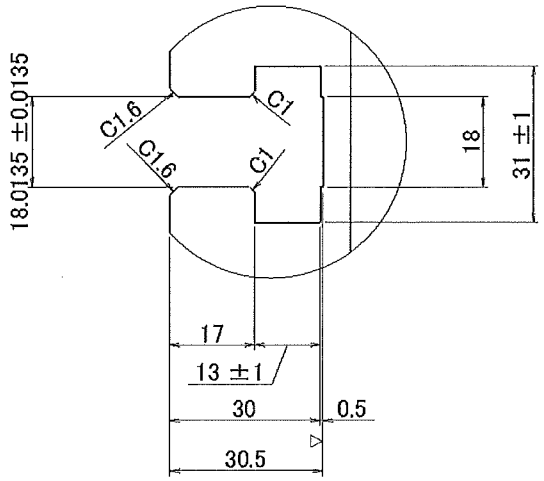
8-2-1 Machine table

Item		VCN Compact
Table overall dimensions	Crosswise	650 (25.59 in)
	Longitudinal	400 (15.75 in)
Table working surface	Crosswise	650 (25.59 in)
	Longitudinal	400 (15.75 in)
T-slots	Width (Meets ISO R299)	18 mm (0.71 in)
	Number of T-slots (The slot in the center is a reference slot.)	3
	Distance between centers	125 mm (4.92 in)
	Reference slot	18H8 $^{+0.027}_{0}$ mm (18H8 $^{+0.001}_{0}$ in)
Maximum load on table		300 (661 lbs)
Table height from machine bottom		780 (30.71 in)

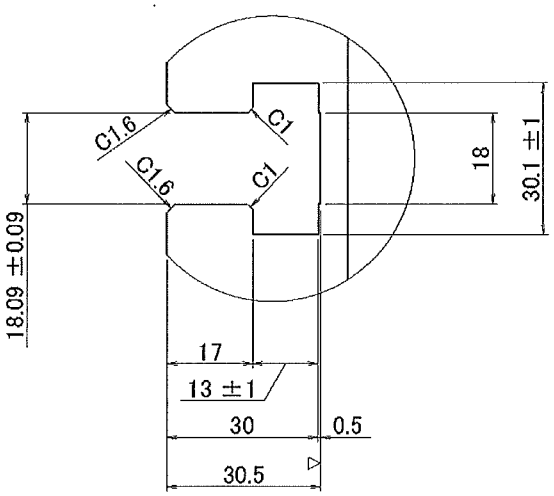
1. Table dimensions

A. VCN Compact





Standard groove



other grove

8-2-2 Tilting rotary table

Item		RT80	RT100
Table size		ϕ80 mm	ϕ100 mm
Maximum workpiece diameter		ϕ100 mm	ϕ160 mm
Reduction ratio	A-axis	1/48	
	C-axis	1/60	
Maximum rotating speed	A-axis	62.5 min^{-1}	
	C-axis	50 min^{-1}	
Movable range	A-axis	+20° ~120°	
	C-axis	±360°	
Maximum contouring torque (A-axis)	180%	35N·m	56N·m
Maximum contouring torque (C-axis)	180%	70N·m	129N·m
Mass of tilting rotary table		70 kg	91 kg
Allowable weight		10 kg	30 kg

8-3 Automatic Tool Changer (ATC)

8-3-1 ATC

Item		Specification
		VCN Compact
Tool change method		Double-arm method
ATC drive		0.5 kW AC servo motor + cam drive
Cam unit		Oil bath lubrication type roller gear cam mechanism
Tool changing time	Chip-to-chip time	2.8 s
	Tool-to-tool time	1.3 s
Tool change position		2nd homes of Y and Z

Note 1: The conditions used for measuring the chip-to-chip tool change time are as follows:

- Tool 190.5 mm (7.5 in) (Tool length from gauge line), 5 kg (11.02 lbs)
- Z-axis Distance from table top to tool tip: 127.5 mm (5.02 in) (Z= –342.5)

8-3-2 Tool magazines

Item	Specification
Tool storage capacity	20 tools
Tool selection	MAZATROL Memory Random mood
Max. tool diameter of storable tool	ϕ80 mm (ϕ3.14 in)
With adjacent pockets empty	ϕ125 mm (ϕ4.92 in)
Max. tool length in magazine	190.5 mm (7.5 in) (from gauge line to tool tip)
Max. tool mass in magazine	8 kg (17.6 lbs) (including tool shank and pull stud)/5 kg (11.0 lbs) or more is specified to a heavy tool
Max. total mass in magazine	120 kg (264.6 lbs)
Magazine rotating drive	0.5 kW AC servo motor
Magazine rotating speed	0.7 s/1 pocket, 3.0 s/15 pockets
Magazine position	Left side of column
Manual magazine rotation	By operation on the main operation panel and the magazine operation panel on the left side of the machine
Tool shank	MAS BT 40

Note 1: Mount tools in the magazine in good balance.

Note 2: When a tool such as angle tool has a pin as a stopper against rotating and the pin interferes with the edge of adjacent pocket, removal of the pocket may be required before using the machine. Please check it in advance.

8-4 X-, Y- and Z-axis Drive Systems

8-4-1 Specifications

1. VCN Compact / VCN Compact 5x

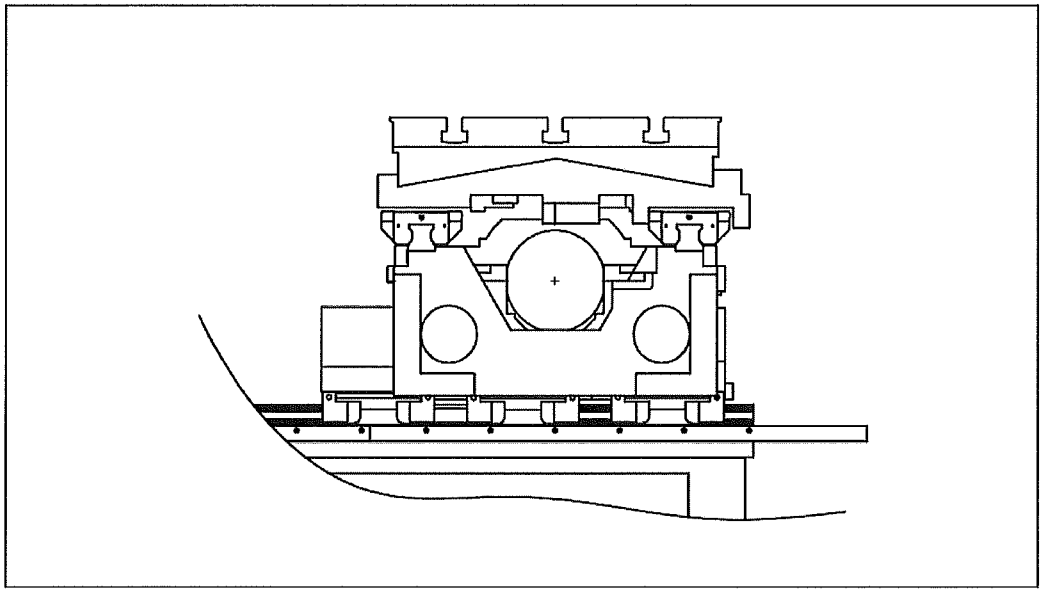
Item		Unit	VCN Compact		
			X	Y	Z
Stroke		mm (in)	500 (19.65)	430 (16.93)	510 (20.8)
Ball screw	Diameter	mm (in)	ϕ36 (1.42)		
	Lead	mm (in)	12 (0.47)		
Drive method		-	Directly connected to servomotor		
Rapid traverse rate		m/min (IPM)	36 (1417)		
Ball screw & nut lubrication		-	Forced lubrication (grease)		
Cutting feedrate		mm/min (IPM)	1 to 8000 (0.039 to 315)		
			1 to 36000 (0.039 to 1417.3) for MAZAK-2D or 3D		
Servomotor	Type	-	HF-H154S-A48	HF-H204S- A48	HF-H354BS- A48
	Power	kW	1.5	2.0	3.5
Guideway		-	Linear motion bearings		
Guideway lubrication		-	Forced lubrication (grease)		
Feedback unit		-	Encoder integrated in the motor		
Rated thrust		kN (lbf)	3.5 (788)	5.7 (1281)	5.1 (1146)
Maximum thrust (180%)		kN (lbf)	- -	- -	13.6 (3057)

Note: Consult us if average traverse rate in use exceeds 2 m/min (79 IPM).

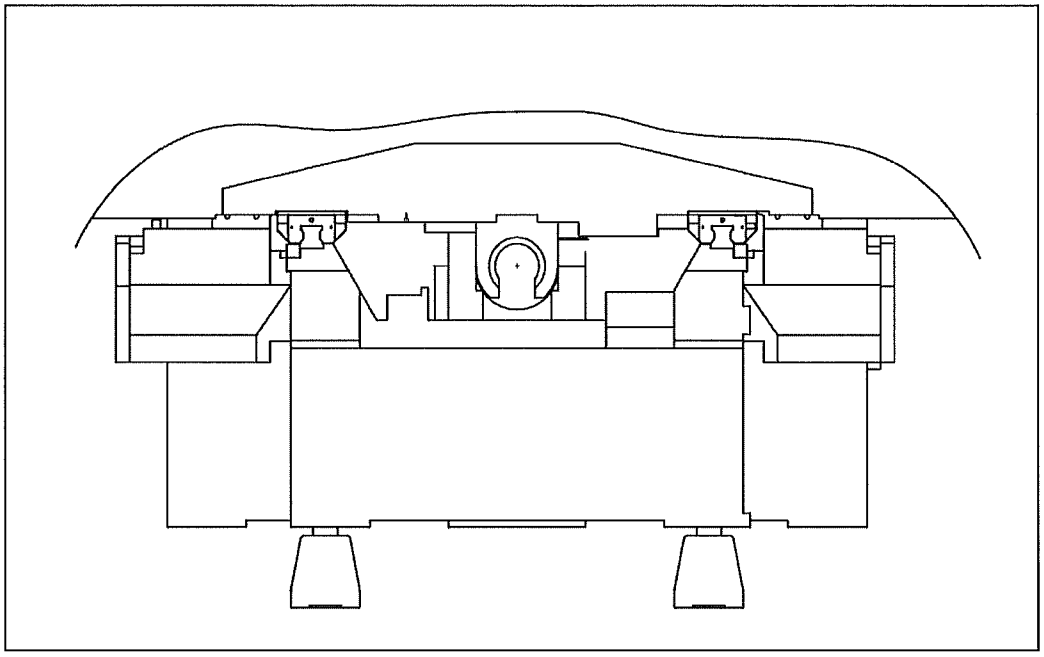
8-4-2 Guidway drawing

1. VCN Compact

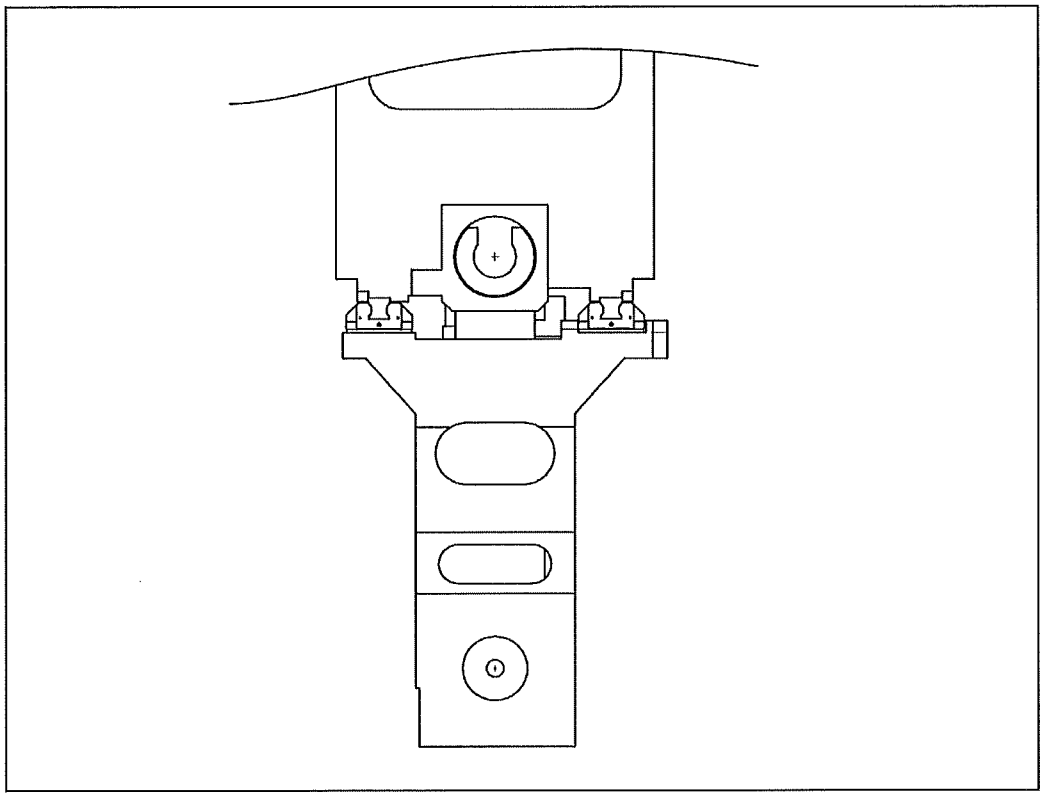
A. X-axis guide way



B. Y-axis guide way

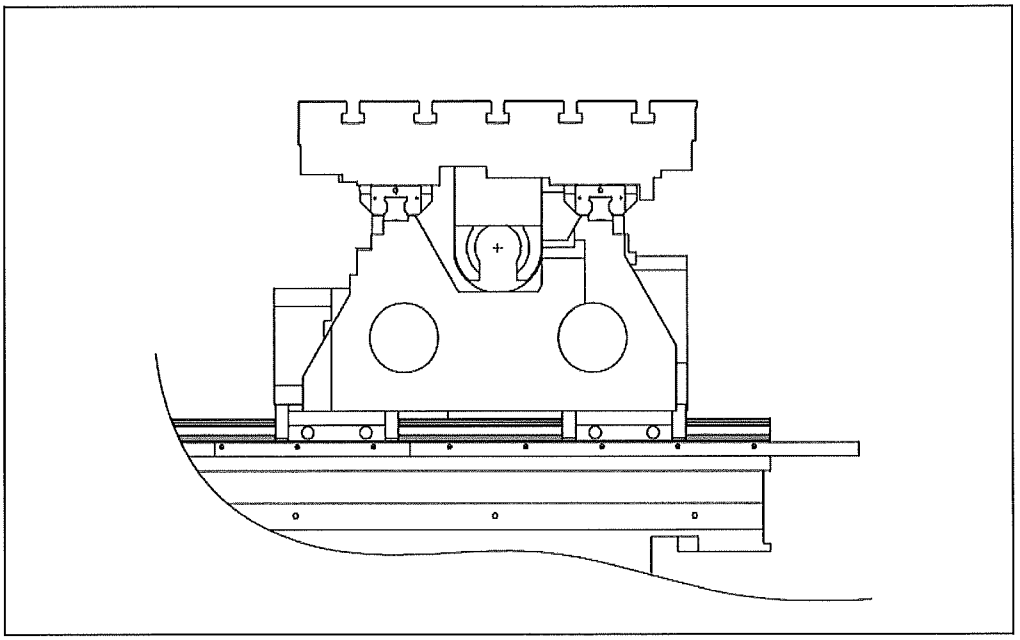


C. Z-axis guide way

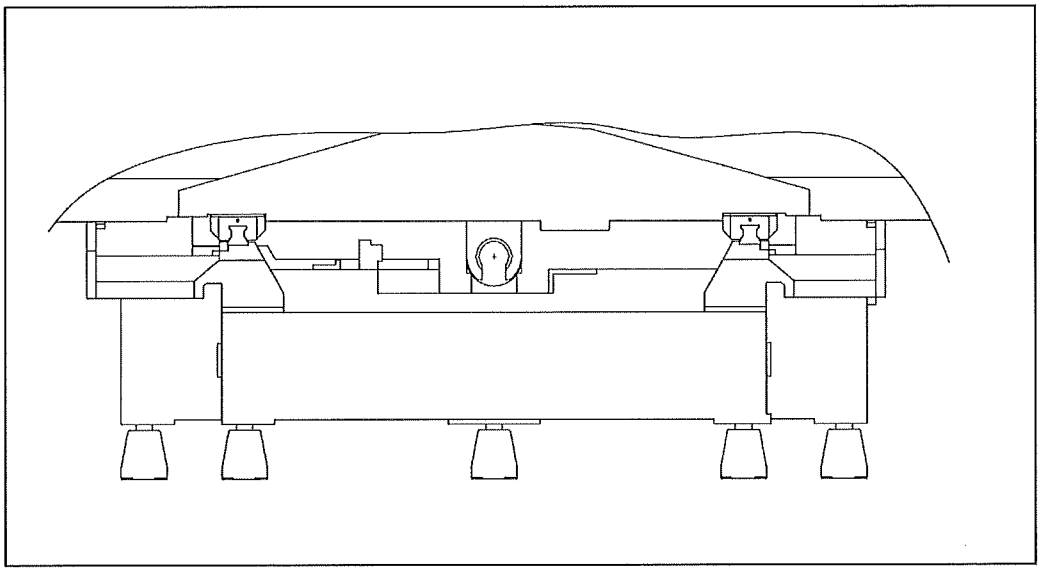


2. VCN Compact 5x

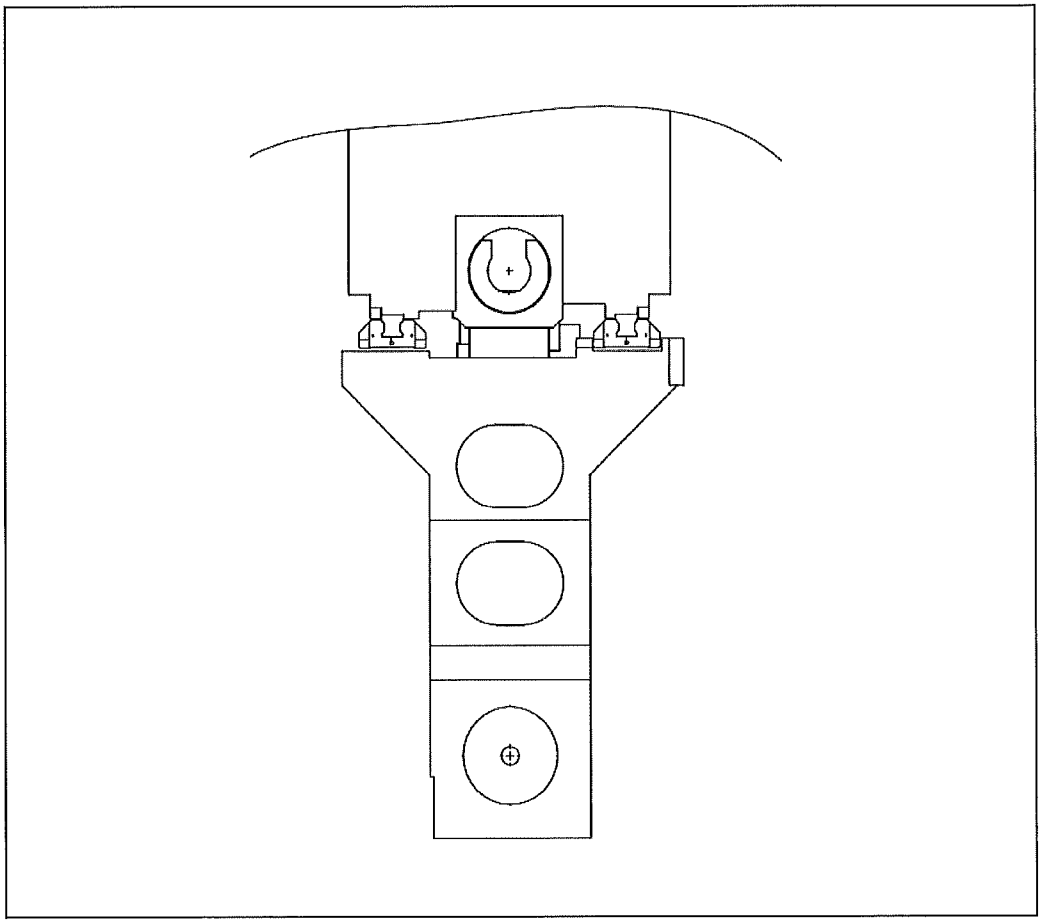
A. X-axis guide way



B. Y-axis guide way

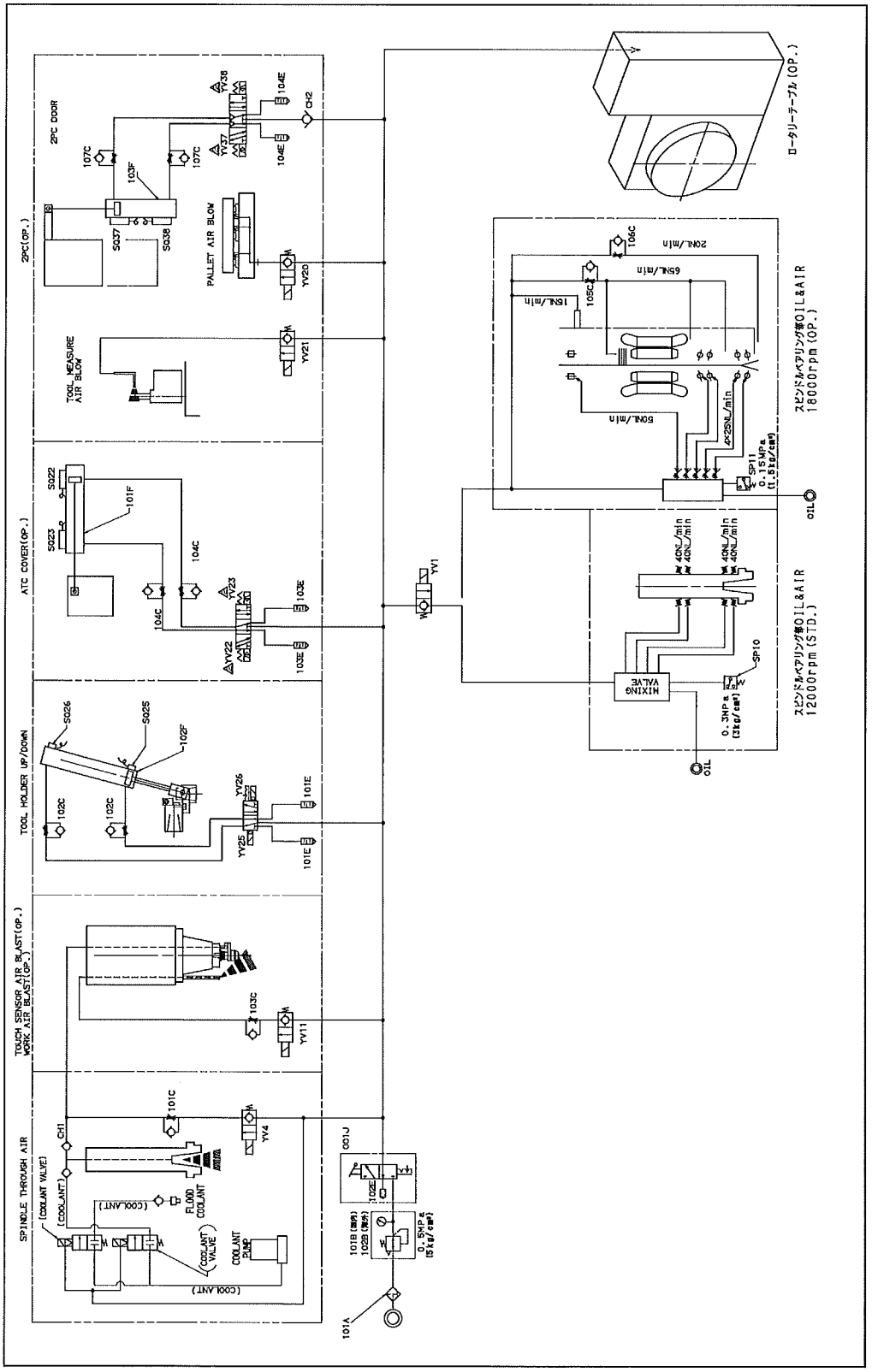


C. Z-axis guide way



8-5 Pneumatic System Diagram

1. VCN Compact



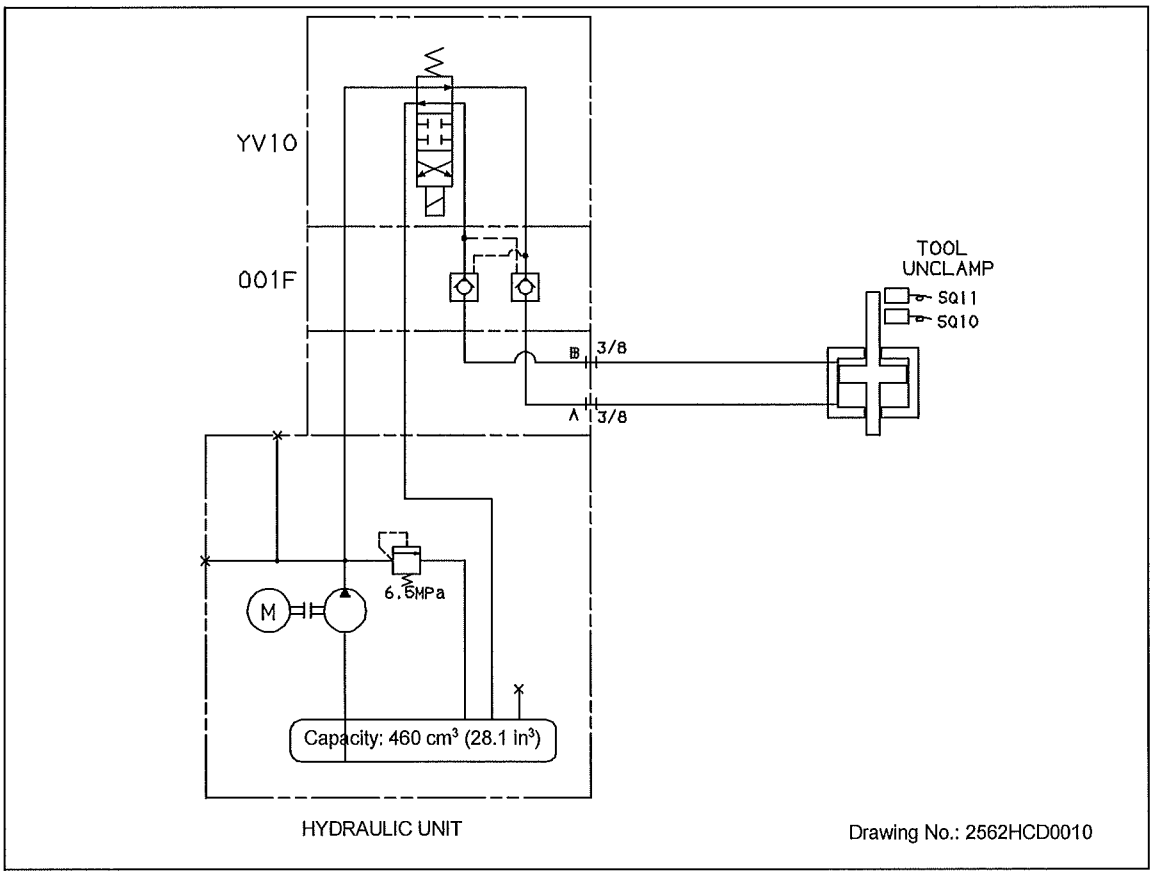
8-6 Hydraulic Circuit

8-6-1 Hydraulic unit

Item		Specification
Oil tank capacity		460 cm^3 (28.1 in^3)
Hydraulic pump	Type	Gear pump
	Pressure	6.5 MPa (943 psi)
	Flow rate	14.2 L/min (0.50 ft^3/min) (50 Hz), 17.0 L/min (0.60 ft^3/min) (60 Hz)
Pump drive motor		1.2 kW (2P)
Applicable hydraulic fluid		Mobil DTE 24, etc. **(Note)**

Note: The hydraulic unit installed on this machine is maintenance-free and customers are free from replacing hydraulic operating fluids.

8-6-2 Hydraulic circuit diagram



HYDRAULIC UNIT

Drawing No.: 2562HCD0010

Part No.	Part name	Type (Remark)
G49BY007981	Hydraulic unit	E4115-02200U (KAYABA)

Abbreviation-No.	Part No.	Part name	Type (maker name)	Comment
SQ10	R25YB002591	Proximity sensor	FL7M-3J6HD-L3 (YAMATAKE)	Tool unclamp
SQ11				Tool clamp
YV10	G16FH005241 (Attached to hydraulic unit)	Solenoid valve	SA-G01-A3X-D2-31 (FUJIKOSHI)	Tool unclamp
001F	(Attached to hydraulic unit)	Pilot check valve	CPC-02 (KAYABA)	Tool unclamp

8-7 Central Lubrication Unit

8-7-1 Guideways and ball screw lubrication

Lubricated place	Effective capacity	Recommended grease	Remarks
Electric grease pump	260 cm^3 (15.86 in^3) [400 cm^3 (24.41 in^3)]	CITRAX EP No. 1 (Kyodo Yushi) MULTI NOCK GREASE 1 (Eneos) MOBILUX EP1 (Mobil)	

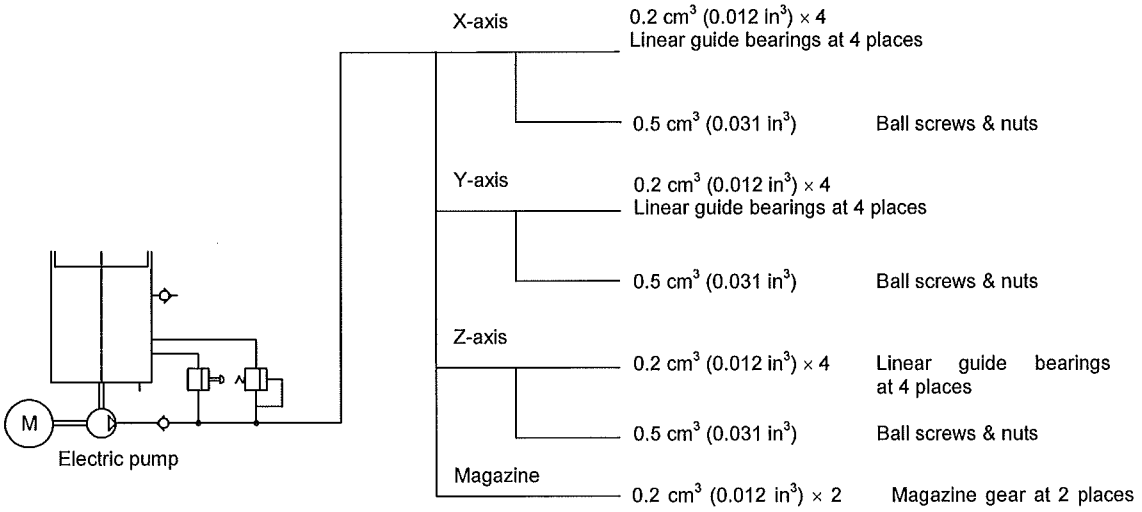
Note : The value in [ ] is for the cartridge type grease pump.

1. Central lubrication unit (LUBE make)

Pump unit	Electric intermittent type grease pump
Pump discharge amount	10 cm^3/min (0.61 in^3/min)
Pump discharge pressure	10 MPa (1450 psi) set at the relief valve
Effective capacity	260 cm^3 (15.86 in^3) [400 cm^3 (24.41 in^3)]
Operation interval	24 hours
Oil supply interval	6 months [9 months] (operation based on 3000 hours a year)
Alarm	Pressure detection

Note : The value in [ ] is for the cartridge type grease pump.

2. Circuit diagram and discharge amount per cycle



8-7-2 Lubrication in the spindle bearing (20000 min^{-1} spindle)

Lubricated place	Effective capacity	Recommended oils	Remarks
Central lubrication tank	1.8 L (0.06 ft^3)	SUPER MULPUS DX32 (Eneos) DAPHNY SUPER MULTI 32 (Idemitsu) DTE 24 (Mobil)	Automatically and timely lubricated

3. Central lubrication unit (LUBE make)

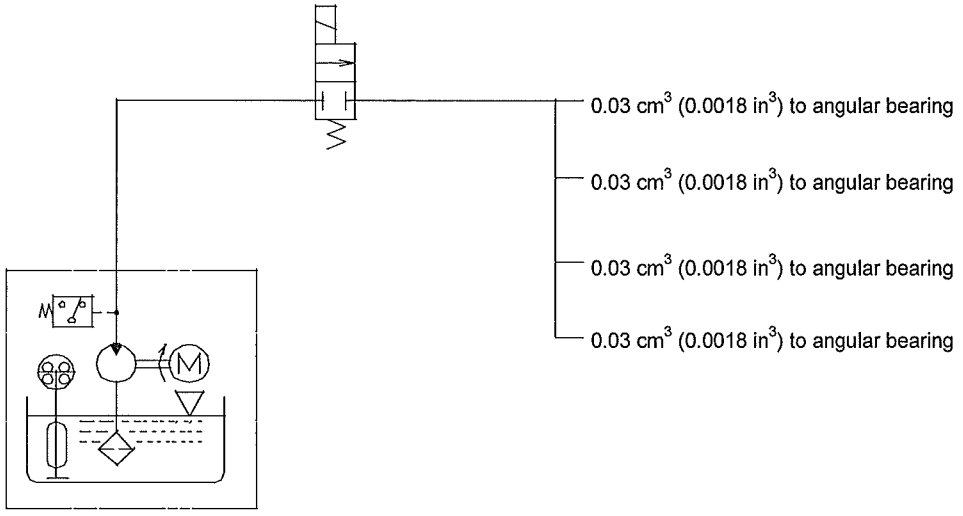
Pump unit	Electric intermittent discharge gear pump
Motor	Power AC100V, output 19/18 W (50/60 Hz)
Pump discharge amount	90/110 cm^3/min (5.49/6.71 in^3/min) (50/60 Hz)
Pump discharge pressure	1.5 MPa (217.5 psi) set at the relief valve
Effective capacity	1.8 L (0.06 ft^3)
Level switch	The contact switch B goes off when the oil drops down to the lower limit.
Pressure switch	Contact switch A
Lubrication point	Spindle bearing

4. Circuit diagram and discharge amount per cycle

A. VCN Compact 20000 min^{-1} spindle

Operation interval: 4-minute cycle (3.5 minutes off and 0.5 minute on)

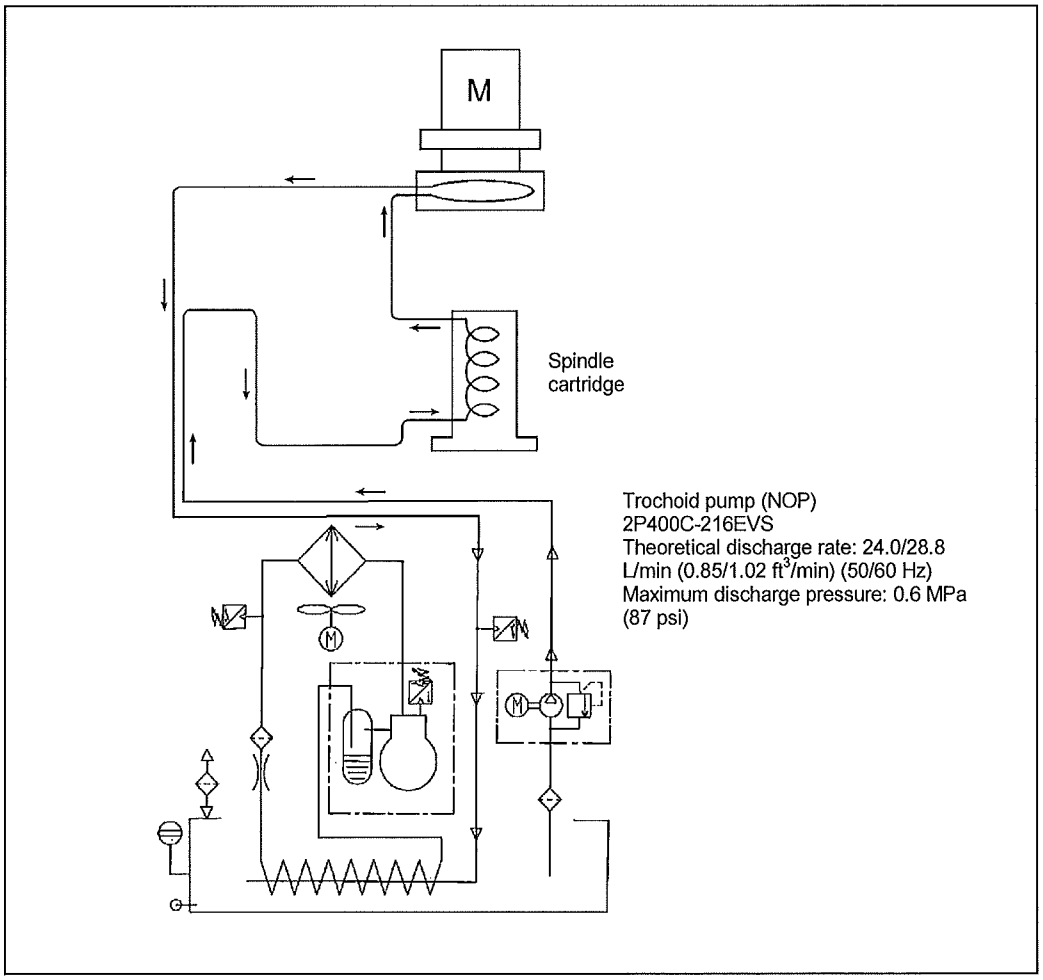
Oil supply interval: About 4 months (operation based on 3000 hours a year)



8-8 Spindle Head Cooling System

8-8-1 Cooling system (12000 min^{-1} spindle) in spindle head

1. Cooling system circuit diagram

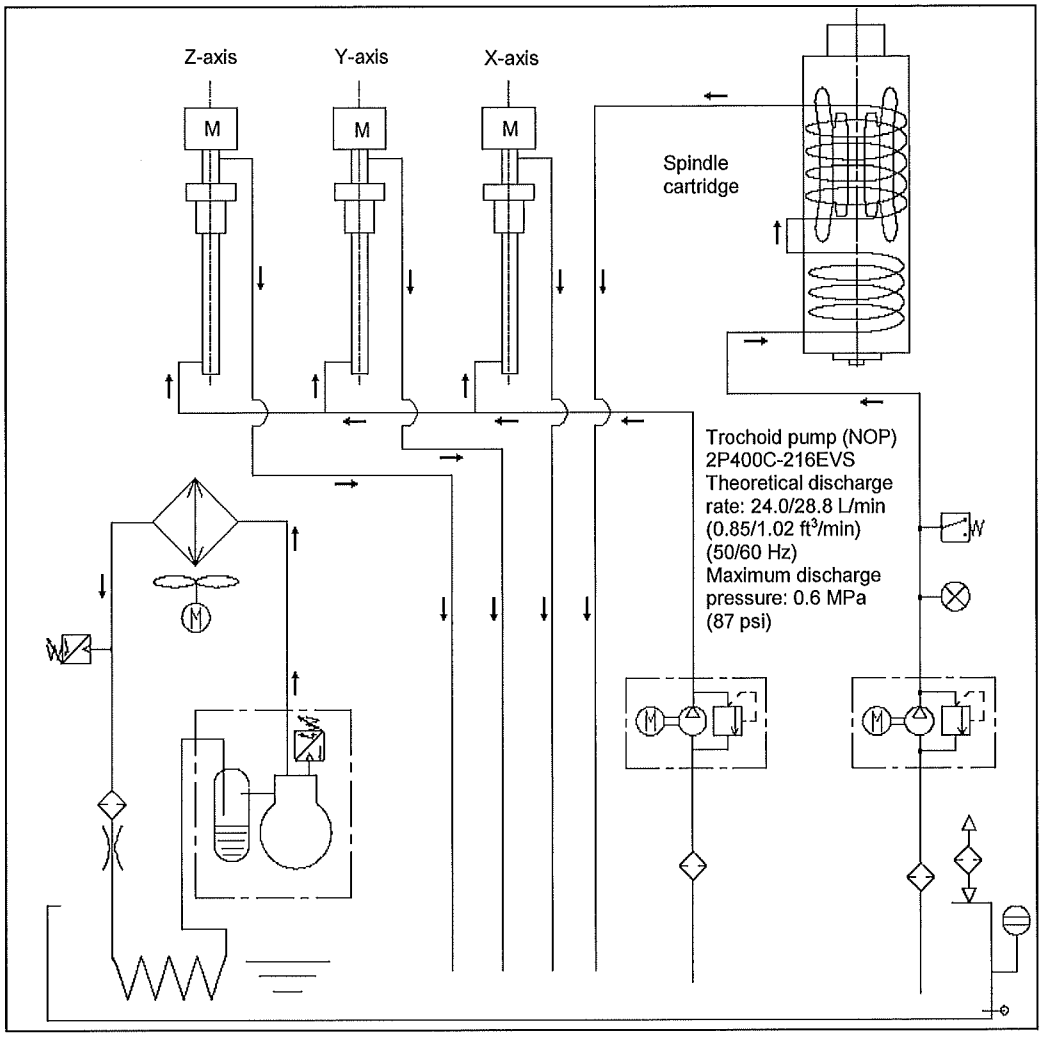


2. Specifications

Chiller unit specification	
Power	AC 200 V × ϕ3 (50/60 Hz)
Power capacity	3.0 kVA
Cooling capacity	3000/3350 W (50/60 Hz)
Type	KMV-75-M02 (Made by Kowa Kogyo)
Paint color	Silver gray (Munsell No. 9.2B6.7/1.2)
Mass	75 kg (165 lbs)
Tank capacity	16 L (0.57 ft³)

8-8-2 Cooling system [20000 min^{-1} spindle] in spindle head

3. Cooling system circuit diagram

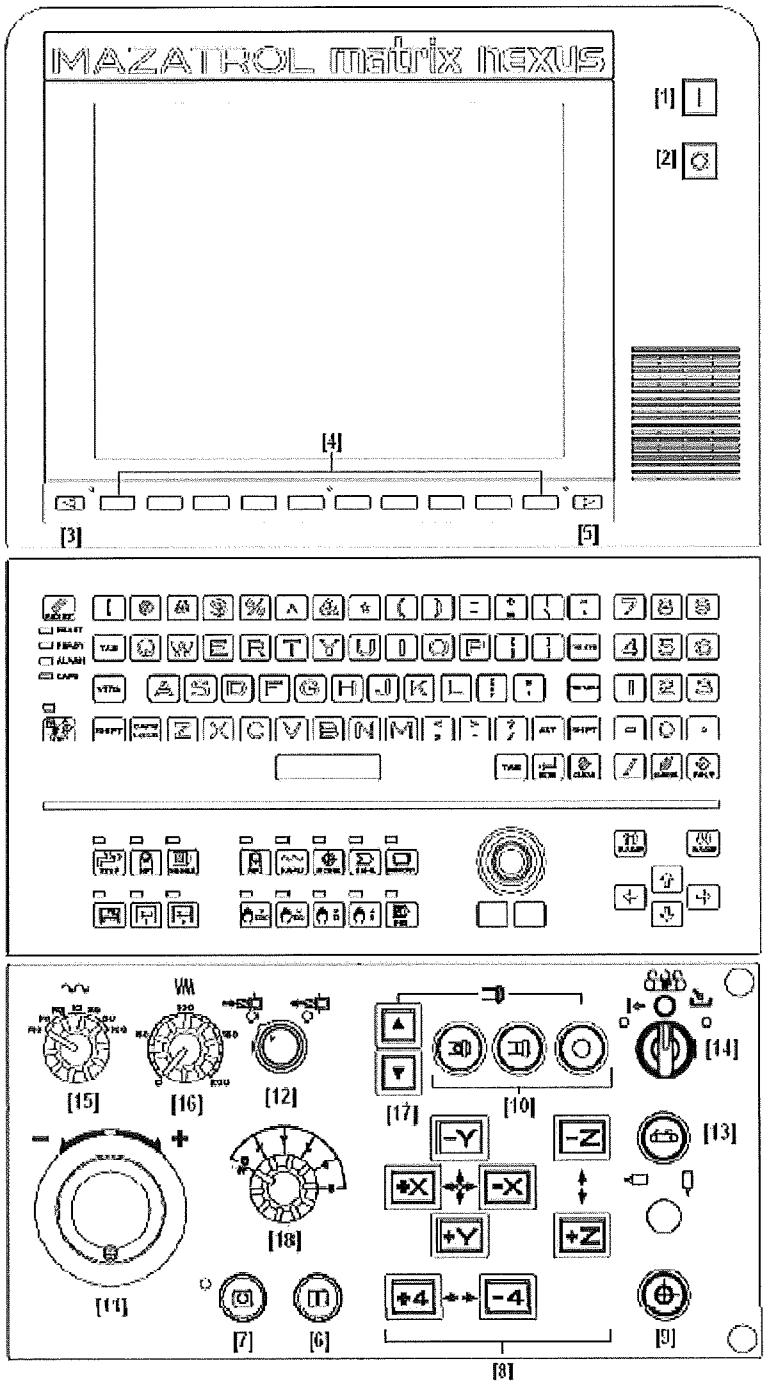


4. Cooling system specifications

Chiller unit specification	
Power	AC 200 V × ϕ3 (50/60 Hz)
Power capacity	3.5 kVA
Cooling capacity	3920/4460 W (50/60 Hz)
Type	KMV-1110-M10 (Made by Kowa Kogyo)
Paint color	Silver gray (Munsell No. 9.2B6.7/1.2)
Mass	120 kg (265 lbs)
Tank capacity	72 L (2.54 ft^3)

8-9 NC Operation Panel

8-9-1 Operation panels



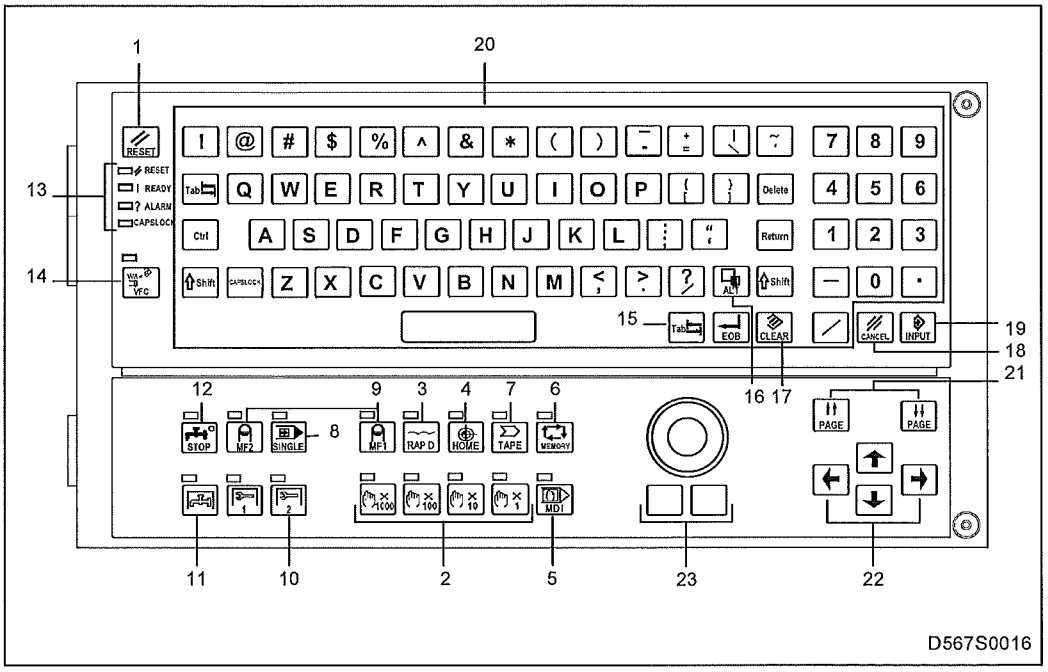
Switches, etc.

No.	Name	No.	Name
1	Power ON button	12	Tool unclamp switch
2	Power OFF button	13	Chip conveyor switch (optional)
3	Screen selector key	14	Spiral conveyor switch (optional)
4	Menu key	15	Rapid traverse override switch
5	Menu selector key	16	Cutting feed override switch
6	Start button	17	Spindle speed override keys
7	Feed hold button	18	Axis selector switch
8	Axis travel button	19	Emergency stop button
9	Each axis zero return button	20	Door unlock button
10	Spindle stop/start/normal/reverse button	21	Machine set up switch
11	Manual pulse handle	22	Program change switch

A. NC operation panel keys

Several keys on the operation panel have a small lamp on the left shoulder. This lamp, called "key lamp," lights up when its key is pressed or is ON when its key function is active. When this lamp is OFF, its key function is inactive.

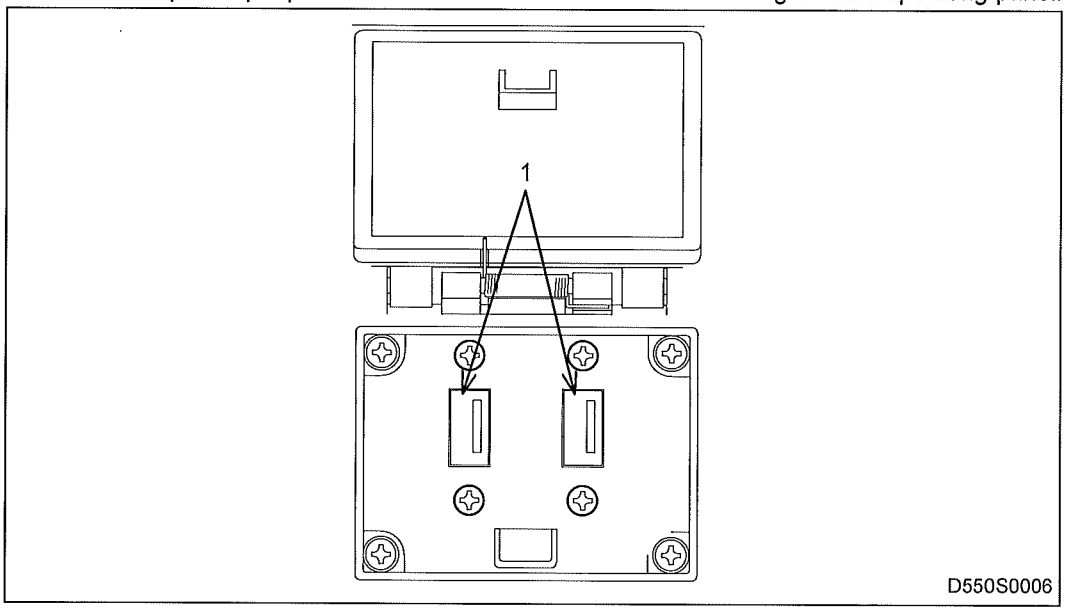
Several buttons on the operation panel have a built-in lamp. This lamp lights up when its button is pressed or is ON its button function is active. When this lamp is OFF, its button function is inactive.



No.	Name	No.	Name
1	RESET key	13	Machine status indicator
2	Cutting feed/Pulse handle feed keys	14	VFC key
3	RAPID traverse key	15	Tab key
4	1st HOME key	16	Window key
5	MDI key	17	CLEAR key
6	MEMORY operation key	18	Data CANCEL key
7	TAPE operation key	19	INPUT key
8	SINGLE block key	20	Address/numeric keys
9	Machine function (MF1) key	21	Page feed keys
10	Machine menu key	22	Cursor keys
11	Coolant menu key	23	Tablet pointer
12	Coolant stop key		

B. USB I/F Input/Output Panel

The USB I/F input/output panel shown below is located on the lower right of the operating panel.



No.	Name	Function
1	USB (Universal Serial Bus) connector	This enables interfacing with an FD (floppy disk) drive, mouse, keyboard or other external devices.

8-9-2 NC specification

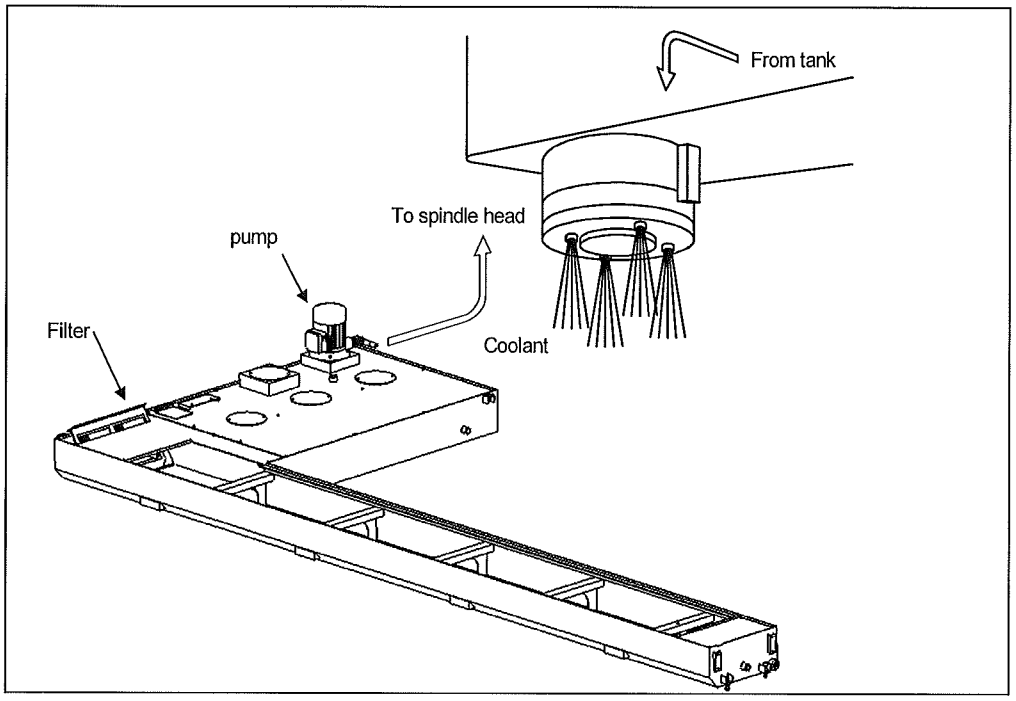
For the specifications of NC, refer to the separately published volumes.

NC	Machine model
MAZATROL MATRIX NEXUS	VCN Compact
MAZATROL MATRIX	VCN Compact 5x

8-10 Coolant Unit

Outline of Structure and Operation

Coolant tank unit comprises of two chip pans which separate chips from coolant, tanks which reserve coolant, a filter and a coolant pump unit. The coolant flows through the coolant tank filter, then through the tubing with the help of the coolant pump and sprays through the nozzles installed at the bottom of the spindle head.

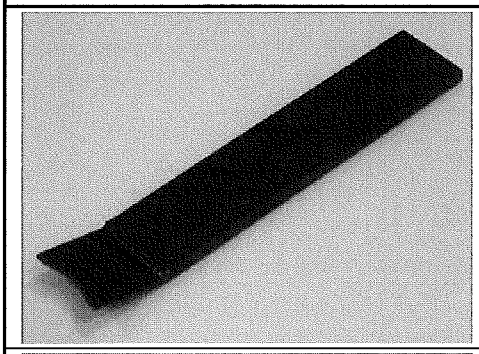
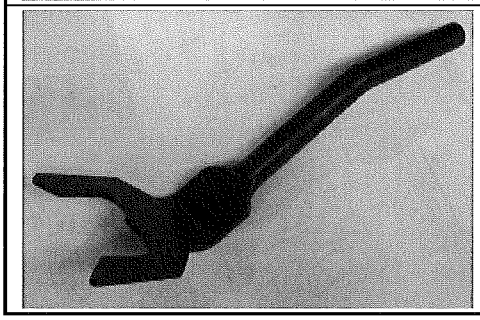


Item	Specification
Coolant pump	MTH2-50/2A (Grundfos) 230/365 W (50/60 Hz) 20 L/min (0.71 ft^3/min) (Condition : 50 Hz) 24 L/min (0.85 ft^3/min) (Condition : 60 Hz) : Discharge amount from nozzle
Filter	Mesh 10 net (stainless steel): 2 pieces

Coolant tank capacity

Item	VCN Compact / VCN Compact 5x
	L (ft^3)
Standard specification	200 (7.06)
With chip conveyor (hinge type or scraper type)	200 (7.06)
With chip conveyor (ConSep2000II WS)	357 (12.61)
Large capacity tank	400 (14.13)

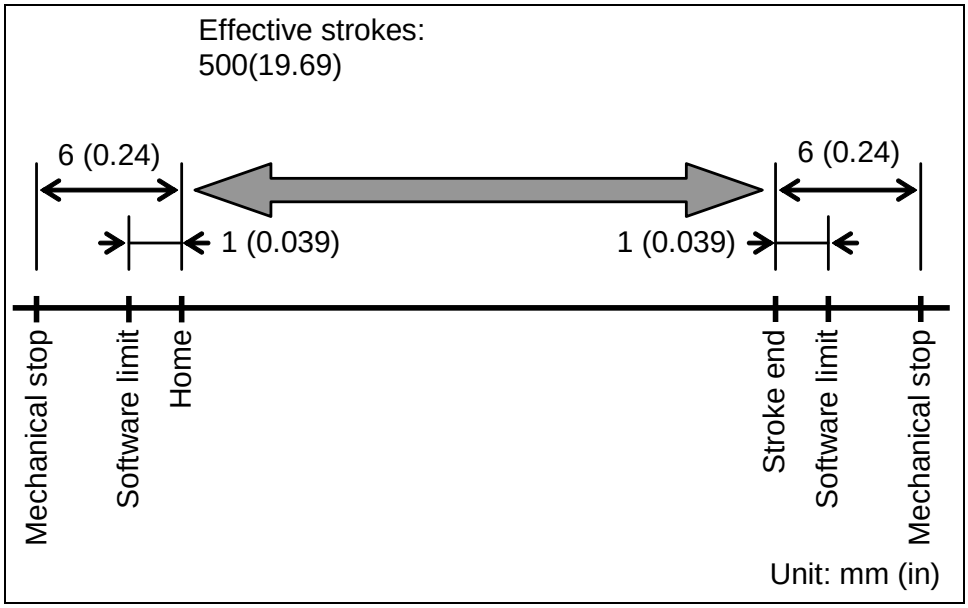
8-11 Accessory Tools

Tool Name	Type	Q'ty
	Lever Mazak part No.: 34221817761 (Used for removing MAS and CAT tools from the magazine)	1
	Lever (option) Mazak part No.: 25211839041 (Used for removing BIG-PLUS tools from the magazine)	1

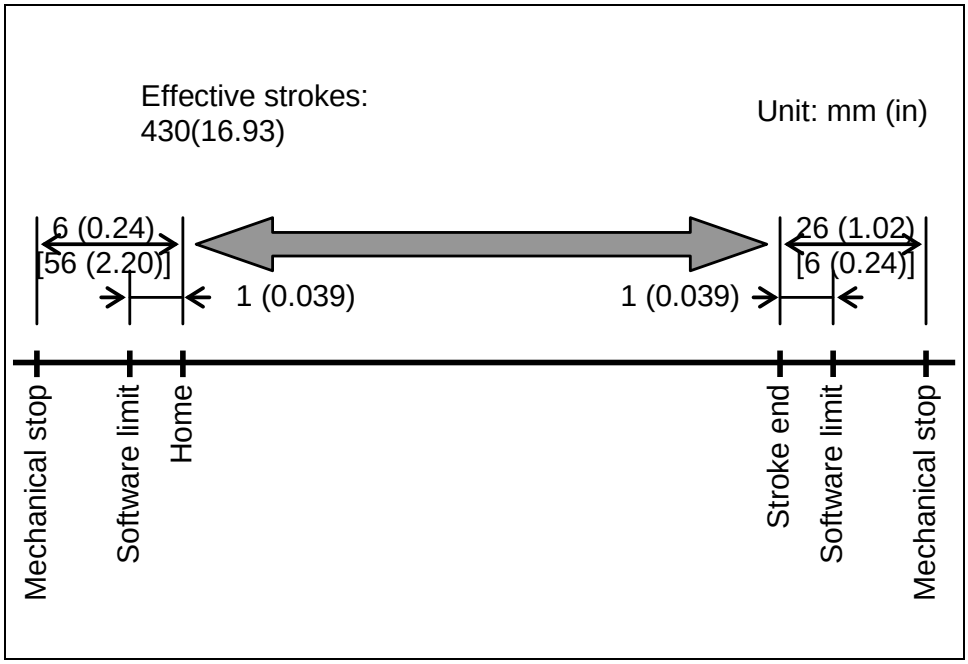
9 MACHINING CAPABILITIES

9-1 Stroke Dimensional Diagrams

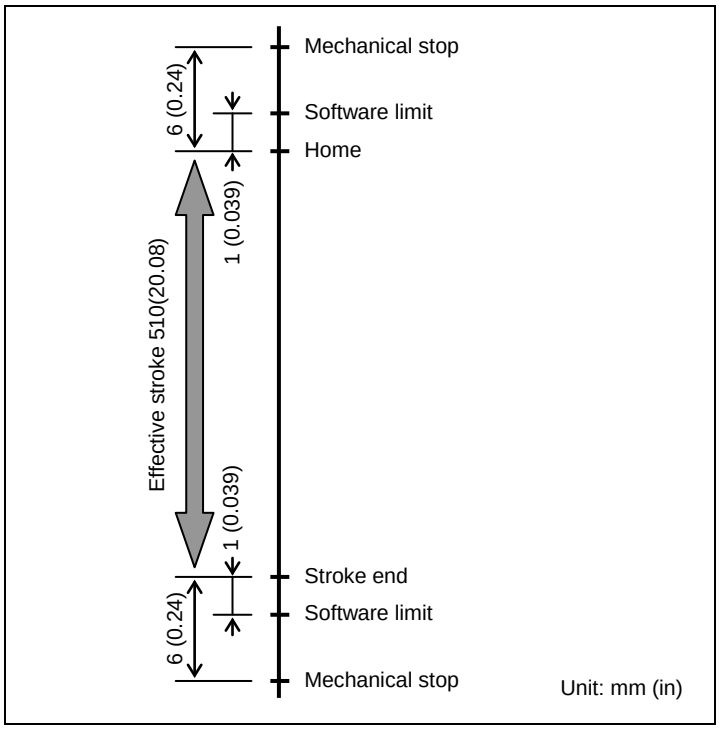
1. X-axis stroke



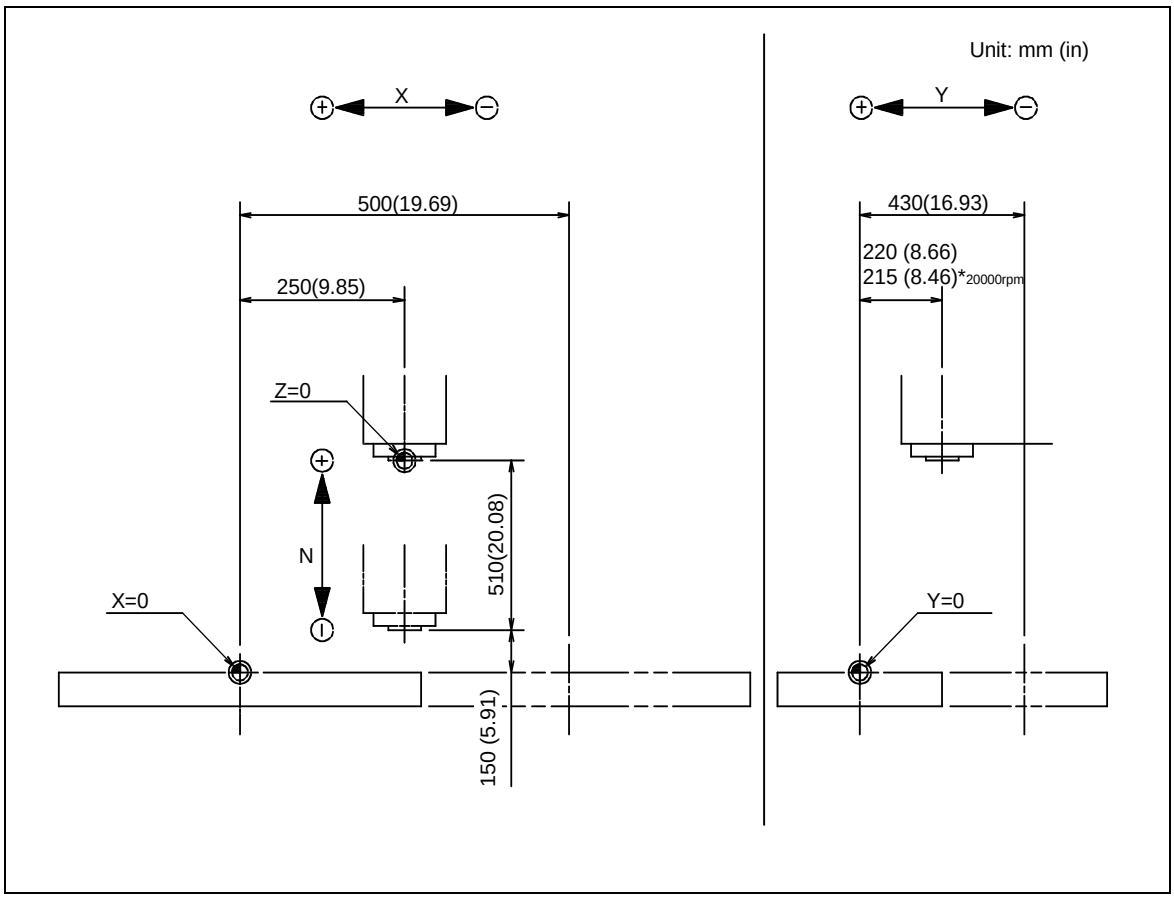
2. Y-axis stroke



3. Z-axis stroke



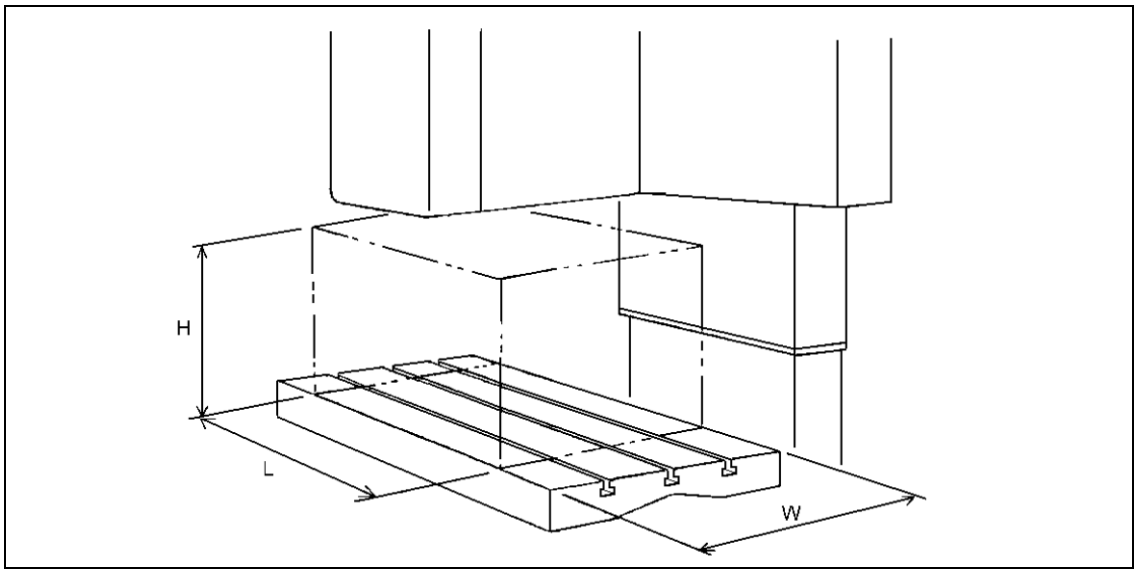
4. Stroke diagram



9-2 Limitations

9-2-1 Maximum workpiece dimensions

Workpieces that can be mounted on the table are only within the figure shown below. Never mount other workpieces that exceed the dimensions. Otherwise, such workpieces could cause troubles including damage to the machine.



1. Maximum workpiece dimensions

Type		VCN COMPACT
Max. length	L [mm (in)]	650 (25.59)
Max. width	W [mm (in)]	400 (15.75)
Max. height	H [mm (in)]	570 (22.44)
Max. mass	[kg (lbs)]	300 (660)

Note 1: When determining the dimensions of the workpieces to be machined, factors such as whether or not the tool length measurement unit is used, interference during tool change operation, etc. must also be taken into consideration.

2. Maximum workpiece dimensions 5x

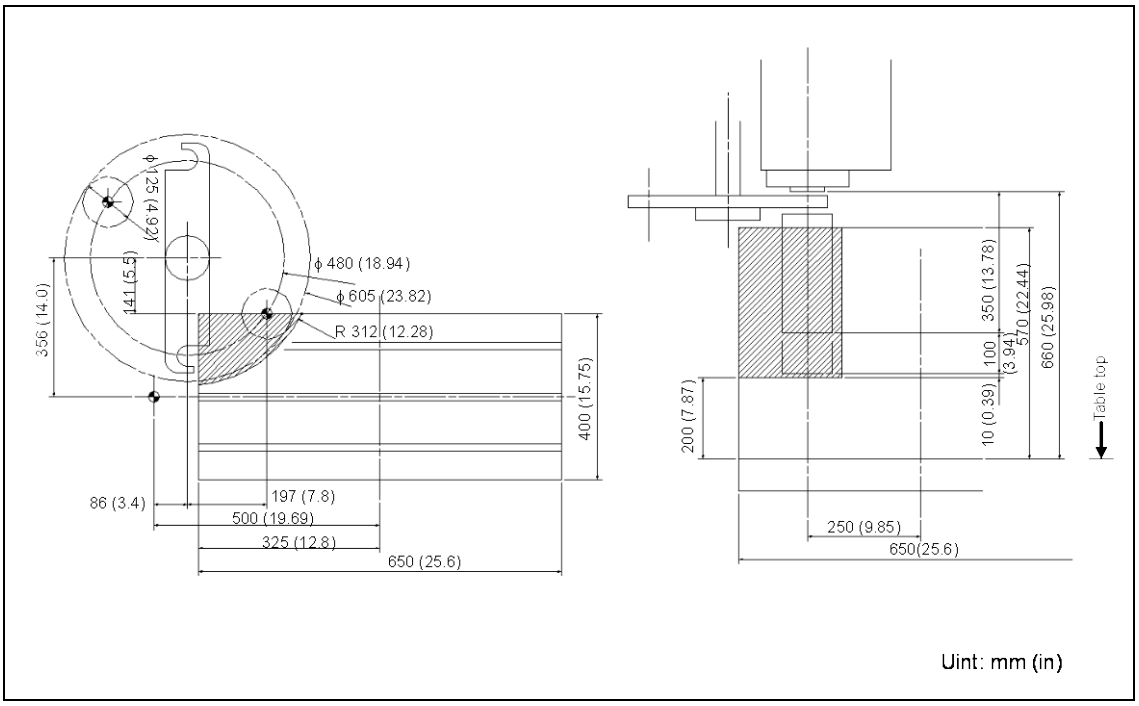
Type		RT080	RT100
Max. length	ϕL [mm (in)]	100 (3.94)	160(6.30)
Max. mass	[kg (lbs)]	10 (22.05)	30(66.15)

9-2-2 Interference of tool with workpiece when tools are changed

Be careful not to have a tool interfered with a workpiece on the table when tools are changed by referring to the figure below.

1. VCN Compact

When the table is escaped to its full stroke (X: –500, Y: 0) during ATC arm swings:

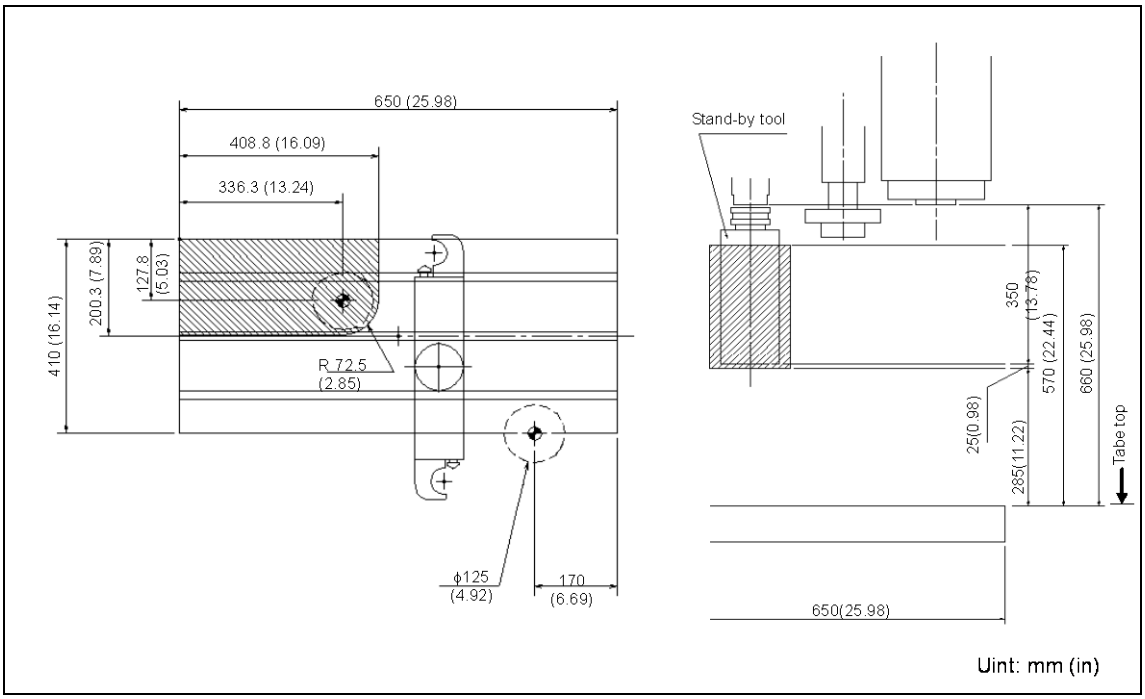


9-2-3 Interference of stand-by tool with workpiece in automatic run

With VCN 410A-II, VCN 410B-II or VCN 510C-II, be careful not to have a stand-by tool interfered with a workpiece on the table referring to the figure below in automatic run.

1. VCN Compact

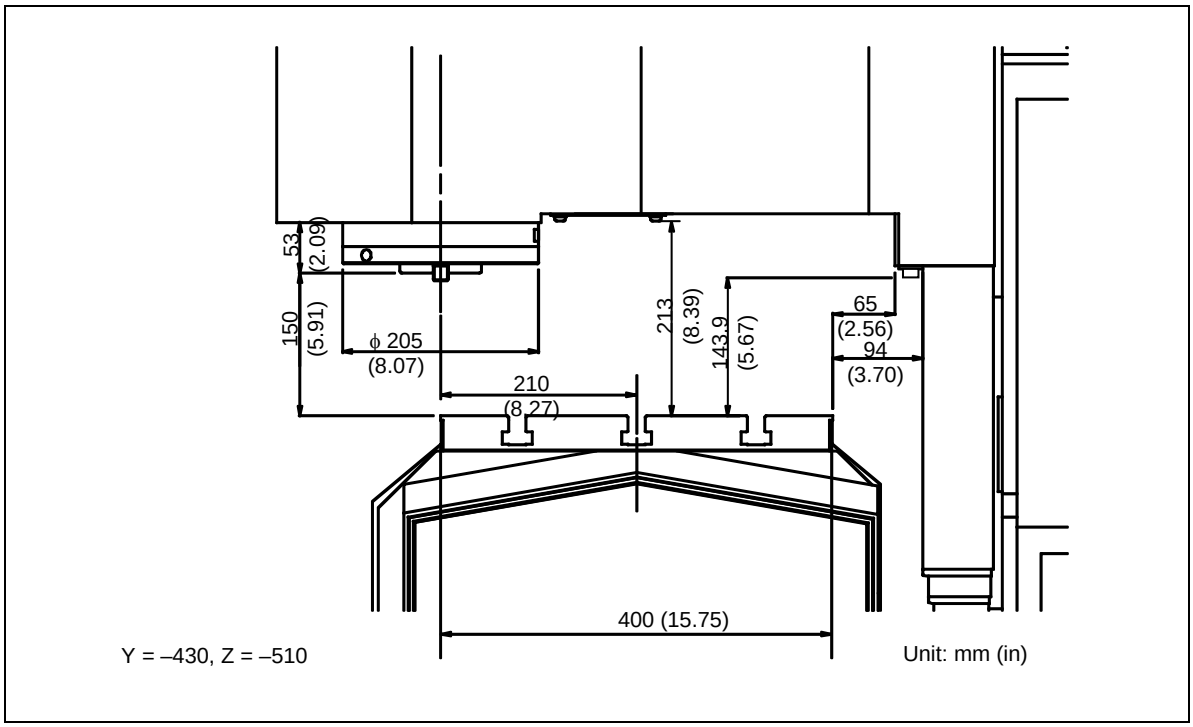
When the table is moved to its full stroke (X: 0, Y: –400) in automatic run:

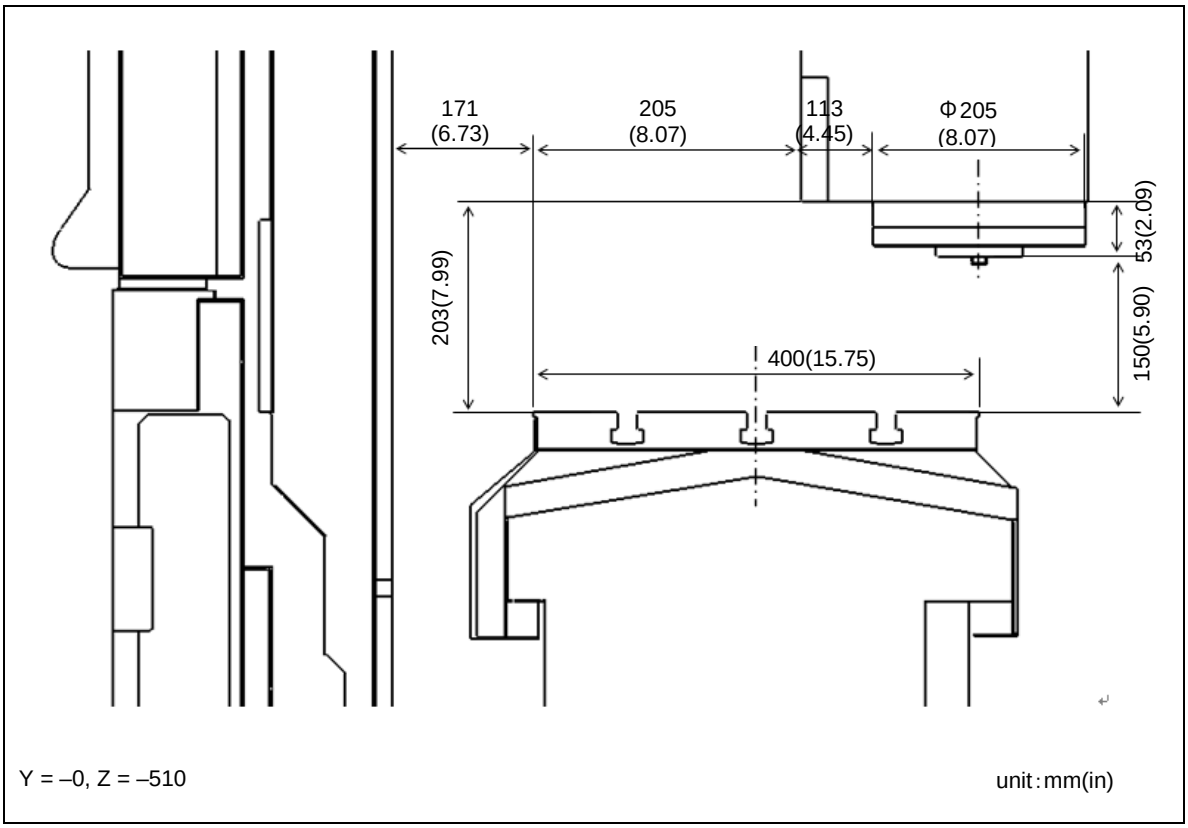


9-2-4 Cover interference (standard specification)

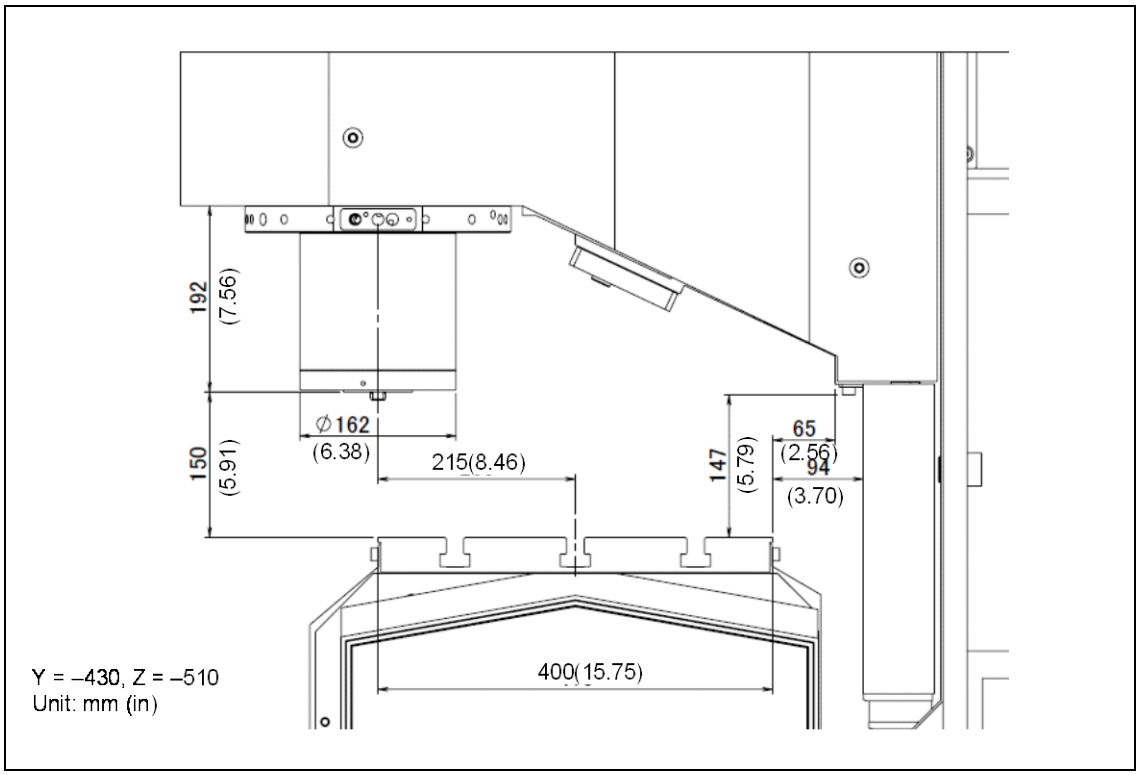
The values shown in the following figures are reference dimensions. There may be some errors between them and actual values. Take extra care about machine interference.

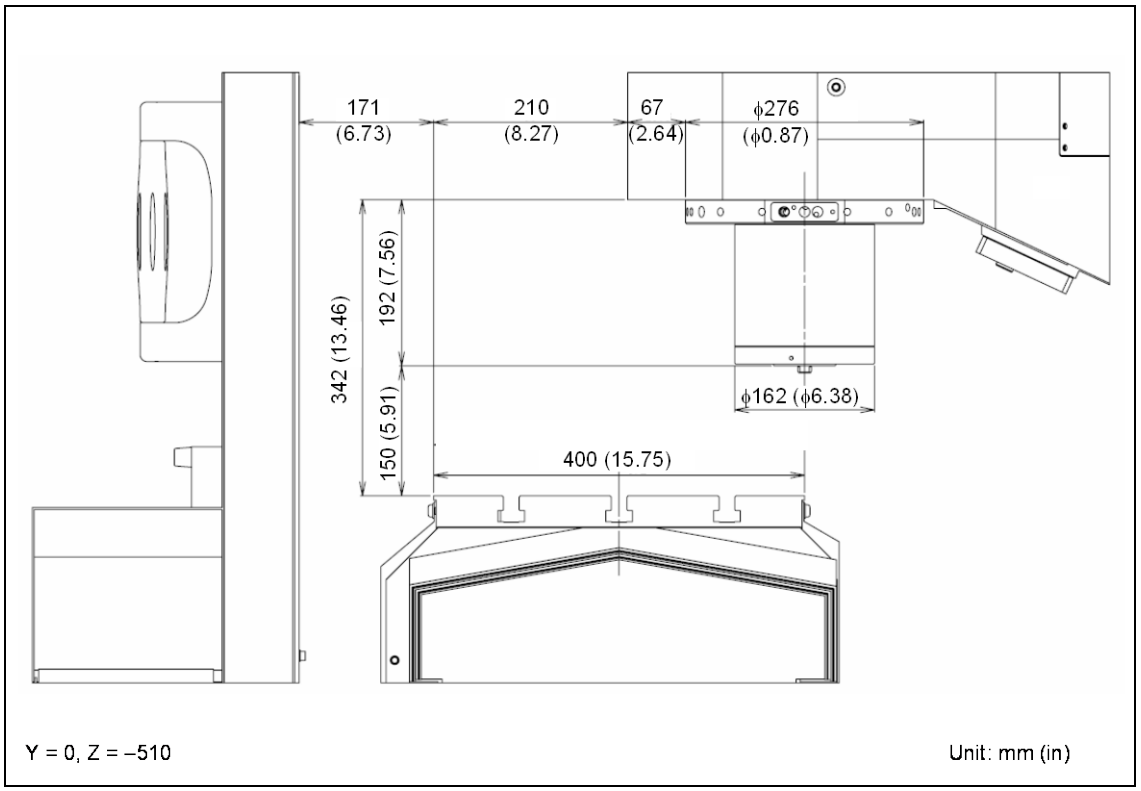
1. VCN Compact





2. VCN Compact (20000 rpm)

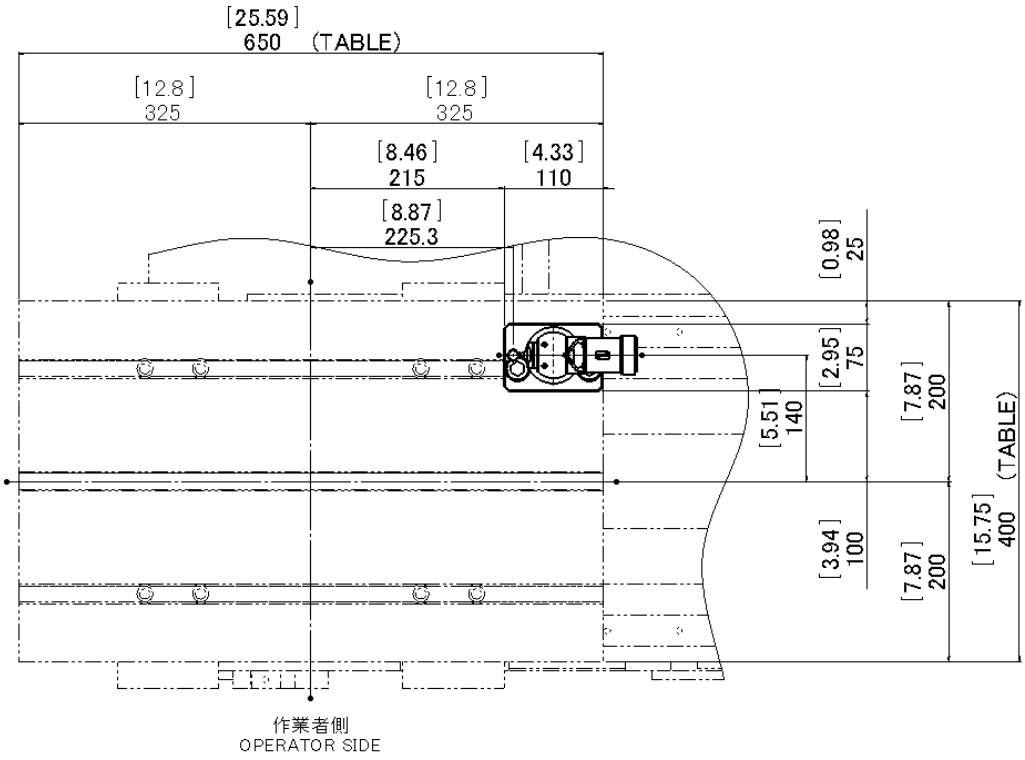




9-2-5 Interference of automatic tool-length measuring unit (option)

As the automatic tool length-measuring unit is mounted as shown below, it must not interfere with a workpiece, spindlehead, tool, fixture, or the like.

1. VCN Compact



9-3 Cutting Capabilities

An actual machining example is shown.

Some of the machining conditions may not be reproduced due to the rigidity of workpiece setting jig and workpiece and the tools to be used.

9-3-1 12000 min^{-1} spindle

1. Milling

A. Arbor: BT40-FMA25.4-45 (FUJIKOSHI)

B. Cutter: EHG4080R (SUMITOMO)

Cutter diameter: ϕ80 mm (ϕ3.15 in)

No. of teeth: 4

Corner angle: 45°

Radial rake angle: −3°

Axial rake angle: +20°

C. Tip: SERN42MT (Material: AC230)

D. Workpiece material: S45C (JIS)

E. Coolant: Dry cutting

Spindle speed	Cutting speed	Feed rate	Feed per tooth	Width of cut	Depth of cut	Cutting amount	Spindle load	
min^{-1}	m/min (IPM)	mm/min (IPM)	mm (in)/tooth	mm (in)	mm (in)	cm^3/min (in^3/min)	kW	(%)
1193	300 (11811.02)	1861 (73.27)	0.39 (0.015)	60 (2.36)	3.8 (0.15)	419 (25.56)	13.9	126

A. Arbor: BT40-FMA25.4-45 (FUJIKOSHI)

B. Cutter: RA265.2-080E-20 AL

Cutter diameter: ϕ80 mm (ϕ3.15 in)

No. of teeth: 4

Corner angle: 75°

Radial rake angle: +15°

Axial rake angle: +15°

C. Tip: SFAV1023EFRH10

D. Workpiece material: Aluminum (A5052)

E. Coolant: Wet cutting

Spindle speed	Cutting speed	Feed rate	Feed per tooth	Width of cut	Depth of cut	Cutting amount	Spindle load	
min^{-1}	m/min (IPM)	mm/min (IPM)	mm (in)/tooth	mm (in)	mm (in)	cm^3/min (in^3/min)	kW	(%)
7500	1884 (74173.23)	8000 (315.0)	0.27 (0.011)	78 (3.07)	3.9 (0.15)	2433 (148.4)	23.9	129

2. End milling

A. Chuck: BT40-CHN32-105 (FUJIKOSHI)

B. End milling:

Diameter of end milling: ϕ20 mm (ϕ0.79 in)

Milling type: 7562HF (DIXI)

No. of teeth: 2

Material: Carbide solid

Helix angle:

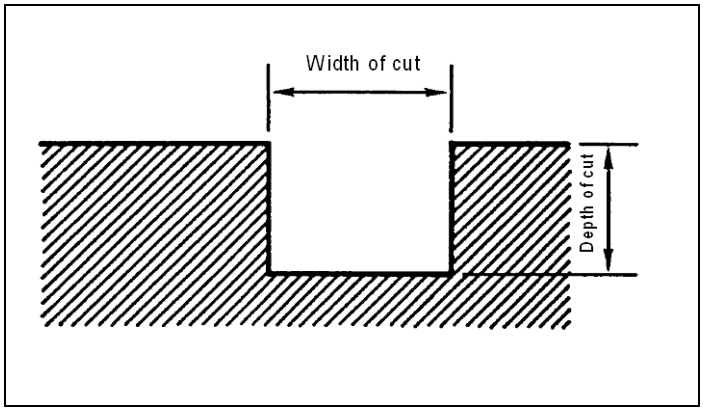
Redial rake angle:

Length from spindle end to tool tooth: 145 mm (5.71 in)

C. Workpiece material: Aluminum (A5052)

D. Coolant: Wet cutting

E. Machined configuration:



Spindle speed	Cutting speed	Feed rate	Feed per tooth	Width of cut	Depth of cut	Cutting amount	Spindle load	
min^{-1}	m/min (IPM)	mm/min (IPM)	mm (in)/tooth	mm (in)	mm (in)	cm^3/min (in^3/min)	kW	(%)
12000	754 (29685.04)	7920 (311.8)	0.33 (0.013)	20 (0.79)	8 (0.31)	1267 (77.29)	15.0	120

A. Chuck: BT40-CHN32-105 (FUJIKOSHI)

B. End milling:

Diameter of end milling: ϕ20 mm (ϕ0.79 in)

End milling type: 7562HF (DIXI)

No. of teeth: 2

Material: Carbide solid

Helix angle:

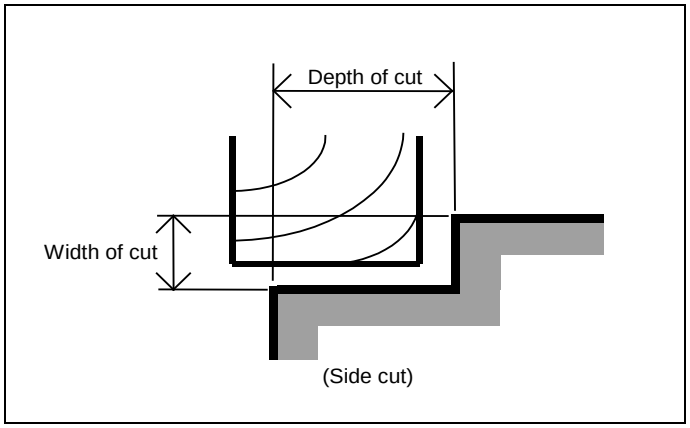
Radial rake angle:

Distance between spindle end and tool tooth: 145 mm (5.71 in)

C. Workpiece material: Aluminum

D. Coolant: Wet cutting

E. Machined configuration:



Spindle speed	Cutting speed	Feed rate	Feed per tooth	Width of cut	Depth of cut	Cutting amount	Spindle load	
min^{-1}	m/min (IPM)	mm/min (IPM)	mm (in)/tooth	mm (in)	mm (in)	cm^3/min (in^3/min)	kW	(%)
8000	503 (19803.15)	5760 (226.8)	0.36 (0.012)	12 (0.47)	25 (0.98)	1728 (105.4)	21.6	117

9-3-2 20000 min^{-1} spindle

1. Milling

A. Arbor: BT40-FMA25.4-45 (FUJIKOSHI)
B. Cutter: EUG4080R (SUMITOMO)
Cutter diameter: ϕ80 mm (ϕ3.15 in)
No. of teeth: 4
Corner angle: 45°
Radial rake angle: −3°
Axial rake angle: +20°
F. Tip: SERN42MT (Material: AC230)
G. Workpiece material: S45C (JIS)
H. Coolant: Dry cutting

Spindle speed	Cutting speed	Feed rate	Feed per tooth	Width of cut	Depth of cut	Cutting amount	Spindle load	
min^{-1}	m/min (IPM)	mm/min (IPM)	mm (in)/tooth	mm (in)	mm (in)	cm^3/min (in^3/min)	kW	(%)
1500	377 (14842.52)	2340 (92.1)	0.39 (0.015)	70 (2.76)	4.7 (0.19)	770 (46.98)	21.6	117

A. Arbor: BT40-FMA25.4-45 (FUJIKOSHI)
B. Cutter: RA265.2-080E-20 AL (SANDVIC)
Cutter diameter ϕ80 mm (ϕ3.15 in)
No. of teeth: 4
Corner angle: 75°
Radial rake angle: +15°
Axial rake angle: +15°
C. Tip: SFAV1023EFRH11 (SANDVIC)
D. Workpiece material: Aluminum (A5052)
E. Coolant: Dry cutting

Spindle speed	Cutting speed	Feed rate	Feed per tooth	Width of cut	Depth of cut	Cutting amount	Spindle load	
min^{-1}	m/min (IPM)	mm/min (IPM)	mm (in)/tooth	mm (in)	mm (in)	cm^3/min (in^3/min)	kW	(%)
5000	1256 (49448.82)	8000 (314.96)	0.4 (0.016)	72 (2.83)	7.5 (0.30)	4320 (263.6)	35.1	117

2. End milling

A. Chuck: BT40-CHN32-105 (FUJIKOSHI)

B. End mill:

End mill diameter: ϕ20 mm (ϕ0.79 in)

End mill model: 7562HF(DIXI)

No. of teeth: 2

Material: Carbon solid

Helix angle:

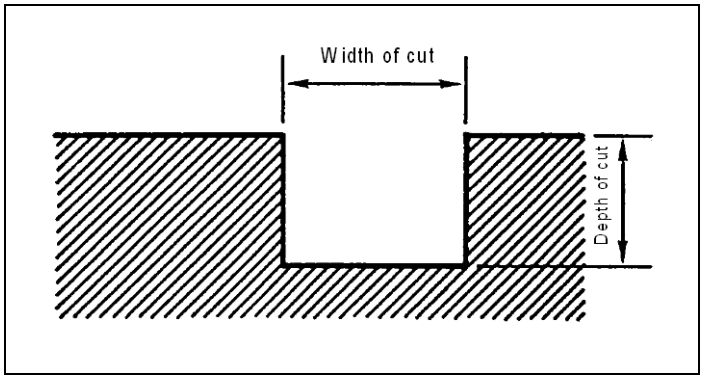
Radial rake angle:

Distance between spindle end and tool tooth: 145 mm (5.71 in)

C. Workpiece material: Aluminum (A5052)

D. Coolant: Dry cutting

E. Machined configuration:



Spindle speed	Cutting speed	Feed rate	Feed per tooth	Width of cut	Depth of cut	Cutting amount	Spindle load	
min^{-1}	m/min (IPM)	mm/min (IPM)	mm (in)/tooth	mm (in)	mm (in)	cm^3/min (in^3/min)	kW	(%)
15000	942 (37086.61)	9900 (389.76)	0.33 (0.013)	20 (0.79)	14 (0.55)	2772 (169.13)	26.2	109

A. Chuck: BT40-CHN32-105 (FUJIKOSHI)

B. End mill:

End mill diameter: ϕ20 mm (ϕ0.79 in)

End mill model: 7562HF (DIXI)

No. of teeth: 2

Material: Carbide solid

Helix angle:

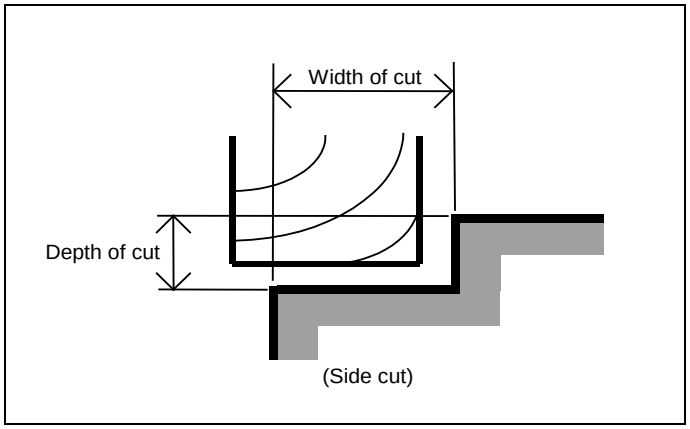
Radial rake angle:

Distance between spindle end and tool tooth: 145 mm (5.71 in)

C. Workpiece material: Aluminum (A5052)

D. Coolant: Dry cutting

E. Machined configuration:



Spindle speed	Cutting speed	Feed rate	Feed per tooth	Width of cut	Depth of cut	Cutting amount	Spindle load	
min^{-1}	m/min (IPM)	mm/min (IPM)	mm (in)/tooth	mm (in)	mm (in)	cm^3/min (in^3/min)	kW	(%)
12000	754 (29685.04)	9600 (377.95)	0.4 (0.016)	12 (0.47)	25 (0.98)	2880 (175.72)	31.8	106

10 ACCURACY

Refer to the separately supplied “*CERTIFICATION OF THE MACHINE ACCURACY” <MAZAK PRECISION STANDARD>*.

11 OPTIONS

11-1 Option List

○: Option that customers can mount　　□: Special order

◎: Option that customers cannot mount　　×: Unavailable

3D machine model (Virtual modeling function of Mazatrol MATRIX):

●: Already equipped　×: Cannot equip　-: Unnecessary

Item		VCN Compact	VCN Compact 5x
Position detector	Scale feedback system (X, Y, Z)	◎	◎
	Scale feedback system (X, Y)	◎	◎
FA equipment	Automatic tool length measurement function	○	○
	Automatic power breaker	○	○
	Fully closed ceiling cover	○	○
	Preparation for visual tool ID/data control	◎	◎
	Automatic opening/closing front door with both-hand start switch	◎	◎
Coolant related options	Workpiece air blast	○	○
	Through-spindle coolant system (0.5 MPa [72.5 psi])	○	○
	High-pressure through-spindle coolant system (1.5 MPa [217.6 psi])	○	○
	High-pressure through-spindle coolant system (7.0 MPa [1015.3 psi])	○	○
	Cover coolant system	○	○
	Niagara coolant	○	○
	Hand held coolant nozzle	○	○
	Oil skimmer	○	○
	Oil hole coolant system	◎(note1)	◎(note1)
	Coolant temperature control	□	□
	Oil-mist coolant	○	○

Item		VCN Compact	VCN Compact 5x
Chip disposal system related options	Chip conveyor (Hinge belt type)	O	O
	Chip conveyor (ConSep2000II WS)	O	O
	Chip bucket (Fixed type)	O	O
	Chip bucket (Rotary type)	O	O
Others	Single-color signal tower (yellow)	O	O
	Three-color signal tower (red, yellow and green)	O	O
	Mist collector	O	O
	Lighting system	O	O
	Additional light (halogen light)	O	O
	Additional M-functions	O	O
	Leakage breaker (only for Japan)	O	O
	Specially specified color paint	◎	◎
	Foundation parts (anchor bolts)	O	O
	Grease hand pump	O	O
	Separate manual pulse generator (1 set)	O	O

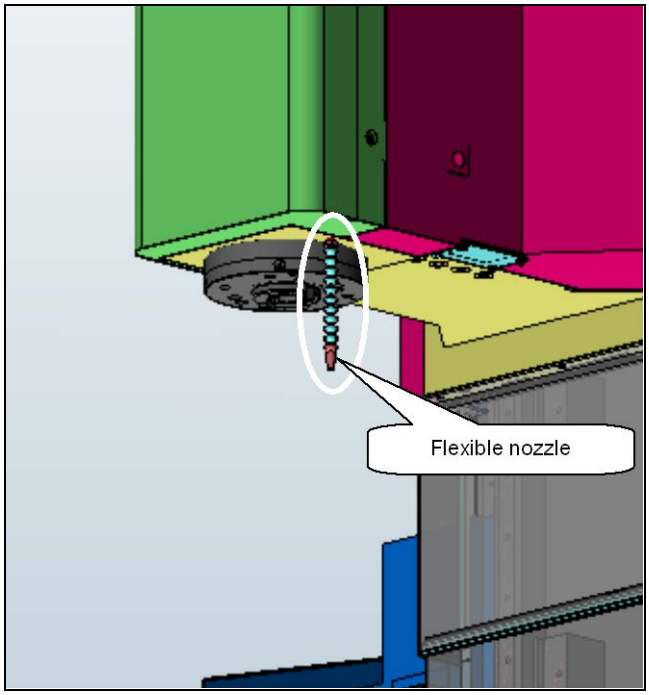
Note 1: Special order

11-1-1 Restriction of Intelligent Safety Shield function

Mazatrol MATRIX has the Intelligent Safety Shield function that checks machine actions in advance for interference of a tool model with a 3D machine model (upper/lower turret, chuck, or the like) from a commanded travel amount in manual mode of operation. If it judges that a 3D machine model interferes with a tool, it immediately stops axis movements, displaying a warning message. However, it has the following restrictions:

1. There is no 3D-intereference check model of a part that can change its directions like a flexible nozzle

As MATRIX has no 3D-intereference check model of a part that can change its directions like a flexible nozzle, be fully cautious of operation when the nozzle, workpiece, tool, etc. approach each other.

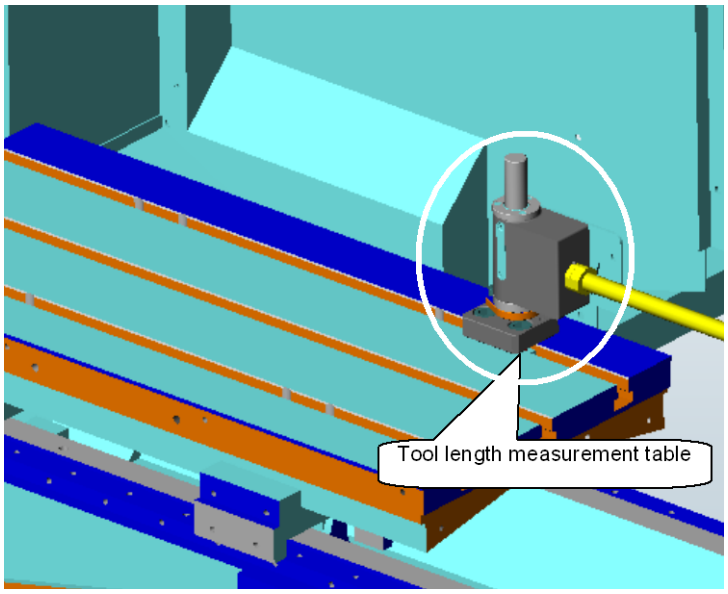


2. Interference check is available only when the tool length measurement table is at the standard setting position.

If the tool length measurement table is used, interference check is available only when the table is at the standard setting position. So if the measurement table is moved, interference check becomes unavailable. So make the measurement table invalidated by the interference check function selected from the 3D-monitor menu.

In addition, even if you remove the measurement table from the table and do not use the measurement table, make the measurement table invalidated by the interference check function selected from the 3D-monitor menu.

For setting the tool length measurement table without equipping the sub table, refer to 11-1-1 “3”.



3. Interference check is available both under the sub table equipped and unequipped conditions.

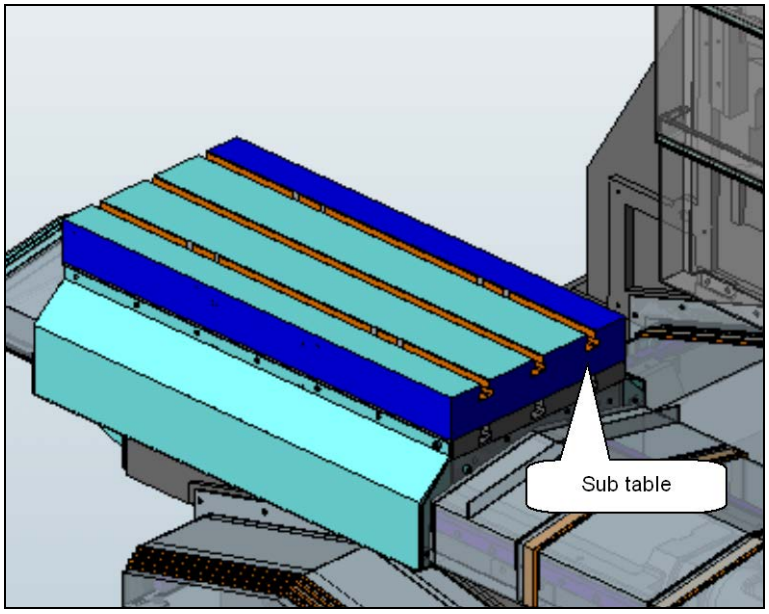
The 3D-machine model below shows the sub table equipped on the table.

If you use the sub table equipped on the table, validate the measurement table 1 (on the sub table) and invalidate the measurement table 2 (not on the sub table) by the interference check function selected from the 3D-monitor menu.

If you use the sub table not equipped on the table, invalidate the sub table and the measurement table 1 (on the sub table) and validate the measurement table 2 (not on the sub table) by the interference check function selected from the 3D-monitor menu.

If you arrange a material model or a fixture model on the 3D SETUP display under the condition of a sub table unequipped, move the material model or the fixture model in the minus (-) Z direction by the amount of the sub table thickness.

(Refer to the *OPERATING MANUAL for MAZATROL MATRIX* for setting the interference check parts and the material models or fixture models on the 3D SETUP display.)



4. Interference check is unavailable on an index table or NC rotary table.

Index table and NC rotary table are not included in the standard 3D-machine models. 3D interference check is not available to a special order like the oil hole coolant system and the like. If you want these tables modeled as a special order, ask us (VCN Product).

5. Shaping tools cannot be checked for interference.

MATRIX cannot check interference of a tool like a shaping tool that is not rotated by a spindle. So fully be cautious of interference of such a tool.

11-2 Scale Feedback System

Scale feedback devices are installed to two axes (X and Y) or three axes (X, Y, and Z) and full closed-loops are created. This enables high accuracy machining especially against thermal expansion.

<Resolutions and accuracy of scales>

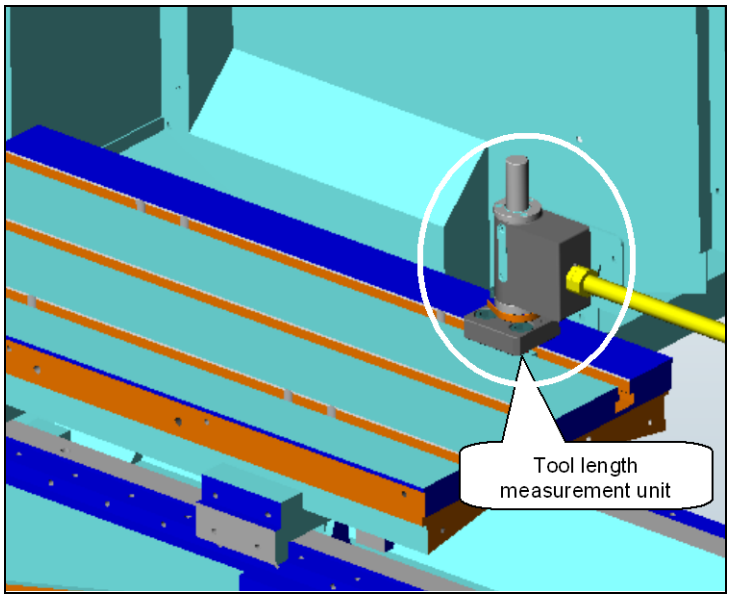
Axis	Resolution	Accuracy
X	0.05 μm	± 5 μm
Y	0.05 μm	± 5 μm
Z	0.05 μm	± 5 μm

The accuracy of this linear scale at 20°C (68°F) is within +/–5 μm against any section of scaling length (maximum 1 m (3.28 ft)). However, this applies only for the accuracy of scale itself, not that of this machine.

11-3 Automatic Tool Length Measurement

11-3-1 Outline

This function automatically measures the tool length (or offset value) by means of an automatic tool-length measurement unit and registers the data into the specified tool data.



11-3-2 Tool length measurement function

This function can measure the length of a tool in MDI mode. There are three measuring methods; full automatic, semi-automatic and manual.

1. Full-automatic tool length measurement

If the pocket numbers for the tools whose lengths are to be measured are set, tools are automatically changed and the lengths of the specified tools are measured one by one.

The tools whose lengths can be measured by this function are spots, drills, reamers, taps, back facing tools, chamfer cutters, etc. which are fundamentally those having their tips or measuring surfaces on the centerline of the spindle.

2. Semi-automatic tool length measurement

This method is effective to tools whose tips or measuring surfaces are not on the centerline of the spindle such as face mills, end mills, boring bars, chamfer cutters, etc. whose length cannot be measured in **1** above.

This function is effective only to the tools that have already been mounted on the spindle. It is necessary to move forward the tools to the spindle end by ATC before measurement.

3. Manual tool length measurement

This method utilizes the tool tip memory function. The length of a tool is measured by using a reference block whose height is already known but not using a measuring stand.

If the height of the reference block is set, the NC automatically calculates the distance from the home position to the reference block, also calculates the Z-axis travel from the machine home position, and automatically sets the tool length in the tool data.

11-4 MAZAK Monitoring System

1. Tool Life Management (TLM) and Spare Tool Change functions
2. Adaptive Feedrate Control (AFC) function
3. Automatic Alignment Function (AAF) (optional)
4. Tool Breakage & Recovery (TBR) function (optional)

11-4-1 Tool Life Management (TLM) and Spare Tool Change functions

1. Outline

Individual tool life of a multiple number of tools must be registered into NC as one group using the TOOL DATA screen. Then individual tool life can be controlled when a machining program is carried out. Tools in the group are selected in the registered order. When a tool reaches its lifetime, the next tool in the same group is selected when tools are changed.

When the last tool in the group has reached the lifetime or any spare tools have been used up, the machine stops in a single block, displaying an alarm on the NC screen.

2. Setting of spare tools

Spare tools must be specified on the TOOL LAYOUT screen.

11-4-2 Adaptive Feedrate Control (AFC) function

1. Outline

AFC (Adaptive Feedrate Control) detects the load current of the spindle motor or the Z-axis servo motor during cutting operation and compares it with a target amount (% for the rated load) preset as tool data. If a detected amount does not meet with the target amount, AFC automatically changes the feedrate, matches the motor load current with the target load current to perform cutting smoothly and prevent an overload.

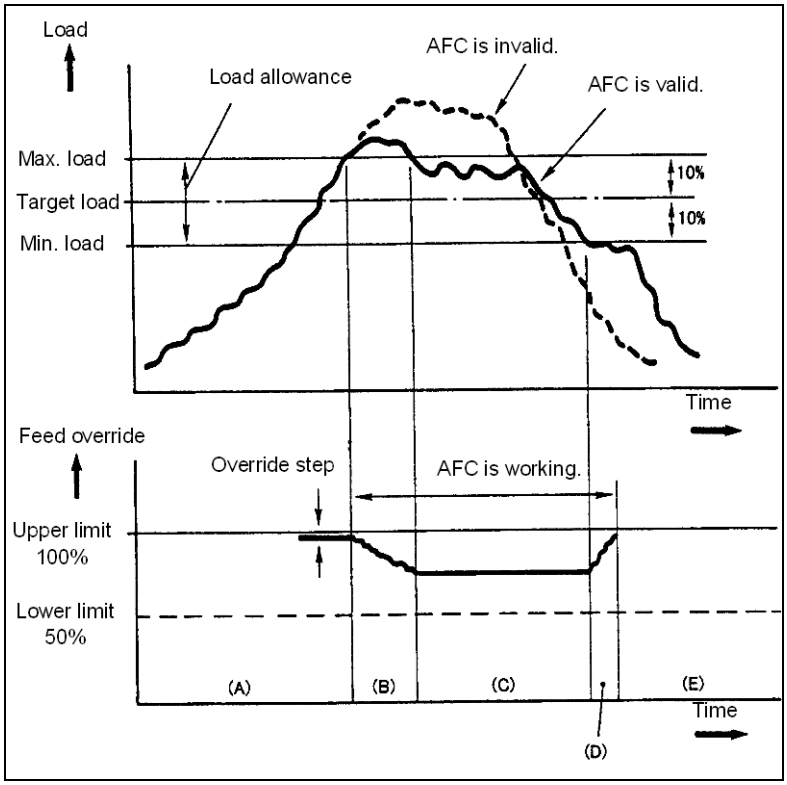
The target amount is simply set on the TOOL DATA screen before machining and does not need to be set with an M code into a machining program. So this function is very effective.

2. Mechanism

Actual load current varies depending on a load or cutting condition. To prevent the AFC from working only in the load current a target amount should be set with both in the upper and lower limits of a load allowance. The feedrate is changed only when the load goes over or under the allowance.

In order to keep the target amount a feedrate can be down to 50% of a commanded value. However, if it lasts for 5 seconds, NC judges it is an overload error and temporarily holds the feed.

The outline of this function is as shown in the next page.



Area	Load status	Feed override
A	Load < Max. load	Feed override is 100%.
B	Load ≥ Max. load	Feed override is stepped down so that the load becomes < the max. load. The load is clamped at its 50%.
C	Load < Max. load	Feed override becomes to meet an actual load. The feed is held when the 50% feed override continues for 5 seconds.
D	Load ≤ Min. load	Feed override steps up and is clamped at its 100%.
E	Load < Min. load	Feed override is 100%.

3. General specifications

A. Setting of a target amount

It can be set percent between 0 and 100%.

B. Setting of the upper limit of the Adaptive Feedrate Control

It is 100% of a commanded value.

C. Detection of an overload error

Feed is held in 5 seconds after the commanded feedrate has reached its 50%.

D. Allowance of a load

It is within ± 10% of a setting value.

E. Detective modes

Spindle AFC and Z-axis AFC

11-4-3 Optional Automatic Alignment Function (AAF)

1. Measurement

The Automatic Alignment Function (AAF) measures the workpiece machining reference and

automatically shifts the coordinate values of the reference coordinates.

2. Measuring method

AAF reads the present position of a workpiece by means of a signal output from the touch sensor contacting with the workpiece.

3. Measuring system

Touch sensor tool: RENISHAW MP3 or OMP60 type
Stylus PS-3 (ϕ5 mm or 0.197 in x 100 mm or 3.937 in long)

Interface board

4. Measured axes (X-, Y- and Z-axes)

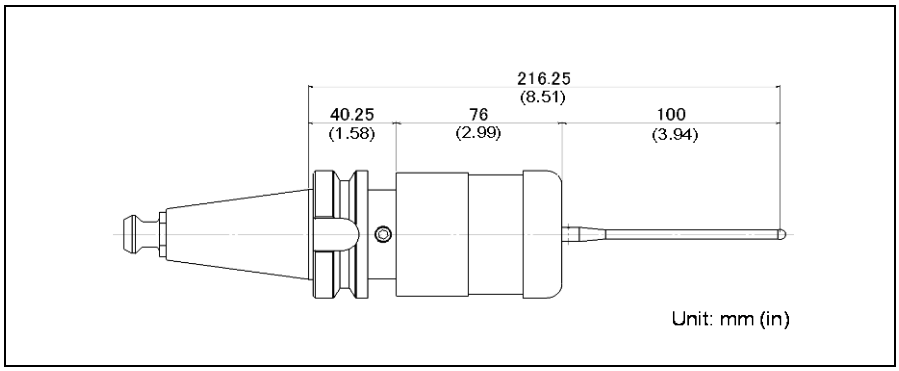
Offset θ is done by the X- and Y-axes or by rotating the X- and Y-coordinates.

5. Accuracy

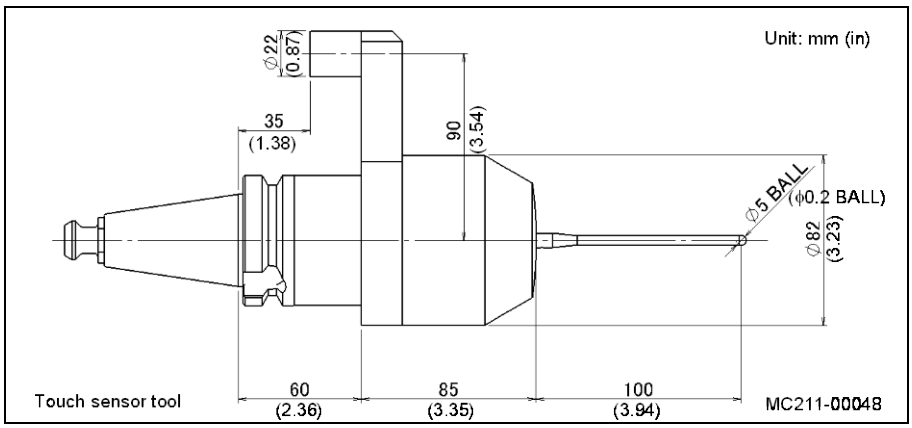
Alignment accuracy: Within ± 0.02 mm (0.000787 in)

6. Touch sensor tool dimension drawing

A. Touch sensor tool dimension drawing（OMP60）



B. Touch sensor tool dimension drawing（MP3）



The touch sensor tool (MP3) restricts the use of adjacent tool.

11-4-4 Optional Tool Breakage & Recovery (TBR) function

1. Outline

(1) This function automatically checks a breakage of a tool on a tool length measuring unit equipped on the machining table after a machining operation by commanding M35 (tool breakage detection) in a machining program.

(2) If a tool is detected to be broken, the next tool in the same group is automatically selected

when tools of the same tool group are changed. You can select by setting a parameter whether a machining operation should be continued after an end unit or from the next sequence when the machine stops in a single block because of a tool breakage or it should be continued by jumping to the end unit without stopping in a single block.
In addition, when the machine stops in a single block or when the last tool in the same group is broken, an alarm is indicated on the NC screen.

(3) If the next tool is not broken, it is exchanged and machining continues.

(4) The tools that can be detected by this function are drills and taps. The detecting abilities are decided by the parameter.

2. Setting of spare tools

Set the spare tools on the TOOL LAYOUT screen.

11-5 Automatic Power Breaker

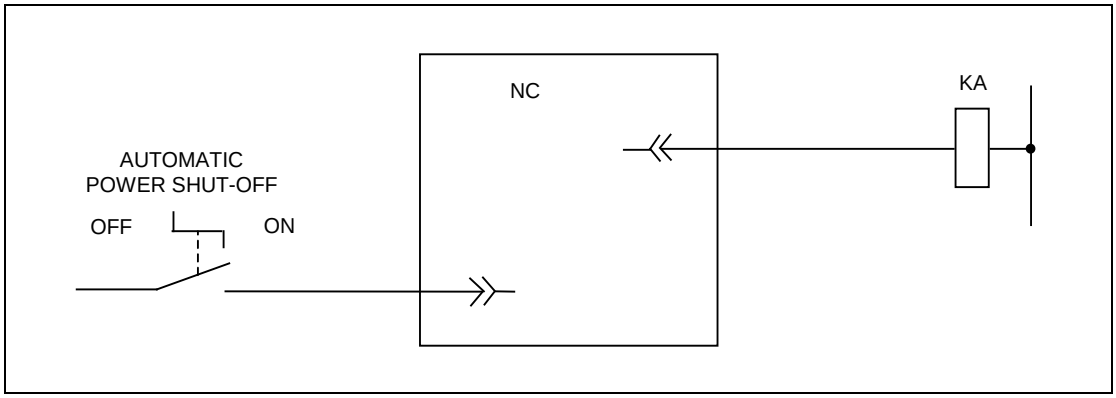
1. Function

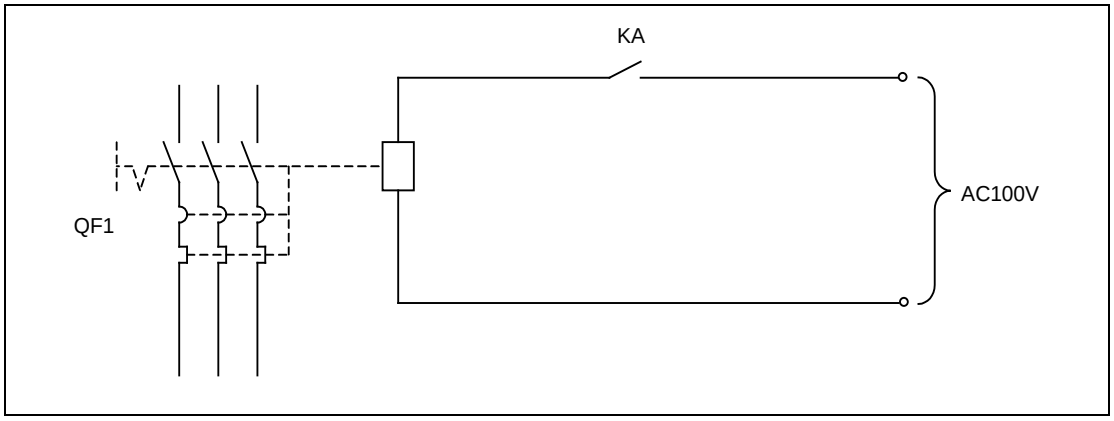
If the AUTOMATIC POWER SHUT-OFF switch is on, the main breaker QF1 is automatically turned off in response to the program end signal given from the control. The main power goes off after completion of machining.

If the switch is turned to the OFF position, the automatic power shut-off operation becomes ineffective.

2. Construction

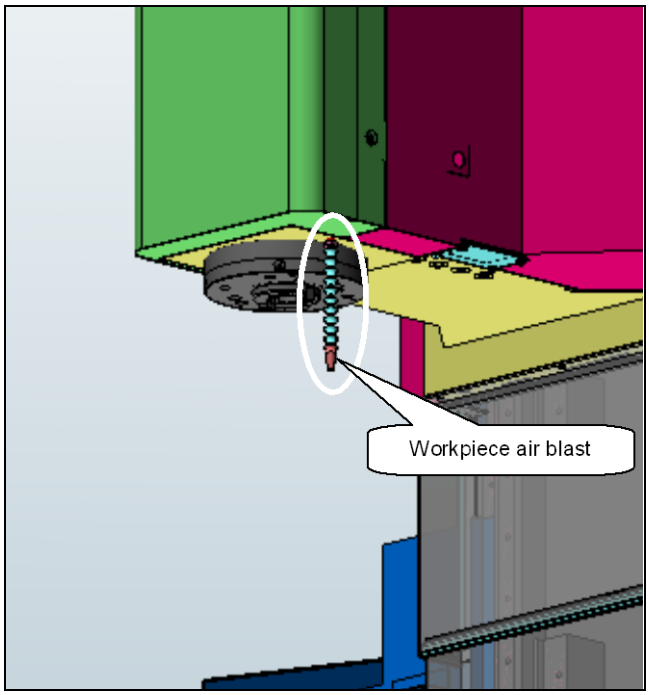
The software for processing the given signal by the sequencer (PC sequence) is included in the standard features. It is necessary to prepare the hardware.





11-6 Workpiece Air Blast

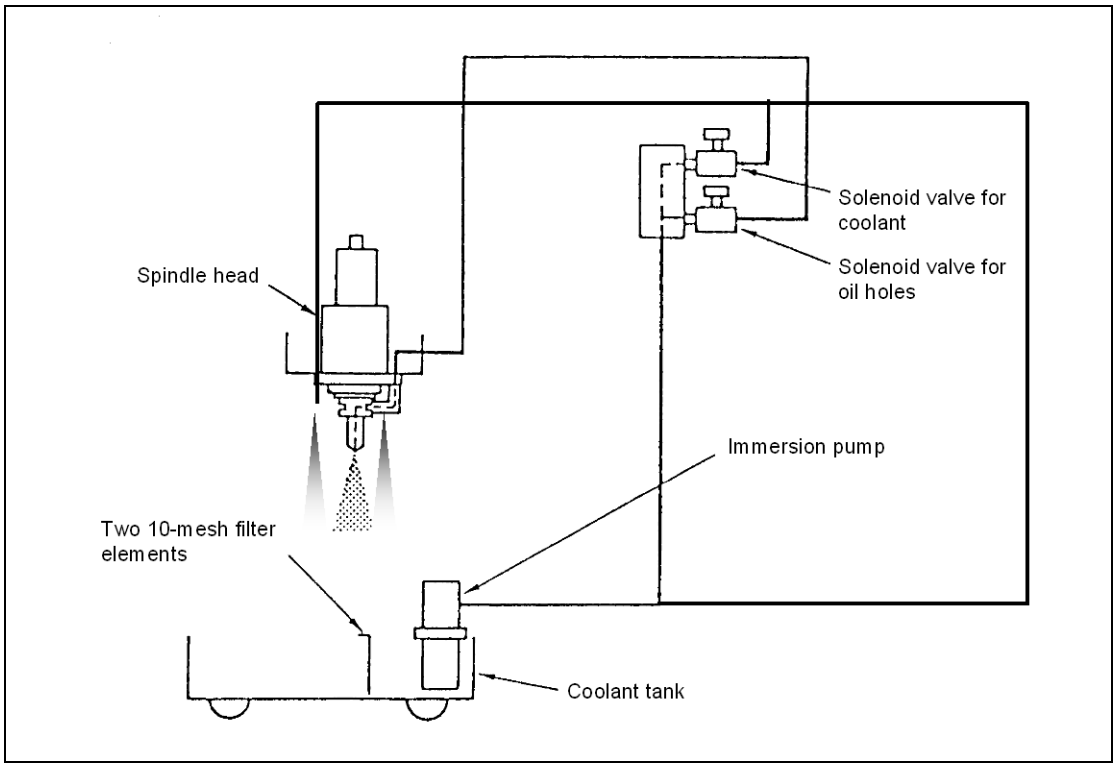
No. of nozzles	1
Air requirement	0.5 MPa (70 psi) or higher (to be provided by customer)
Command	M-codes or manual switch operation
Air consumption	Refer to Section 14-3 “Required Air Pressure and Consumption”



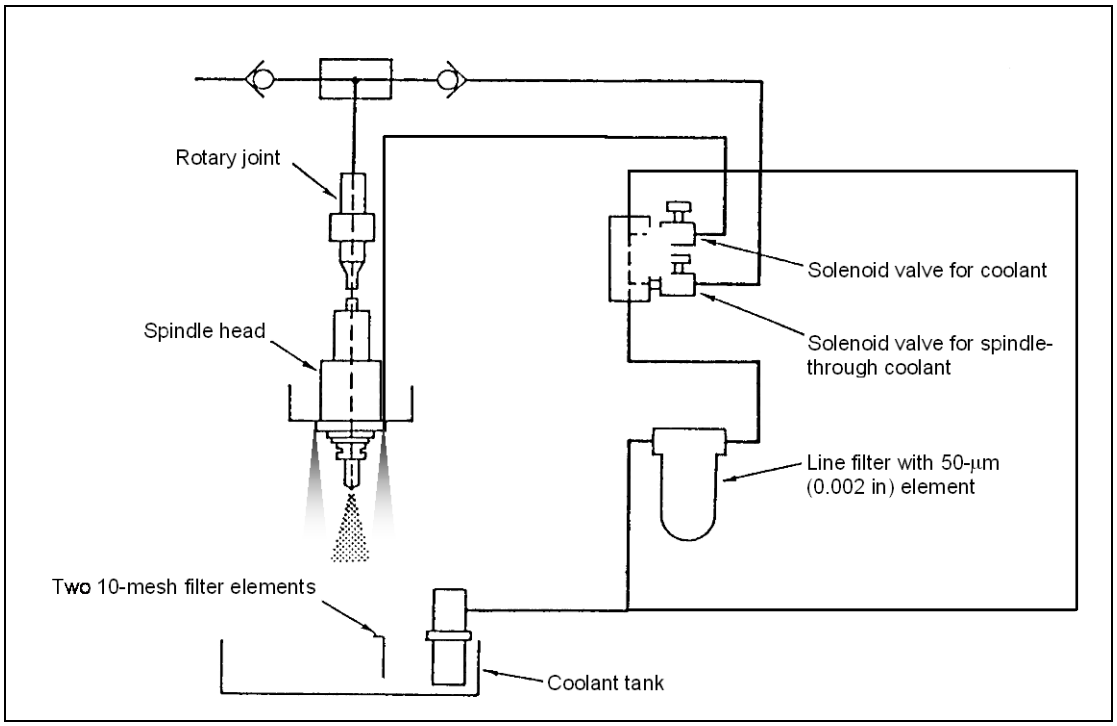
11-7 Oil Hole Coolant, Through-spindle Coolant

How to command: M codes or manual switches

A. With oil hole coolant unit



B. With through-spindle coolant



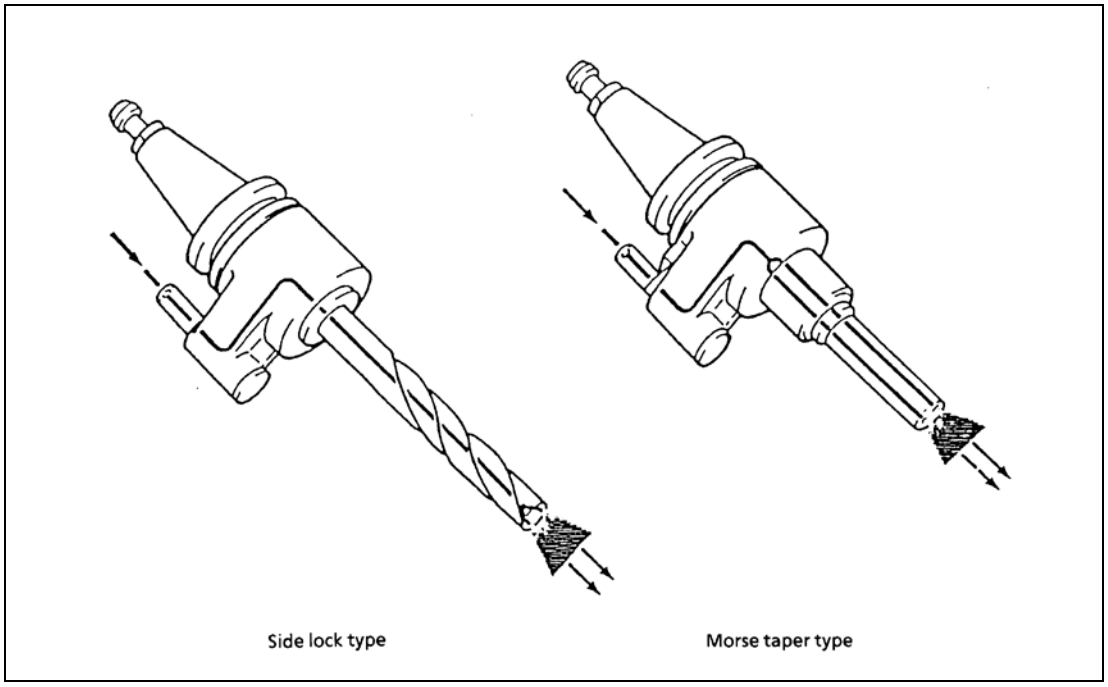
- Oil hole coolant and through-spindle coolant cannot be used at the same time.
- Do not use spindle through coolant or oil hole coolant together with flood coolant.

Item	Specifications
	Through-spindle coolant
Pump model	MTH2-60/6A
Motor output kW	0.635 [50 Hz], 1.04 [60 Hz]
Discharge L/min (ft^3/min) **(Note 1)**	Standard nozzle: 27 (0.95) [50 Hz], 30 (1.06) [60 Hz] Through-spindle coolant **(Note 2)** : 27 (0.95) [50 Hz], 30 (1.06) [60 Hz]
Discharge pressure (when flow is 0) MPa (psi)	0.5 MPa (70 psi) [50 Hz] 0.7 MPa (100 psi) [60 Hz]
Tank capacity L (ft^3)	200 (7.06)
Filter type	Inside the tank: 10 mesh × 2 pieces G-AK-12-50 μK (Mesh wire type 50 μm filter)
Rotary joint	LX84-7920 (RIX)

Note 1: For water-soluble coolant. Discharge is less for oil based coolant. Consult us when you use coolant with viscosity over 35 mm^2/s, which may result in no discharge.
Example: 7 mm^2/s at 40°C (104°F) → 35 mm^2/s at 0°C (32°F)

Note 2: Discharge when no tools are loaded

Reference: Oil hole holder for drill or reamer

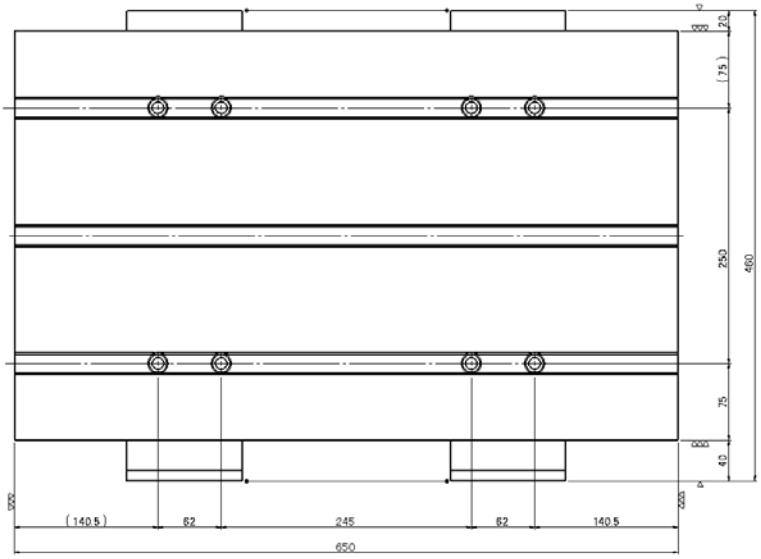


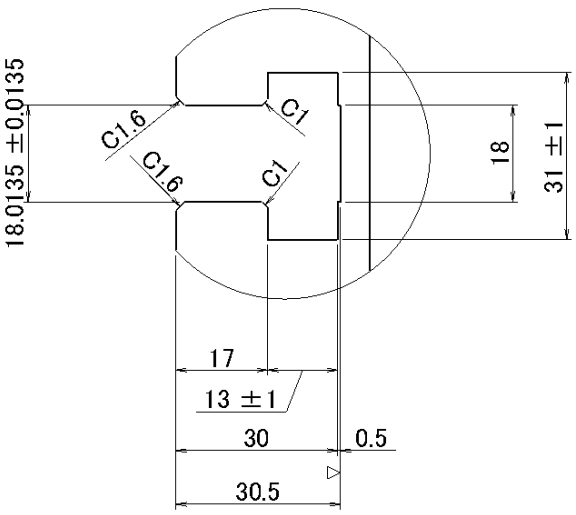
A drill with an oil hole can be used by installing a positioning block on the machine spindle side, a coolant supply pipe and a solenoid ON/OFF changeover valve. The drill with an oil hole has the following advantages:

(1) Prolonged drill life
(2) Reduction of cutting time due to increased speed
(3) Forced discharge of chips
(4) Automatic tool change by ATC operation

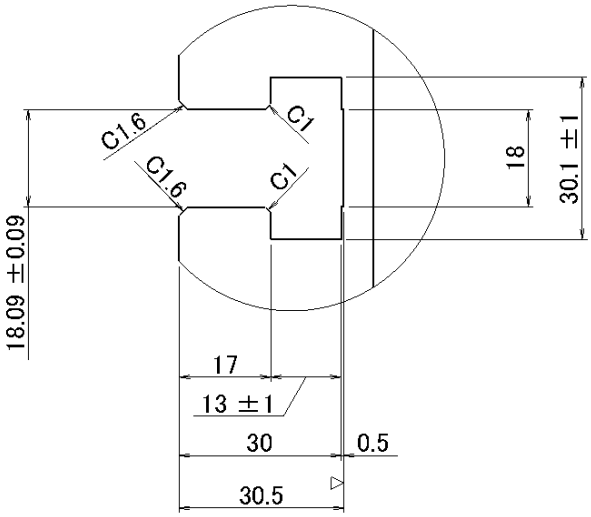
11-8 Sub-Table

1. Sub-table dimension drawing





Standard groove



other grove

11-9 Index Table Availability

Controlled by M-code commands.

11-10 NC Rotary Table Availability (4th Axis Availability)

The 4th axis is controlled by the instructions from a machining program.

The simultaneously controlled axes when an NC rotary table is equipped are the X, Y, Z, and 4th axes and only their linear interpolations are simultaneously controlled.

<Note in placing an order>

If a customer provides the 4th axis (rotary table) , etc., please place an order of the machine tool specifying that it should be prepared for mounting the 4th axis. In such a case, please inform us of the table maker's name, model, motor model, etc.

In addition, each table has its own connectors. You are, therefore, requested to tell the maker that you want the table of Yamazaki Mazak specifications beforehand. The makers of our specification tables are as follows:

- Tsudakoma Industries
- Nikken Kosakusho
- Kitagawa Iron Works
- Matsumoto Machinery

In addition, the motor model for the VCN series is of 400-V specifications (Mitsubishi Electric make HF-H series or HP-H series) .

Servomotor specification

Item		Unit	4th-axis			
Servomotor	Model	—	HF-H54T	HF-H75T	HF-H104T	HF-H105T
	Output	kW	0.5	0.5	1.0	1.0

Unless the table maker's name, table model, motor model, gear ratio, and so forth are informed, parameter setting to NC at our factory would be difficult. If the preparation for mounting a rotary table is requested, assembly of and wiring to the servo amplifier will be done.

Ask us for other information.

Note 1: As the VCN series has no compatibility with conventional 400-V motors (Mitsubishi Electric make HC-H series) , the motors used for the VCN series (M640M) cannot be used.

Note 2: Installation of NC rotary table enables turning operation using the rotational axis controlled by rotation commands.
Speed of lathe turning is up to approximately 30 m/min (1181 IPM) (depending on the specification of table). Since this is limited to short-time and light load machining, contact Mazak Technical Center or Technology Center for usage.

Note 3: Submit an additional axis check sheet when using this specification.

11-11 Single-color Signal Tower (Yellow)

1. Function

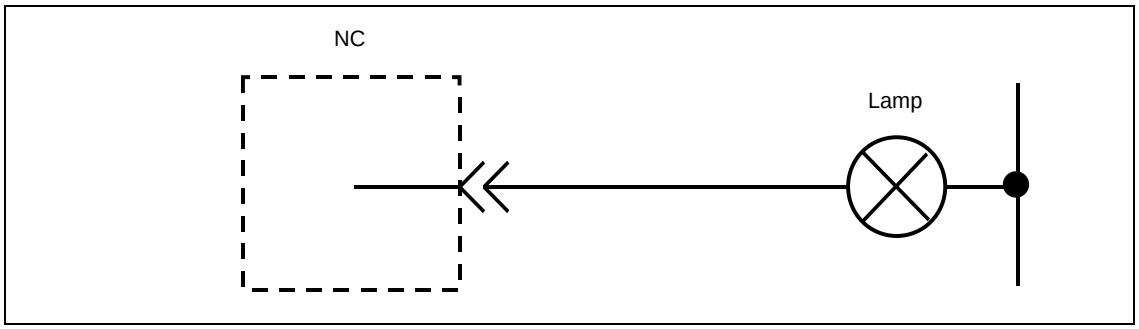
When the operation finish signal (program end) is given from the control, the lamp comes on indicating that the machining cycle has been completed.

The operation finish lamp can be reset by either one of the cycle start switch or the reset switch.

2. Construction

The software for processing the given signal by the sequencer (PC sequence) is included in the standard features. It is necessary to prepare the hardware.

- Reference:



Note : Actual wiring varies depending on models.

11-12 Three-color Signal Tower (Red, Green, and Yellow)

1. Operation

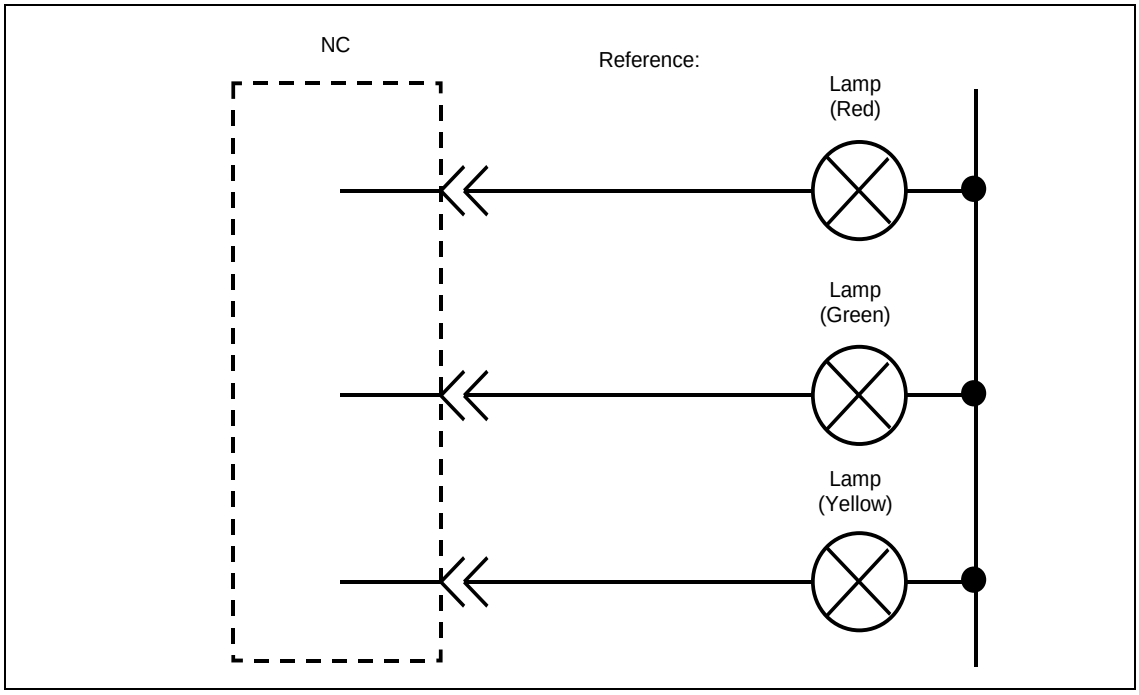
Red: In case of an alarm related to the machine or the NC unit, the red lamp goes lit and an alarm message appears on the screen to indicate that the machine or the NC unit is in an abnormal condition.

Green: The green lamp goes lit when the machine is in automatic operation.

Yellow: The yellow lamp indicates that the NC programmed machining (M02 or M30) is complete and that workpiece machining is over.

2. Function

The software for processing the given signal by the sequencer (PC sequence) is included in the standard features. It is necessary to prepare the hardware.



11-13 Work Light

A 36-W fluorescent work light is mounted on the right side of the machine (electric control cabinet side) (Standard only for Japan).

11-14 Earth Leakage Breaker

1. Function

Detects ground leakage and causes the power to be turned off. For power sources which are positively grounded, leaks are detected to protect the machine and operators from the leaking current.

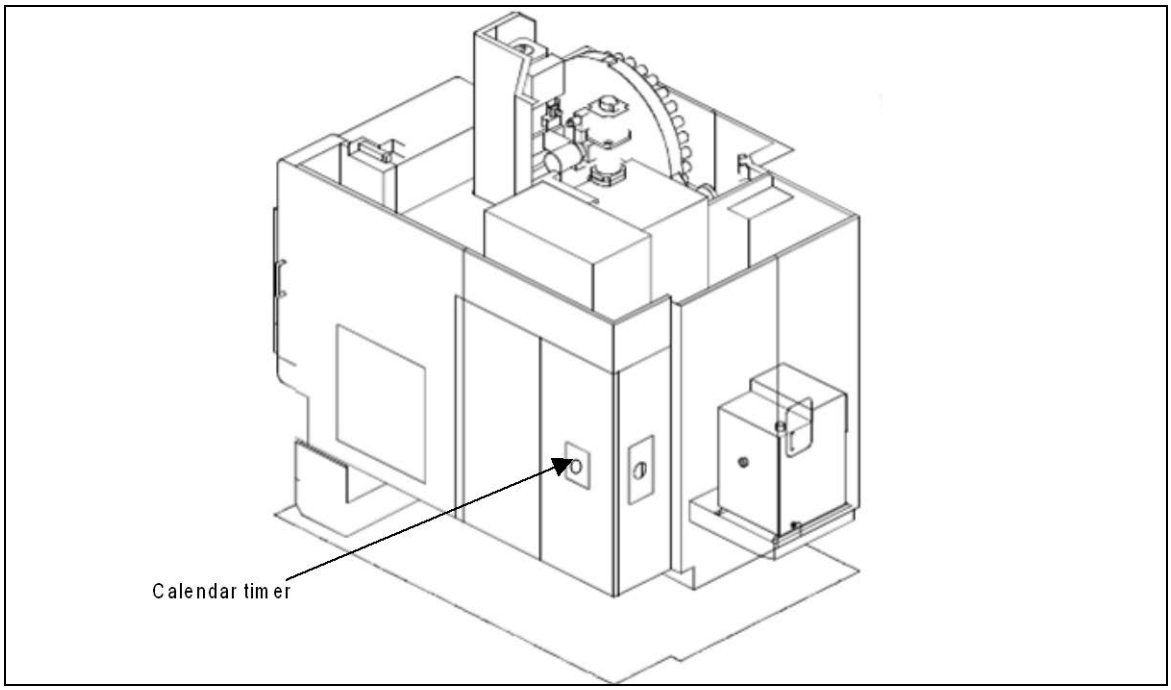
2. Construction

Can be installed by replacing the main circuit breaker QF1 with an earth leakage breaker with a shunt trip.

Dimensions for mounting the main circuit breaker and the earth leakage breaker (sensitivity current: 200 mA) differ from each other. On some models, a bracket for mounting the earth leakage breaker is needed but requires no special wiring.

Note : This device is available only for models for the Japanese market and is not available for models for outside Japan.

11-15 Automatic Power ON/OFF Function (Option)



1. Calendar type automatic power ON/OFF function

A weekly calendar timer is built in.

When the AUTO POWER ON/OFF switch is “active,” the automatic power OFF function automatically turns off the power when the machining completion signal “PROGRAM END” is received from the NC unit.

• Power OFF status

1) NC unit :OFF
2) Servo power supply :Emergency-stop state
3) Main breaker :ON

Note : Be careful that even in the power OFF state, power is still partly on.

When the AUTO POWER ON/OFF switch is “active,” the automatic power ON function

automatically turns on the power according to the timer setting output from the calendar timer.

However, when the AUTO POWER ON/OFF switch is “inactive,” the automatic power ON/OFF function cannot be used.

2. Calendar type automatic power ON/OFF + warming up functions

The machine is automatically energized at the time on the day of the week both preset by the weekly calendar timer and warmed up in the following operation sequence:

(1) The operation ready alarm buzzer sounds, and the lamp (red) lights up.

(2) The machine automatically makes zero return.

(3) The machine selects the workpiece No. (execution program) preset by the parameter.

(4) The machine starts.

A function for shutting off the power to the machine is also provided, which automatically shuts off the power upon the completion of the machining program.

Either of the following 2 different states can be selected by operating the outside switches:

1) The breaker is tripped to completely shut off the power.

2) The breaker is not tripped but only the control power is shut off.

When the state 1) is selected, the automatic power ON function is not active on the next and subsequent days. Therefore, to have the machine automatically warmed up on the next day, select the state 2).

11-16 Special Color Order

Specify the color by its Munsell color system number; a color sample is also required. Standard colors are semi-gloss shrunk gray white No. 31 (Munsell color No. 7.23Y/775/0.26) and semi-gloss shrunk black gray No. 30 (Munsell color No. 2.35B2.20/1.13) which are two liquid mixing type epoxy resin paints.

11-17 Grease Hand Pump

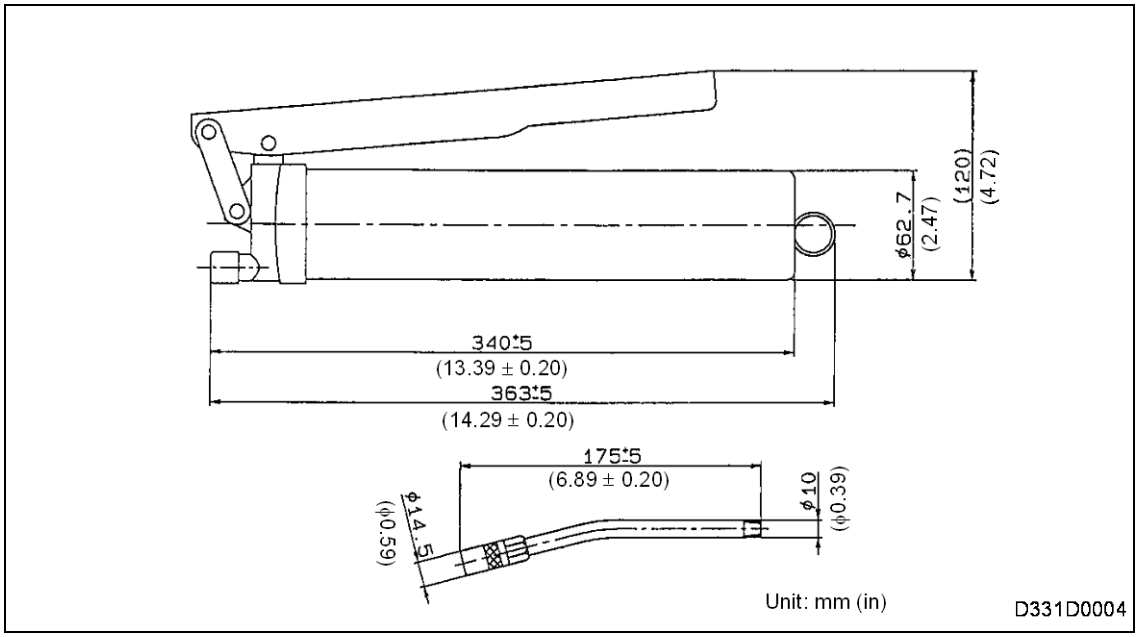
1. Outline

Use the grease hand pump to replenish grease to a grease pump this machine maintenance panel.

Use a hand grease pump to replenish grease to the grease pump indicated on the machine maintenance panel. For a cartridge type grease pump, replace the grease cartridge.

<Recommend oils>

- CITRAX EP No. 1 (KYODO YUSHI)
- MULTINOC GREASE 1 (NIPPON OIL)
- MOBILUX EP1 (MOBIL)



2. Specifications

Type	Cartridge type
Model (maker)	K-400 (Lube)
MAZAK part No.	P21LA000210
Capacity	400 g (0.88 lbs)
Maximum pressure	42 MPa (6092 psi)
Mass	1.38 kg (3.04 lbs)

3. Device mountability by customer

Possible: No additional machining is necessary.

11-18 Coolant Temperature Control

1. Outline

The coolant chiller functions to keep coolant water heated by cutting or the like at a constant temperature so that machining does not give bad influence to workpiece accuracy.

2. Specifications

Model	KTCG-7.5ASHC6NCE
Maker	Kanto Seiki
Standard cooling ability	2900 W (50 Hz) (35°C or 95°F)
Refrigerant	R407C(HFC32/125/134a)
Regulator	Automatic control to reference temperature
Setting temperature	Reference temperature ± 5.0°C (41°F)
Protector	Overcurrent relay with noise killer
Ambient temperature area	5-45°C (41-113°F)

3. Device mountability by customer

Possible: Drilling (additional machining) is necessary to mount a reference temperature sensor.

4. Others

(1) Acquire some floor space for installation of the coolant chiller.

(2) Circulate filtrated clean liquid through the coolant chiller. It is recommended to use the ConSep2000II WS together.

11-19 Mist Collector

1. Outline

Mist gives the following influences to environment:

(1) Some kinds of mist give bad influence to human bodies.

(2) Floor becomes slippery to cause a secondary disaster.

(3) Mist attached on electric system part cause a fault current or a fire.

The above items deteriorate factory interior environment, drop desire to work, and consequently drop productivity.

The mist collector collects micro mist emitted out of the gaps of a machine when a high-pressure coolant system or cutting oil is used in machining or when a workpiece is mounted or removed to prevent the job environment from deteriorating. So such a mist collector is recommended to a customer who use the cutting oil under such conditions.

2. Specifications

Model	CRD-1500R-CE
Maker	SHOWA-ELC INC
Output	1.5 kW
Air blow amount	15/18 m^3/min (20/24 ft^3/min) (50/60 Hz)
Mass	59 kg [130 lbs]

<Characteristics of CRD-1500R-CE>

(1) Compact and simple for installation
(2) Excellent collection ability (99.8% of mist separated and collected)
(3) Capable of collecting large dust and swarf
(4) Double antivibration structures by antivibration rubber and pad
(5) Easy maintenance

3. Device mountability by customer

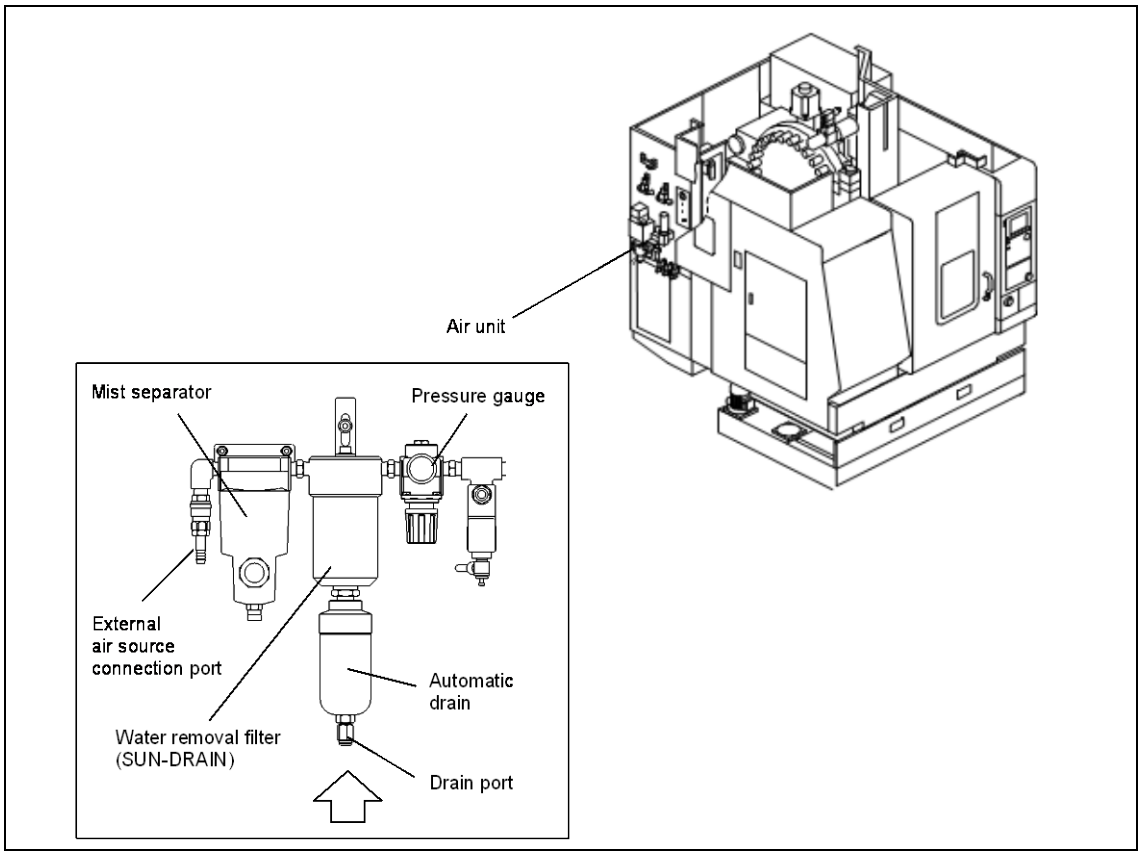
Possible: No additional machining is necessary.

11-20 Water Removal Air Filter

If water or oil mist is contained in the air of the air circuit, it may condense and cause a valve or pipe to clog or rust. At worst, the spindle bearing may seize.

By installing the water removal air filter in the air circuit, water and oil mist in the air is removed and the circuit is kept clean.

No.	Part No.	Type	Maker
G46SV000670	Water removal air filter (sun-drain)	Y301-PT3/8	SMC

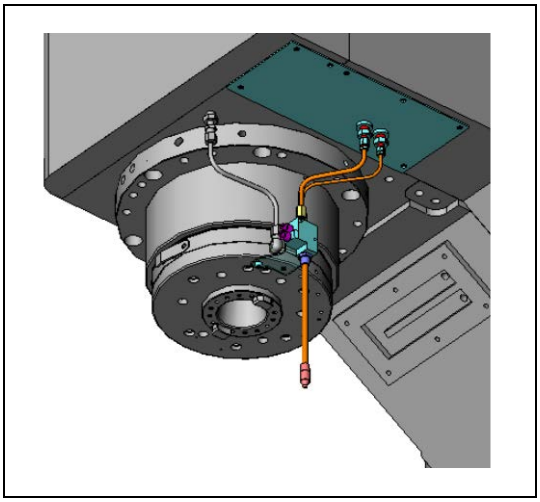


Note : The water removal air filter can remove only water in the form of liquid which is already contained in the air before entering to the air circuit. This filter cannot remove water in the form of gas.

11-21 Oil Mist

1. Outline

This is an optional unit for semi-dry cutting by blowing the oil-mixed air to the tool nose.



The nozzle end of oil mist coolant is flexible. Adjust the angle according to the tool.

2. Usability of coolant for oil mist

Usability of coolant for oil mist

◎ Good ○ Fair × Cannot be used

	Coolant type	Resistivity	Function	Judgment
Water-insoluble coolant	Kerosene	◎	◎	◎
	Light oil	◎	◎	◎
	Spindle oil	◎	◎	◎
	Machine oil	◎	◎	◎
	JIS K2241 Class 1, #1 to #6	◎	◎	◎
	JIS K2241 Class 2, #1 to #8	○ (Causes slight corrosion to copper)	◎	○
	JIS K2241 Class 3, #1 to #8	○ (Causes slight corrosion to copper)	◎	○
Water-soluble coolant	JIS K2241 Class W1, #1 to #3	× (Causes deterioration of FPM and NBR due to alkali)	× (Corrodes)	×
	JIS K2241 Class W2, #1 to #3	× (Causes deterioration of FPM and NBR due to alkali)	× (Corrodes)	×
	JIS K2241 Class W3, #1 to #2	× (Causes corrosion to copper and aluminum)	○ (Corrodes if left for a long time)	×

Note 1: From the standpoint of material

Materials used at areas that contact coolant are indicated below.

- Tank body: → Aluminum die-cast (ADC12, JIS)
- Coolant passage: → Copper pipe (C1220T, JIS), Tube (nylon)
- Needles, etc.: → Copper product (C3604B, JIS)
- Packing (stationary areas): → NBR
- Packing (sliding areas): → FPM

Please check the resistivity against oil and the resistivity against solvent for the materials stated above.

Note 2: From the standpoint of functions

Do not use water soluble coolant of emulsion or soluble type. If it is left for a long time, it is separated into oil and water, get corroded and gelled, and finally it blocks oil passages.

Note 3: Viscosity

Viscosity should be as indicated below.

Within 600 mm^2/s (0.93 in^2/s) at 25°C (77°F)

Within 200 mm^2/s (0.31 in^2/s) at 40°C (104°F)

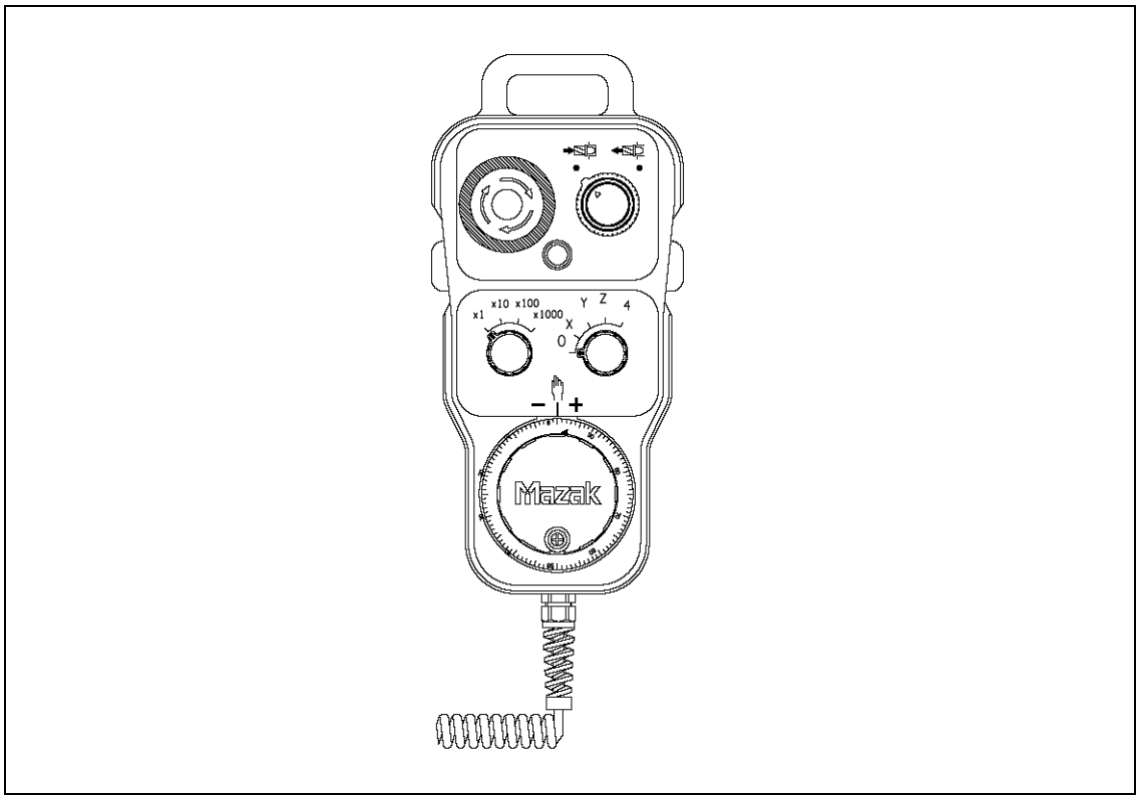
Note 4: Others

Taking into consideration the resistivity against oil and solvent and also the functions, select appropriate coolant referring to 2. “Usability of coolant for oil mist” above.

For more details of coolant, contact the coolant manufacturer since they use their own additives and thus usability judgment is difficult.

11-22 Separate Manual Pulse Generator

To improve the workability, separate manual pulse generator has pulse handle, axis select switch, and emergency stop button on it, and it can be moved from the NC unit. This will help operators to approach the spindle head side and set-up operation gets easier.



11-23 Inch/Metric Unit System Change Simplifying Function

11-23-1 Outline

Conventionally the change in unit system (inch/metric) of dimensional and feed data input has required the corresponding modification of the related parameters, cutting conditions, etc.

The newly developed function allows an easy change in unit system, without having to be supported by the above modifications, in order that MAZATROL or EIA/ISO programs prepared in reference to machining drawings different in unit system (inch/metric) shall immediately be run on the machine.

There are two methods available to change the unit system (inch/metric) of data input.

1. Use of the preparatory functions concerned (Power off/on not required)

   - G20: Dimensional data input in inches
   - G21: Dimensional data input in millimeters

   This method changes the unit of coordinate data input, but does not have any influence upon the data internally processed.
   Angle commands, however, are always given in degrees, irrespective of the modal G-function.

2. Setting the parameter concerned (Power off/on required)

   - **F91** bit 4 = 1: Inch system
     = 0: Metric system

   G20 and G21 are respectively modal when bit 4 of the **F91** parameter is set to “1” and “0”.
   This method not only changes the unit of coordinate data input, but also accordingly converts the data displayed on the screen or internally processed.
   Angle commands, however, are always given in degrees, irrespective of the parameter setting.

3. Menu-based selection (Not requiring power off/on)

   The display mode and an inch/metric input unit system on the **TOOL DATA** and **TOOL OFFSET** displays can be selected using the menu keys.

   - When bit 4 of parameter **F91** = 0 (metric system), selection of **[INCH MODE]** highlights the menu item and the display mode as well as the input unit system change from metric to inch.
   - When bit 4 of parameter **F91** = 1 (inch system), selection of **[METRIC MODE]** highlights the menu item and the display mode as well as the input unit system change from inch to metric.

Automatic modification of various types of data with the present function, therefore, only refers to the setting of the above parameter (bit 4 of **F91**).

For input of tool data different in inch/metric unit system, the selection can be immediately made using the **TOOL DATA** and **TOOL OFFSET** display menus.

4. Selection of a unit system on the **POSITION** display

   When bit 1 of parameter **F82** is set to “1” (inch/metric display selection valid), the unit of data representation on the **POSITION** display is automatically selected according to the particular modal command code (G20 or G21).

11-23-2 Data concerned

Except for programs, the unit system change function acts upon the following two types of data:

1. Variable data (on the displays **PARAMETER**, **WORK OFFSET**, **CUTTING CONDITION**, **CUTTING CONDITION LEARN** and **ADDITIONAL WPC**)

Variable data are preset in both inch and metric units prior to shipping. The modification of a preset value in one unit system cannot be supported by an automatic modification of the corresponding data in the other. Manually modify the data concerned, therefore, as required to effectively use the unit system change function.

2. Characteristic data (on the displays **TOOL DATA**, **TOOL FILE**, **TOOL OFFSET**, **HEAD OFFSET**, and the FIX. OFFSET data on the **PALLET MANAGEMENT** display)
   Independently of the present function, characteristic data are automatically converted into values appropriate to the unit system currently selected. No manual modification of characteristic data, therefore, is required for the present function.

The present function does not refer to any data other than the above.

Note: The data items on the displays **MACHINING NAVIGATION – PREDICTION** and **RESULT** cannot directly be influenced by the present function since they are only obtained by a tool path checking or an automatic operation of the program concerned.

11-23-3 Operating procedure

1. Parameter-based selection

(1) Change bit 4 of parameter **F91** from "1" (Inch system) to "0" (Metric system), or reversely.

(2) Turn off the NC unit and then turn it back on.

➔ The corresponding data will be automatically converted into values appropriate to the unit system currently selected.

2. Menu-based selection

(1) Select the **[INCH MODE]** or **[METRIC MODE]** menu item.

➔ When **[INCH MODE]** is selected, the **[INCH MODE]** is highlighted and the unit of data representation on the display changes from millimeters to inches.
When **[METRIC MODE]** is selected, the **[METRIC MODE]** is highlighted and the unit of data representation on the display changes from inches to millimeters.

(2) When the menu is highlighted, enter data in the selected unit.

Note: Selection with the menu cannot be made if bit 1 of parameter **F82** is set to "0" (inch/metric display selection invalid).

11-23-4 Internal management of data

1. Variable data (on the displays **PARAMETER**, **WORK OFFSET**, **CUTTING CONDITION**, **CUTTING CONDITION LEARN** and **ADDITIONAL WPC**)
   The NC unit has two storage areas provided for variable data: area of "inch data and metric data for saving" and that of "data being used". The latter is updated according to the particular setting of the parameter concerned as follows:

   Power off: The "data being used" are automatically saved onto the storage area of "inch or metric data for saving" according to the value in bit 4 of parameter **F91**.

   Power back on: The "inch or metric data for saving" are automatically copied onto the area of "data being used" according to the value in bit 4 of parameter **F91**.

2. Characteristic data (on the displays **TOOL DATA**, **TOOL FILE**, **TOOL OFFSET**, **HEAD OFFSET**, and the FIX. OFFSET data on the **PALLET MANAGEMENT** display)
   The NC unit has one set of characteristic data described in millimeters, and, upon turning-on the power, provides the data as they are, or converts them into values appropriate to inch system, according to the setting in bit 4 of parameter **F91**.

11-24 EIA/ISO Conversion

11-24-1 Outline

Any MAZATROL program that has been created using the MATRIX can be converted into an EIA program by EIA/ISO conversion. Conversion into an EIA program makes machining possible even with a machine not having a MAZATROL NC.

As for point-machining, two output schemes are available for an EIA/ISO converted program, as tabulated below. Select the desired scheme using bit 2 of parameter **F88**.

Output schemes

		EIA conversion 1	EIA conversion 2
Bit 2 of parameter **F88**		1	0
Point-machining	- Counterboring - Boring (Roughness level 2 to 9) - Chamfering (Cycle 2) - End-milling (Cycles 2, 3) - Tornado cycle - Planet tapping	Output with a code from G0 to G4	
	Synchronous tapping	Output with G84/G74 or G84.2/G84.3 (Parameter-selectable)	
	Other point-machining patterns	Output with a code from G0 to G4	Output of a fixed-cycle code from G73 to G87
Feature		For point machining, since a code from G0 to G4 is issued automatically, workpieces can be machined even with a machine not having a fixed-cycle option. Operation is the same as for the original MAZATROL program.	For point machining, the length of the program decreases since a fixed-cycle code is issued automatically.

To execute an EIA/ISO converted program using other machines, edit the program according to the particular NC specifications or machine configuration. Before machining a workpiece, edit the functions listed in the table below and then perform checks by cutting test pieces.

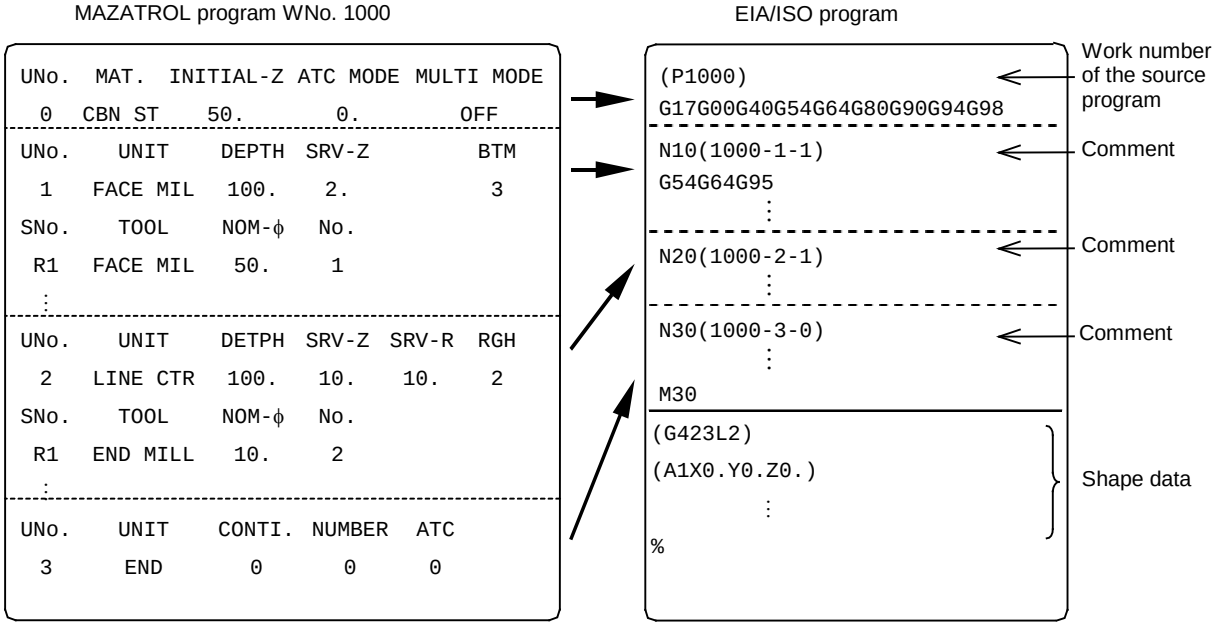
Functions required for editing

Function	Editing
Workpiece coordinate system rotation (G92.5)	- Since workpiece coordinate system rotation is a characteristic function of the NC unit of Mazak, this function cannot be used for other machines. Therefore, after changing the “th” of the WPC unit into 0, convert the program into EIA form and delete G92.5 from the EIA program. - For the M32, rewrite G92.5 into G92.1.
M-code (M_ _)	- Edit M-codes into the form appropriate for the intended machine. - During EIA/ISO conversion, a maximum of four M-codes are issued automatically for one block. The number of M-codes which can be included in one block differs according to the particular configuration of the machine. Therefore, edit M-codes into the form appropriate for the intended machine.
Positioning for tool change (G30)	- Edit the command appropriately to the intended machine.
Tool change command (M6T_T_)	- Edit the command appropriately to the intended machine. **Remark:** Set **F89** bit 6 to “1” as required to output a command (G30) for return to the 2. zero-point before each tool change command.
Geometry compensation (G61.1)	- Edit the command appropriately to the intended machine.

11-24-2 EIA/ISO conversion program format

The format of program conversion from MAZATROL into EIA/ISO is shown below. The work number of the source program is assigned on the first line and comments are automatically inserted for each tool sequence. These comments take the format of “source program work number - unit number - sequence number”.

Whether shape data (the data for drawing the shape of the workpiece) is to be added to the end of the EIA/ISO program can be selected using bit 0 of parameter **F89**. To add shape data, set this bit to “1”. Set the bit to “0” if addition is not required. The shape of the workpiece can only be drawn for the MATRIX.



11-24-3 Output data unit

Coordinate data is always output with a decimal point. If the data is 0, then 0 is output. If the least significant digit in data with a decimal point is 0, then the digit is omitted.

Example 1: 0.000 → 0

Example 2: 10.100 → 10.1

Digit number of decimal fraction

Metric (mm)	Inch
4 digits	5 digits

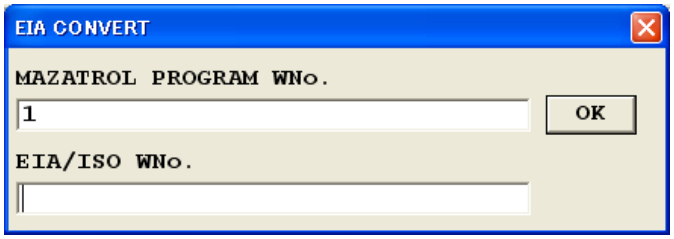
11-24-4 Operating procedure

(1) Move the cursor on the **PROGRAM FILE** display to the line where the work number of the program to be converted is displayed.

- The cursor can be set at any of the items present on the line where the work number of the intended MAZATROL program is displayed.

(2) Press the **[EIA/ISO CONVERT]** menu key.

➔ **[EIA/ISO CONVERT]** will be hifhlifhted and the **EIA CONVERT** window will appear on the screen.



(3) Enter a new work number for the conversion destination, and press the INPUT key.

- The conversion can also be started by clicking the **[OK]** button in the window, instead of pressing the INPUT key.
- With the window opened (before pressing the INPUT key), the source program number can be changed after selecting the upper **MAZATROL PROGRAM WNo.** text box with the Tab key  or the mouse.
- During conversion, **EIA/ISO CONVT** is displayed above the message display area.
- When conversion is completed, the corresponding EIA/ISO program will be created under the new work number and the message **EIA/ISO CONVT** will disappear.
- Press the **[EIA/ISO CONVERT]** menu key once again to stop converting.

Note: During step (2) above, alarm **440 EIA/ISO PROGRAM DESIGNATED** will be displayed if an EIA/ISO program has been designated in step (1).
During step (3) above, alarm **433 SAME PROGRAM EXISTS** will be displayed if another NC-registered program is designated.
During step (3) above, alarm **418 EIA/ISO CONVERTING** will be displayed if an attempt is made to change, delete, or copy the work number of the conversion source program with an **EIA/ISO CONVT** message remaining on the display.

11-24-5 Supplementary description and precautions

MAZATROL programs operate considering the machine conditions existing during the start of processing. Programs that have been converted into EIA/ISO ones, on the other hand, are those which considered the machine conditions existing when they were converted into the EIA/ISO format.

Therefore, the EIA/ISO converted program must be edited accordingly when it is to be run on another machine, as well as after changing tools to be used or modifying tool data.

1. The parameters that were valid during conversion are considered during output of an EIA/ISO converted program. EIA/ISO converted program will not be affected even if modifications are performed on a parameter that is used in a MAZATROL program.
2. Parameter **F97** can be used to select the type of coordinate system to be used for an EIA/ISO converted program.

F97	Coordinate system
1	G54
2	G55
3	G56
4	G57
5	G58
6	G59

(Codes A to J or codes G54.1P1 to G54.1P300 cannot be selected)

3. To select external WPC using the WPC unit of the conversion source program, set any command code from G54 to G59. Command codes A to J or G54.1P1 to G54.1P300 cannot be set.
4. The conversion of a measurement unit (for coordinates, workpiece, and tool) only results in a description of approach and retract paths with information on the source (program, unit and sequence Nos. connected with hyphen in parentheses).
5. For a tool change, data is output in the format of "**M6T** No. of the tool to be changed for **T** No. of the tool to be used next". `M6T0T0` is output if the tool to be used is not registered on the **TOOL DATA** display. The tool suffix, if specified on the **TOOL DATA** display, can be expressed in the resulting T-code as follows:

   Example: Output for Tool No. 10 with suffix "A"
   10A → T10.01

   Refer to Chapter 11 of the separate PROGRAMMING MANUAL (EIA/ISO Program) for details on the designation of suffix in a T-code.
6. Shape data can be assigned to an EIA/ISO converted program.

Converted EIA/ISO program

```
      ⋮
G91G30XYZ
G90
M6T7T8
      ⋮
M30
(.............
 ...........
 ...........)
```

Shape data

With the shape data, the corresponding shape of machining can be displayed on the **TRACE** and **TOOL PATH CHECK** displays.

Use bit 0 of parameter **F89** to select whether shape data is to be assigned.

F89 bit 0 = 0 : Does not assign shape data.
= 1 : Assigns shape data.

7. If line and face machining units in the source program require one section to be used repeatedly in the converted program, the total program size can be reduced by shifting that section into a subprogram and calling it up repeatedly.

A sequence number is set on the beginning line of the subprogram section, and M99 on the ending line. M98<_>H_ is set in the main program to call up the particular subprogram section.

Whether a subprogram is to be created can be selected by setting bit 0 of parameter **F88**. Set the bit to “1” for creation, or “0” for no creation.

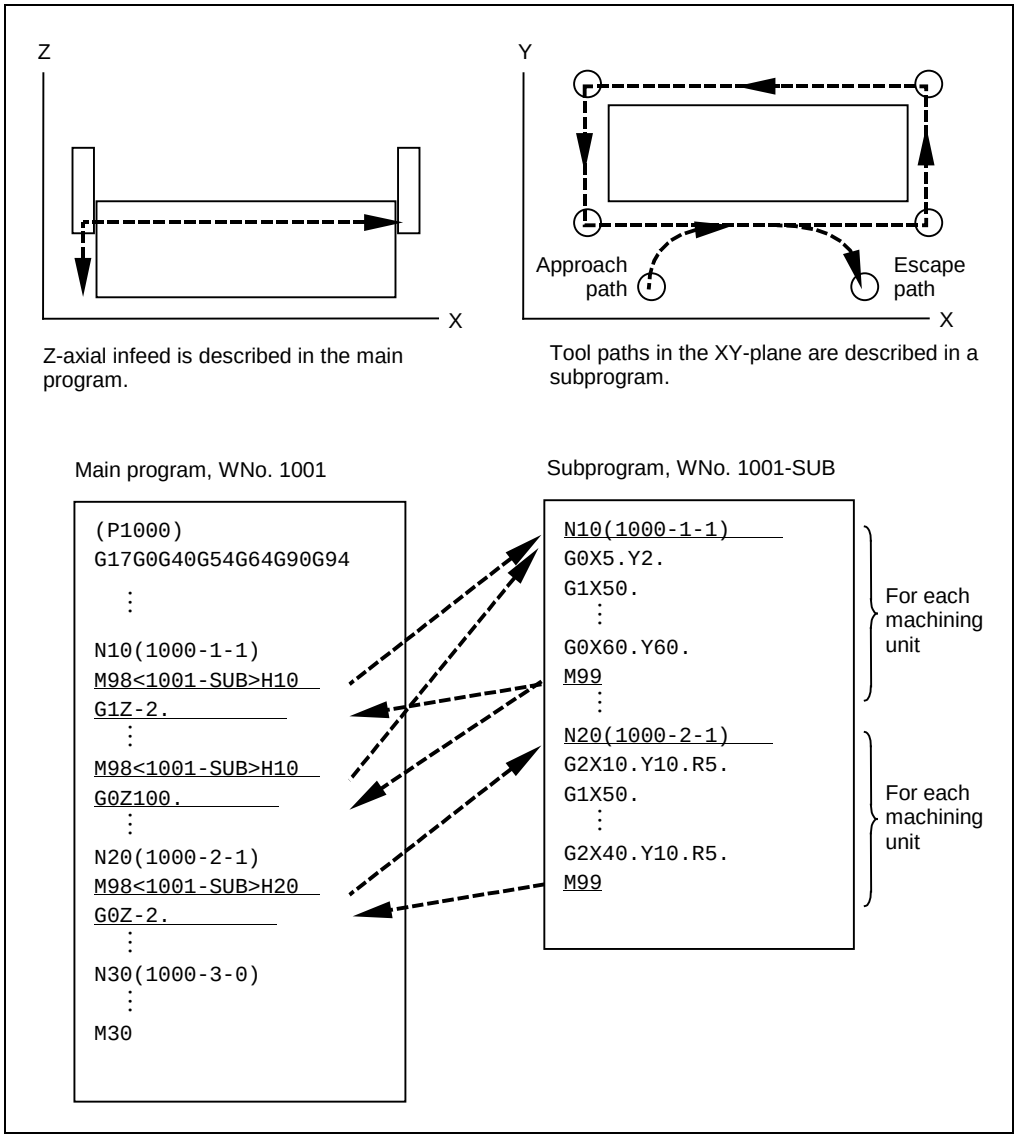
The created subprogram is automatically named by adding “-SUB” to the main program name.

Example: When the name of the main program is “1001”, then the subprogram is named “1001-SUB”.

(Note) If the above naming should result in a subprogram name of more than 32 characters, then the main program name used will be shortened as required (to the leading 28 characters).

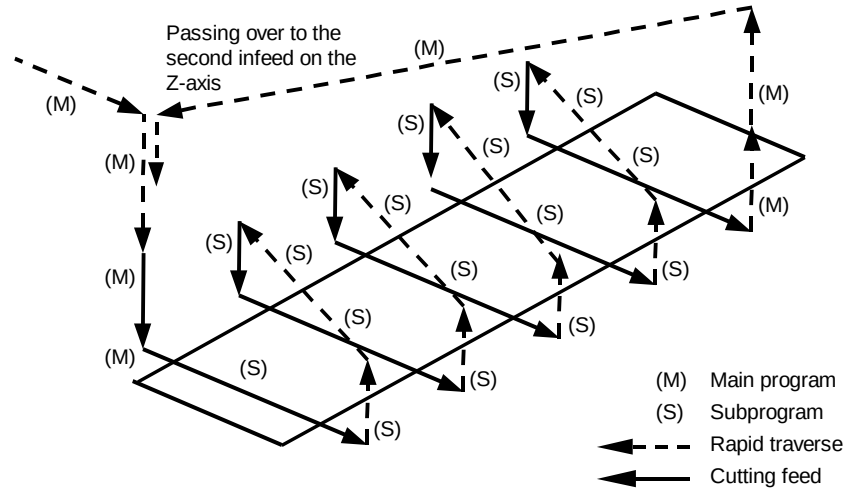
Absolute-data command G90 is used to give positional information within a subprogram.

Tool paths in the XY-plane for line machining and face machining are described in a subprogram. Z-axial infeed and tool path in the XY-plane are described in the main and subprogram, respectively.



As for some face machining types (FCE MILL (unidirectional), STEP, POCKET, PCKT MT, PCKT VLY), Z-axial infeed is specified in the main program, and the subprogram contains a description of tool path in the XY-plane and of Z-axis movements for passing over to the

next cutting pass.



Main program, WNo. 2001

```
(P2000)
G17G00G40G54G64G90G94G98
N10(2000-1-1)
G80
        ⋮
G1Z  Cutting face height (1)
#  Variable number = Cutting face height (1)
M98<2001-SUB>H10
G0Z  Initial point
   X ____ Y ____
G1Z  Cutting face height (2)
#  Variable number = Cutting face height (2)
M98<2001-SUB>H10
G0Z  Initial point
        ⋮
M30
```

Subprogram, WNo. 2001-SUB

```
N10(2000-1-1)
G1X ____
G0Z  Initial point
   X ____ Y ____
G1Z#  Variable number
   X ____
G0Z#  Initial point
   X ____ Y ____
G1Z#  Variable number
   X ____
      ⋮
M99
```

The value set in the parameter **F98** is output as a macro variable number.

Note 1: The contents of a subprogram which is called by a subprogram unit cannot be converted with the above-mentioned division into a main and a subprogram.

Note 2: Subprogram technique cannot be applied to manual program mode unit.

Note 3: Subprogram technique cannot be applied to multi-workpiece machining.

Note 4: Subprogram technique cannot be applied to three-dimensional machining.

8. For EIA/ISO conversion 2, since the point-machining unit is converted into a standard fixed-cycle code, the machine does not operate as minutely as with the original MAZATROL program.

   Operational characteristics in that case are listed below.

   - Cutting clearances always become equal to the setting of parameter **D41**.
   - Deceleration for escape is not valid for drilling.
   - Tapping tools do not move upward during R-point returning.
   - The returning-speed override function is not valid for tapping, reaming, or boring.
   - Returning at the bottom of a hole is not valid for back-boring.
   - For boring and back-boring, the spindle always rotates forward (M03) after initial point/R-point returning.
   - During synchronous tapping, pecking does not occur (when **F89** bit 1 = 1).
   - The cutting depth does not decrease in steps during drilling.

9. A certain parameter setting causes the tool path to be described in the converted EIA/ISO program with explicite preparatory functions for offsetting (G43 for length, G41 and G42 for radius), where the appertaining H- and D-codes are outputted with respect to the number of the tool concerned. As for a tool with multiple data sets registered, the T-code will be expressed distinctively according to the suffixes, indeed, but the D- and H-codes must be distinguished manually as required for the variety of tool application.

   Example: Output for data sets under Tool No. 10 with various suffixes
   10A → T10.01H10 (D10)
   10B → T10.02H10 (D10)
   10C → T10.03H10 (D10)

10. Remarks on tool offset

    The operational conditions required for normal execution of the converted EIA/ISO program are as follows.

    <Execution on machines with the MATRIX as NC unit>

    a) Tool length offset

       Since the length-offsetting G-code is always outputted, use of the offset value 0 (zero) is requisite when **F93** bit 3 = 1 (application of MAZATROL length data).

    b) Tool radius compensation

Output of compensation G-codes **F88** bit 4	Description of compensated path **F88** bit 5	Requirements
0	0	**F92** bit 7 = 1
0	1	**F92** bit 7 = 0
1	0	When **F92** bit 7 = 1: Offset value zero (0) When **F92** bit 7 = 0: Appropriate offset values
1	1	**F92** bit 7 = 0, and Offset value zero (0)

***** **F92** bit 7 = 1/0 : MAZATROL tool diameter data valid/invalid in EIA/ISO program execution.

<Execution on machines with an NC unit other than MATRIX>

a) Tool length offset

   Edit the offsetting commands as required for the intended machine.

b) Tool radius compensation

Output of compensation G-codes **F88** bit 4	Description of compensated path **F88** bit 5	Requirements
0	0	Edit the offsetting commands as required for the intended machine.
0	1	
1	0	
1	1	No radius compensation

11. When the function for multi-face machining with angular tools is made valid, programs the execution of which requires angular tools are excluded from EIA/ISO conversion.

11-24-6 Parameter and alarm lists

Parameters relating to EIA/ISO conversion are listed below.

Parameter list

Parameter	Function	Setting	Description
F88 bit 0	Subprogram creation	0/1	0: Subprogram creation invalid 1: Subprogram creation valid
F88 bit 2	Point-machining G0-G4 output	0/1	0: Fixed-cycle G-code output (EIA conversion 2) 1: G0-G4 code output (EIA conversion 1)
F88 bit 3	Workpiece offset writing	0/1	0: Output invalid 1: G10/G92.5 output valid
F88 bit 4	Output of tool radius compensation G-codes	0/1	0: No output 1: Output
F88 bit 5	Immediate description of the compensated tool path	0/1	0: Description of contour 1: Description of compensated path
F89 bit 0	Shape data addition	0/1	0: Shape data addition invalid 1: Shape data addition valid
F89 bit 1	Selection of synchronous tapping G-codes	0/1	0: G84/G74 output 1: G84.2/G84.3 output
F89 bit 6	Output of G30 before tool change command	0/1	0: No output 1: Output
F97	Coordinate system selection	1 - 6 Others	1 - 6: G54-G59 output Others: G54 output
F98	Common variable ID number	100 - 199 500 - 699 Others	Set one variable ID number to be used for the main program/subprogram. Others: #100 output

Alarms relating to EIA/ISO conversion are listed below.

Alarm list

Error No.	Error message	Description	Remedy
613	DATA MISSING IN WPC UNIT	Although the program to be converted into an EIA/ISO program contains an MMS unit, a code from G54 to G59 has not been set in the added WPC.	Select a coordinate system by setting a code (G54-G59) in the added WPC.
657	ILLEGAL NUMBER INPUT	Although the program to be converted into an EIA/ISO program contains an MMS unit, the G54.1 coordinate system or a code (A to H, J, or K) has been selected for the added WPC.	Select a coordinate system by setting a code (G54-G59) in the added WPC.
703	PROCESS DEFINITION ERROR	A unit not supported under the specifications, such as multi-face machining or H/V face definition, has been set.	Delete the unsupported unit.

11-25 IC Memory Card Operating Function

11-25-1 Outline

With the IC Memory Card (abbreviated to CARD in this section) operating function, any large-size EIA/ISO program pre-saved within a special folder of the CARD set into the slot on the front of the NC operating panel can be executed for automatic operation while transferring that program to the NC memory.

11-25-2 Preparation for CARD operation

To execute CARD operation, it is required first to create a machining program and save it into a special folder of the CARD. Create and then save (copy) the desired program into the folder shown below by either the Explorer accompanying the Windows system, or another commercially available software.

Folder for CARD operation programs: ¥MCICPROG¥

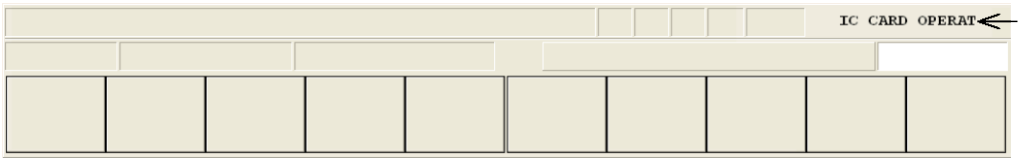
11-25-3 Selection of operation mode

1. Selection between CARD and conventional TAPE operation modes

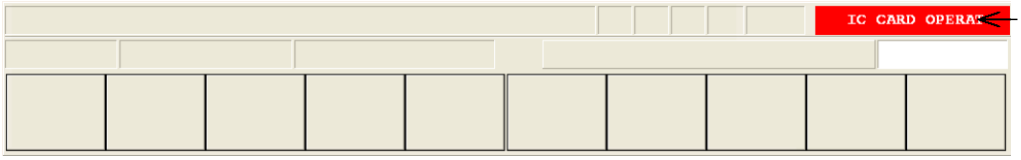
The CARD operating function is provided as the alternative to the conventional TAPE operating function. Use the following parameter to select between the provided operating functions as required for actual operational conditions:

Address	Name		Program type	Description
	Unit	Setting range	Conditions	
F40	TAPE mode selection		–	The operating function to be selected for the TAPE operation mode. 0: Conventional TAPE operating function 1: HD operating function 2: CARD operating function 3: Ethernet operating function
		0, 1, 2, 3	Immediate	

When the CARD operating function is selected, the date and time display area will be used for the indication of the special operation mode, as shown below, on the **POSITION** and **TRACE** displays. The indication is not given, indeed, during selection of the MDI or a manual operation mode nor during execution of a program stored in the NC memory.



The mode indication is highlighted on red background, as shown below, during actual CARD operation.

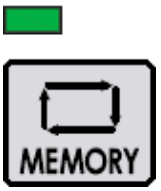


2. CARD operation modes

The CARD operating function can be used in the following two modes:

1. Direct operation mode
   A program stored on the CARD operates as the main program.
2. Subprogram operation mode
   A program stored on the CARD is called up as the subprogram from a main program registered in the NC memory.

Press the TAPE key to select the direct operation mode, and the MEMORY key to use the subprogram operation mode of the CARD operating function.

	
TAPE operation key	MEMORY operation key

3. Restrictions concerning the CARD operating function

General restrictions on the CARD operation are as follows:

- Only programs of the EIA/ISO format can be used for the CARD operation.
- Programs stored on the CARD cannot be checked for tool path and machining shape on the **TOOL PATH CHECK** display.
- Programs stored on the CARD cannot be used for simulation on the **VIRTUAL MACHINING** display.
- A simulation on the **VIRTUAL MACHINING** display causes an alarm (**844 PROGRAM No. NOT FOUND**) at the call for a subprogram which is stored on the CARD.
- Programs stored on the CARD cannot be presented on the **EIA MONITOR** display.
- The **[RESTART 2 NONMODAL]** menu function cannot be applied to a program stored on the CARD.
- Programs stored on the CARD cannot be subjected to the external work number search.

Further particular restrictions for each CARD operation mode are as follows:

<u>For direct operation mode</u>

- The CARD main program cannot call another CARD program as a subprogram. On a subprogram-call command from the CARD main program can only the NC memory be searched for, and an alarm will be given if the specified program is not found there.
- An NC subprogram called up from the CARD main program cannot call another HD program as the further subroutine.
- An alarm will be caused if an “M99” command (used for return from subprogram) is given in the CARD main program.

For subprogram operation mode

- The CARD subprogram cannot call another CARD program as a subprogram. On a further subprogram-call command from the CARD subprogram can only the NC memory be searched for, and an alarm will be given if the specified program is not found there.
- Sequence number specification for subprogram call by "M98H∗∗" is not effective in calling up a CARD program. The CARD subprogram is always executed from the beginning.
- Repeat time specification for subprogram call is not effective in calling up a CARD program. The CARD subprogram is always executed only one time for one call command.
- The subprogram call from the NC main program preferably selects a program in the NC memory to that on the CARD in case the specified work number should have been assigned to the both programs.
- With MAZATROL programs in the NC memory, use a subprogram unit or "G65" (non-modal user macro call) in a manual-program unit for the CARD subprogram operation mode.

11-25-4 Program selection for CARD operation

This subsection describes the operating procedure for selecting the program in each mode for CARD operating function.

1. Direct operation mode

(1) Select the machine operating mode for the direct CARD operation mode.
- Press the TAPE operation key [TAPE].

(2) Select the **POSITION** display on the screen.
- This is required for selecting the program to be run and checking the operational status of the machine.

(3) Specify the desired program stored on the CARD.
- Proceed as follows to specify the program:

1) Press the **[WORK No.]** menu key.
The menu item is highlighted and the **WORK No. SELECT** window appears.

2) Select the desired program from among those stored on the CARD.
To specify the program of work No. 100, for example:

Example 1: Press the keys [1] [0] [0] [INPUT] in this order.

Example 2: Press a cursor key to call up the cursor, move the cursor onto the displayed work number "100" in the window, and then press the INPUT key [INPUT].

Carry out the above procedural steps, referred to as "CARD work number search", to start the direct CARD operation.

2. Subprogram operation mode

(1) Select the machine operating mode for the subprogram operation mode.
- Press the MEMORY operation key [MEMORY].

(2) Select the **POSITION** display on the screen.
- This is required for selecting the program to be run and checking the operational status of the machine.

(3) Specify the desired main program stored in the NC memory.
- Select, or perform work number search for, an NC program (stored in the NC memory) including the subprogram-call command for the desired CARD program.
- The operational procedure required here is just the same as that for normal MEMORY operation. No CARD subprogram operation, however, takes place if the correct command for calling the CARD program is not given in the specified NC program.

11-25-5 Restart in the CARD operation mode

The restart function is restricted for the CARD operation as follows:
- The **[RESTART 2 NONMODAL]** menu function cannot be applied to a CARD program.
- The restart function can be executed in the subprogram operation mode only when the selected NC main program is of the EIA/ISO format.

The restarting procedure for the CARD operation is also the same as that for normal automatic operation.

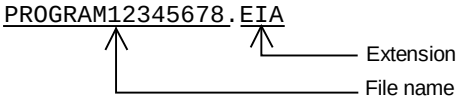
11-25-6 Format for CARD operation programs

The programs on the CARD to be used for the HD operation must be of the text file format. Use a commercially available text editor capable of editing text files to create the desired programs.

Note: Only programs of the EIA/ISO format can be used for the CARD operation.

1. File name

Designate the file of a program to be stored on the CARD for CARD operation as directed below. The file names here serve as the work numbers to be searched for in actual machine operation.



File name	Assign a work number. - Any string of up to 32 characters can be used as a work number. For the use of numerals only, however, the work number may be up to eight digits long (from 1 to 99999999). - Characters available are letters (capital and small: A to Z and a to z), numerals, and the following symbols: "**+**" "**–**" "_" and "**.**" It should be noted here that no distinction is made between capital and small letters. That is, a new program cannot be named "aBC" if a program with the name "ABC" already exists in the storage area concerned. Moreover, the program name must not begin with a period (.). - The work number which is composed exclusively of numerals must begin with a non-zero numeral. The leading zeros of the file name are always ignored, and thus the NC unit cannot distinguish the following two names, for example, from one another: 1234567.EIA 01234567.EIA } Both denote work number "1234567".
Extension	Identification of an EIA/ISO program - All programs for the CARD operation must have this extension assigned.

2. Programming format

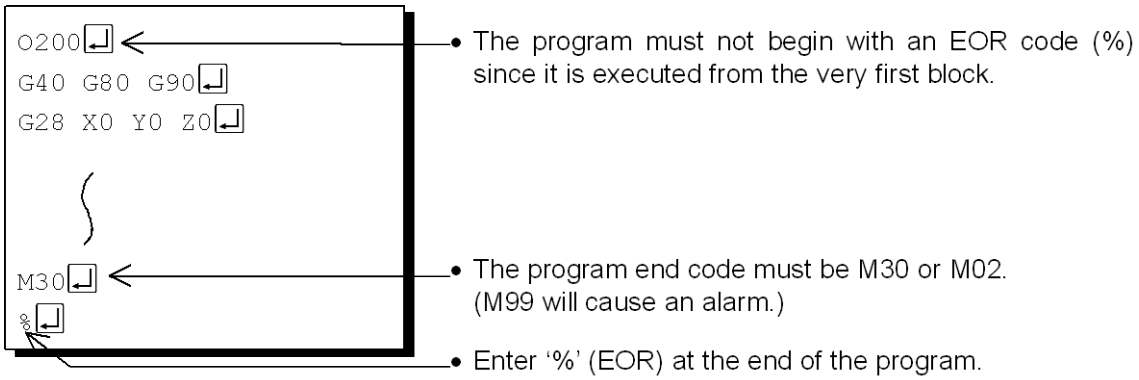
Create CARD operation programs in the following text file format:
- One program must be created for one text file.
- The program must not begin with an EOR code (%) since it is executed from the very first block.

- Enter a line feed code (by pressing the return key) at the end of each block. A semicolon ';' must not be used. An alarm will result if a semicolon is included in the program.
- Macro data cannot be used.
- Only characters listed in the table below may be used. Two-byte codes (such as normal-size characters or uni-codes) are not admissible.

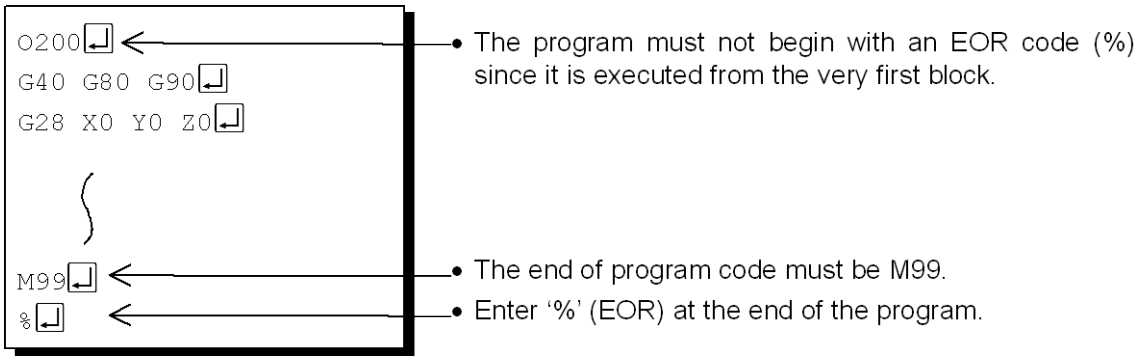
Type	Usable characters	Remarks
Alphabet	- 'A' ~ 'Z' (Capitals only)	- Only one-byte codes can be used. - End of block is to be specified by CR (Carriage Return) plus LF (Line Feed) or simply by LF.
Numeral	- '0' ~ '9'	
Symbol	- '.' (Decimal point) - '%' (EOR) - '(', ')' (Parentheses)	
Others	- Space code - Line feed code (EOB)	

3. Example of programming

Programs for direct operation mode



Programs for subprogram operation mode



11-26 Ethernet Operating Function

11-26-1 Outline

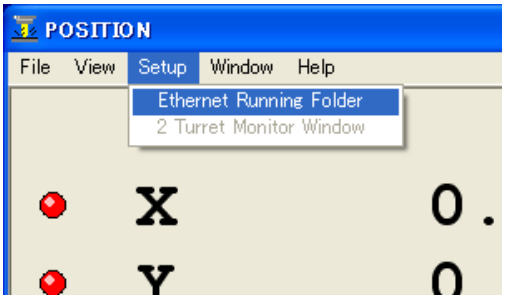
With the Ethernet (abbreviated to ENET in this section) operating function, any large-size EIA/ISO program pre-saved within the host computer can be executed for automatic operation while transferring that program to the NC memory under an Ethernet-based network environment.

11-26-2 Preparation for ENET operation

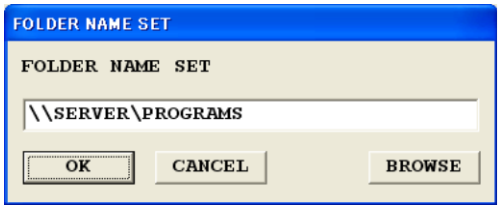
To execute Ethernet operation, it is required first to connect the NC unit and the host computer through an Ethernet cable in order to store the machining program in the host computer. The LAN connector is located on the rear side of the NC unit. Ask the supervisor of the network in your company for more information on the connecting procedure.

To prepare the NC for referring to the folder concerned in the host computer, carry out the following operations on the **POSITION** display:

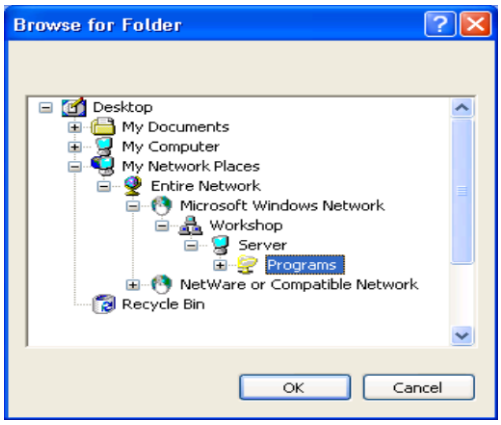
(1) Select **[Ethernet Running Folder]** from **[Setup]** on the menu bar.



(2) Set the name of the reference folder in the dialogue box which appears upon step (1).



- Click **[BROWSE]** to display the tree of the available folders, and select an item under the host computer if it is to be set as a folder name.



(3) Complete the setting by clicking the **[OK]** button.

- Once designated, the name of the folder is not cleared simply by the turning-off.
- The folder name can consist of 64 characters.

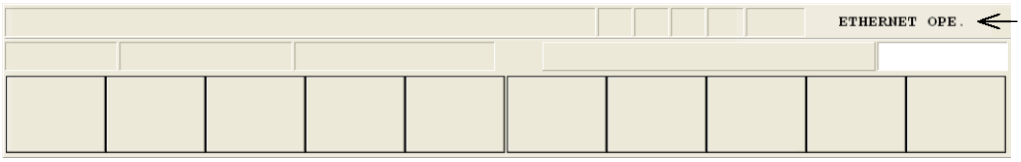
11-26-3 Selection of operation mode

1. Selection between ENET and conventional TAPE operation modes

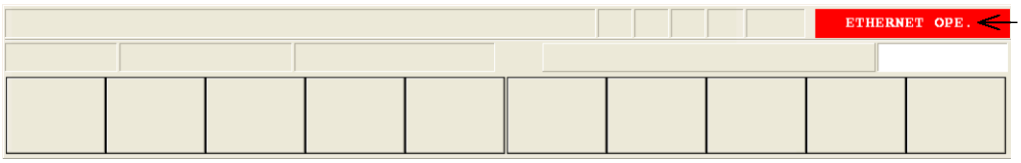
The ENET operating function is provided as the alternative to the conventional TAPE operating function. Use the following parameter to select between the provided operating functions as required for actual operational conditions:

Address	Name		Program type	Description
	Unit	Setting range	Conditions	
F40	TAPE mode selection		–	The operating function to be selected for the TAPE operation mode. 0: Conventional TAPE operating function 1: HD operating function 2: IC memory card operating function 3: Ethernet operating function
		0, 1, 2, 3	Immediate	

When the ENET operating function is selected, the date and time display area will be used for the indication of the special operation mode, as shown below, on the **POSITION** and **TRACE** displays. The indication is not given, indeed, during selection of the MDI or a manual operation mode nor during execution of a program stored in the NC memory.



The mode indication is highlighted on red background, as shown below, during actual ENET operation.

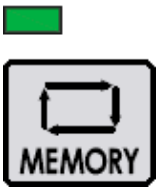


2. ENET operation modes

The ENET operating function can be used in the following two modes:

1. Direct operation mode
   A program stored in the host computer operates as the main program.
2. Subprogram operation mode
   A program stored in the host computer is called up as the subprogram from a main program registered in the NC memory.

Press the TAPE key to select the direct operation mode, and the MEMORY key to use the subprogram operation mode of the ENET operating function.

	
TAPE operation key	MEMORY operation key

3. Restrictions concerning the ENET operating function

General restrictions on the ENET operation are as follows:

- Only programs of the EIA/ISO format can be used for the ENET operation.
- Programs stored in the host computer cannot be checked for tool path and machining shape on the **TOOL PATH CHECK** display.
- Programs stored in the host computer cannot be used for simulation on the **VIRTUAL MACHINING** display.
- A simulation on the **VIRTUAL MACHINING** display causes an alarm (**844 PROGRAM No. NOT FOUND**) at the call for a subprogram which is stored in the host computer.
- The **[RESTART 2 NONMODAL]** menu function cannot be applied to a program stored in the host computer.
- Programs stored in the host computer cannot be subjected to the external work number search.
- Machine operation may sometimes break off in consequence of a retardation of data transfer due to the particular performance of the host computer and communication conditions. It is recommended, therefore, to connect the NC and the host computer one to one for high-speed machining by micro-segmental command blocks.

Further particular restrictions for each ENET operation mode are as follows:

For direct operation mode

- The ENET main program cannot call another ENET program as a subprogram. On a subprogram-call command from the ENET main program can only the NC memory be searched for, and an alarm will be given if the specified program is not found there.
- An NC subprogram called up from the ENET main program cannot call another ENET program as the further subroutine.
- An alarm will be caused if an “M99” command (used for return from subprogram) is given in the ENET main program.

For subprogram operation mode

- The ENET subprogram cannot call another ENET program as a subprogram. On a further subprogram-call command from the ENET subprogram can only the NC memory be searched for, and an alarm will be given if the specified program is not found there.
- Sequence number specification for subprogram call by “M98H∗∗” is not effective in calling up an ENET program. The ENET subprogram is always executed from the beginning.
- Repeat time specification for subprogram call is not effective in calling up an ENET program. The ENET subprogram is always executed only one time for one call command.
- The subprogram call from the NC main program preferably selects a program in the NC memory to that in the host computer in case the specified work number should have been assigned to the both programs.
- With MAZATROL programs in the NC memory, use a subprogram unit or “G65” (non-modal user macro call) in a manual-program unit for the ENET subprogram operation mode.

11-26-4 Program selection for ENET operation

This subsection describes the operating procedure for selecting the program in each mode for ENET operating function.

1. Direct operation mode

(1) Select the machine operating mode for the direct ENET operation mode.
- Press the TAPE operation key [TAPE].

(2) Select the **POSITION** display on the screen.
- This is required for selecting the program to be run and checking the operational status of the machine.

(3) Specify the desired program stored in the host computer.
- Proceed as follows to specify the program:

1) Press the **[WORK No.]** menu key.
The menu item is highlighted and the **WORK No. SELECT** window appears.

2) Select the desired program from among those stored in the host computer.
To specify the program of work No. 100, for example:

Example 1: Press the keys [1] [0] [0] [INPUT] in this order.

Example 2: Press a cursor key to call up the cursor, move the cursor onto the displayed work number “100” in the window, and then press the INPUT key [INPUT].

Carry out the above procedural steps, referred to as “Ethernet work number search”, to start the direct ENET operation.

2. Subprogram operation mode

(1) Select the machine operating mode for the subprogram operation mode.
- Press the MEMORY operation key [MEMORY].

(2) Select the **POSITION** display on the screen.
- This is required for selecting the program to be run and checking the operational status of the machine.

(3) Specify the desired main program stored in the NC memory.
- Select, or perform work number search for, an NC program (stored in the NC memory) including the subprogram-call command for the desired ENET program.
- The operational procedure required here is just the same as that for normal MEMORY operation. No ENET subprogram operation, however, takes place if the correct command for calling the ENET program is not given in the specified NC program.

11-26-5 Restart in the ENET operation mode

The restart function is restricted for the ENET operation as follows:
- The **[RESTART 2 NONMODAL]** menu function cannot be applied to an ENET program.
- The restart function can be executed in the subprogram operation mode only when the selected NC main program is of the EIA/ISO format.

The restarting procedure for the ENET operation is also the same as that for normal automatic operation.

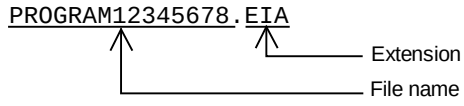
11-26-6 Format for ENET operation programs

The programs in the host computer to be used for the ENET operation must be of the text file format. Use a commercially available text editor capable of editing text files to create the desired programs.

Note: Only programs of the EIA/ISO format can be used for the ENET operation.

1. File name

Designate the file of a program to be stored in the host computer for ENET operation as directed below. The file names here serve as the work numbers to be searched for in actual machine operation.



File name	Assign a work number. - Any string of up to 32 characters can be used as a work number. For the use of numerals only, however, the work number may be up to eight digits long (from 1 to 99999999). - Characters available are letters (capital and small: A to Z and a to z), numerals, and the following symbols: "**+**" "**–**" "_" and "**.**" It should be noted here that no distinction is made between capital and small letters. That is, a new program cannot be named "aBC" if a program with the name "ABC" already exists in the storage area concerned. Moreover, the program name must not begin with a period (.). - The work number which is composed exclusively of numerals must begin with a non-zero numeral. The leading zeros of the file name are always ignored, and thus the NC unit cannot distinguish the following two names, for example, from one another: 1234567.EIA 01234567.EIA } Both denote work number "1234567".
Extension	Identification of an EIA/ISO program - All programs for the ENET operation must have this extension assigned.

2. Programming format

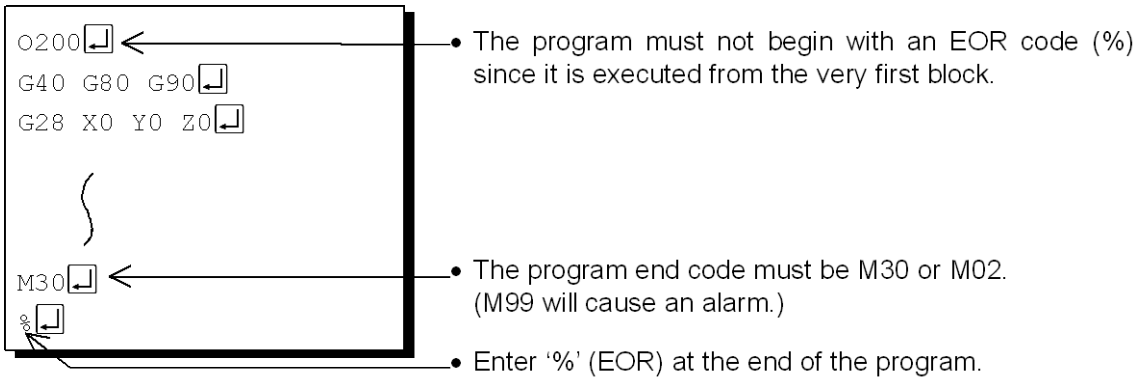
Create ENET operation programs in the following text file format:

- One program must be created for one text file.
- The program must not begin with an EOR code (%) since it is executed from the very first block.
- Enter a line feed code (by pressing the return key) at the end of each block. A semicolon ';'must not be used. An alarm will result if a semicolon is included in the program.
- Macro data cannot be used.
- Only characters listed in the table below may be used. Two-byte codes (such as normal-size characters or uni-codes) are not admissible.

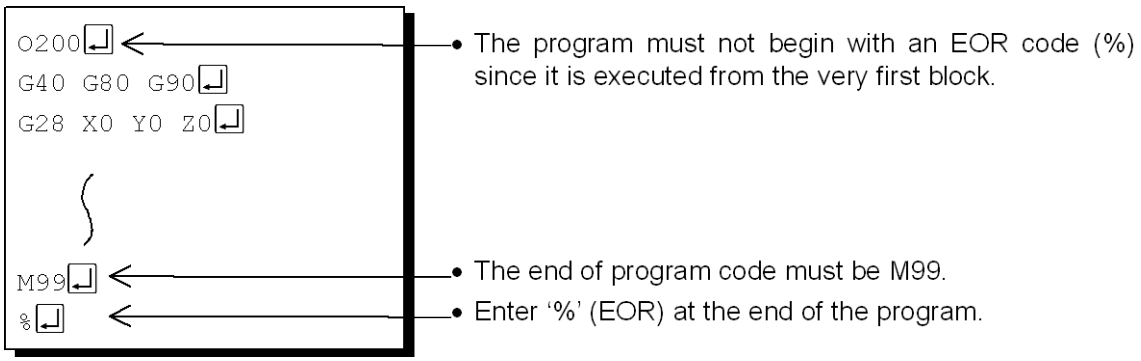
Type	Usable characters	Remarks
Alphabet	- 'A' ~ 'Z' (Capitals only)	- Only one-byte codes can be used. - End of block is to be specified by CR (Carriage Return) plus LF (Line Feed) or simply by LF.
Numeral	- '0' ~ '9'	
Symbol	- '.' (Decimal point) - '%' (EOR) - '(', ')' (Parentheses)	
Others	- Space code - Line feed code (EOB)	

3. Example of programming

Programs for direct operation mode



Programs for subprogram operation mode

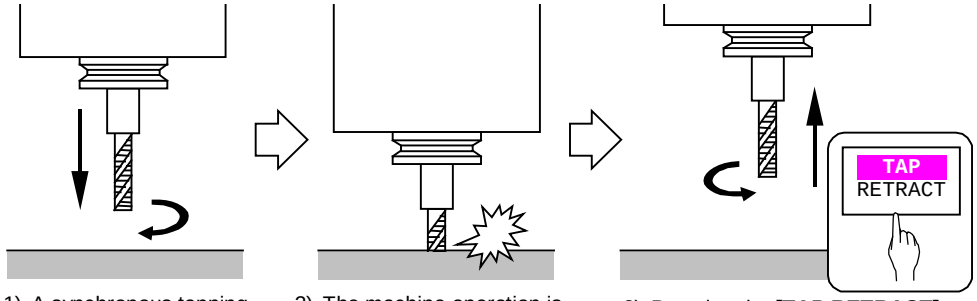


11-27 Tap Retract Function

11-27-1 Outline

If a synchronous tapping process should be stopped halfway due to an emergency stop or abrupt switching-off, the normal conditions for automatic operation cannot be recovered in general without cautious removal of the tap from the workpiece by hand, a very time-consuming job.

The function in question allows the tap to be taken automatically out of the workpiece, resulting in a reduction of recovery time.



1) A synchronous tapping process is started.

2) The machine operation is abruptly stopped with the tapping tool remaining in the workpiece.

3) Pressing the **[TAP RETRACT]** menu key feeds the tool backward out of the workpiece with the spindle rotating synchronously.

D740S30338

11-27-2 Operating procedure

(1) According to the cause of the operation stop, clear the alarm, for example, of emergency stop or switch on the machine again.

(2) Select the manual mode of operation and press the **[TAP RETRACT]** menu key.

- As long as the **[TAP RETRACT]** menu key is held down, a synchronized operation of axis feed and spindle rotation continues, with the menu item being highlighted, in the respective reverse directions of the inside thread cutting so as to take the tapping tool out of the workpiece.

  ➔ The retracting operation of axis feed and spindle rotation will be continued until the initial point of the tapping process is reached and the highlighted state of the **[TAP RETRACT]** menu item cleared.

- The rate of feed for retracting the tap depends on the setting in parameter **BA72** (in %) as follows:

  Tap retracting feed = Feed for the synchronous tapping × **BA72**/100.

  However, **BA72** is processed as 100 (%) if it is set to zero (0).

11-27-3 Supplementary notes

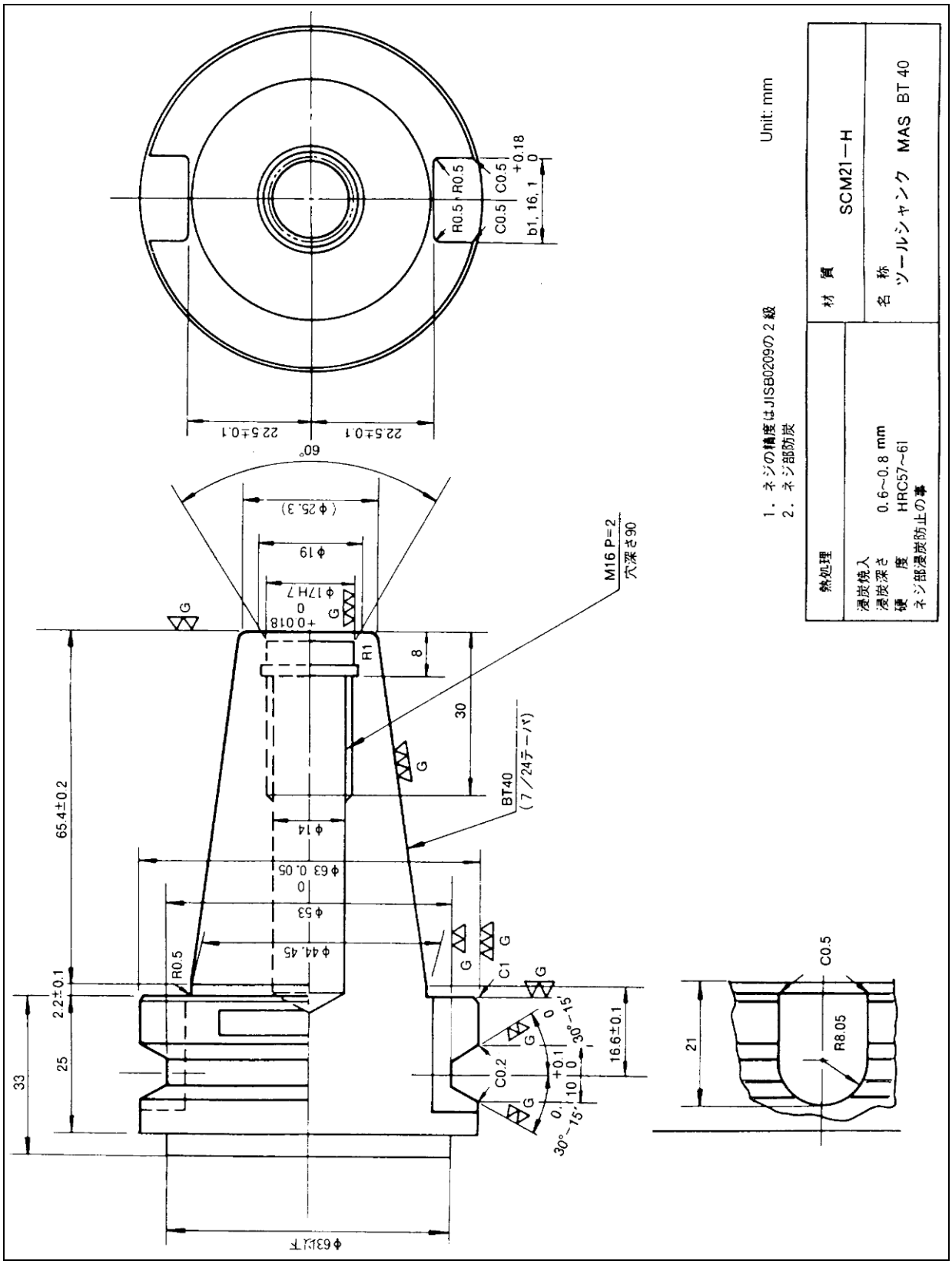
1. The tap retract function cannot be used for an asynchronous tapping process.
2. The tap retract function cannot be used for a process of synchronous tapping in an inclined plane.
3. It is not advisable to use the tap retract function again after a tap retracting operation is interrupted by resetting or an emergency stop, for the reason that the appropriate synchronization of axis feed and spindle rotation may not be obtained any more in general.
4. The INTELLIGENT SAFETY SHIELD function is suppressed during tap retracting operation.

5. The tap retract function cannot be used when the **[MACHINE LOCK]** menu function is selected.
6. The override functions for spindle speed, rapid traverse, and cutting feed are not effective for the tap retracting operation.
7. This optional function may not be obtainable for some machine types or specifications.

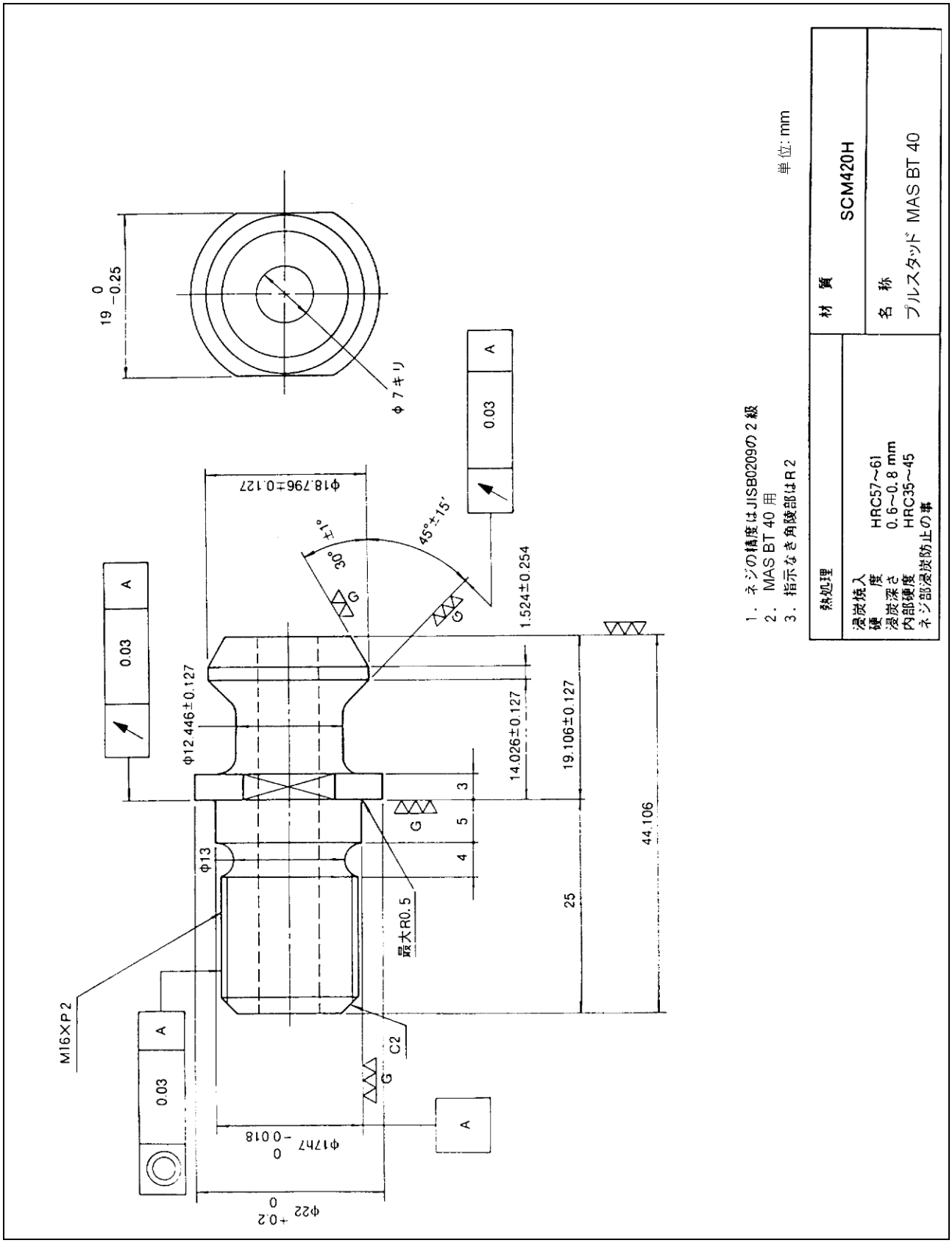
12 TOOLING

12-1 MAS BT 40 System

12-1-1 Tool shank dimensional drawing for JPN/Asia

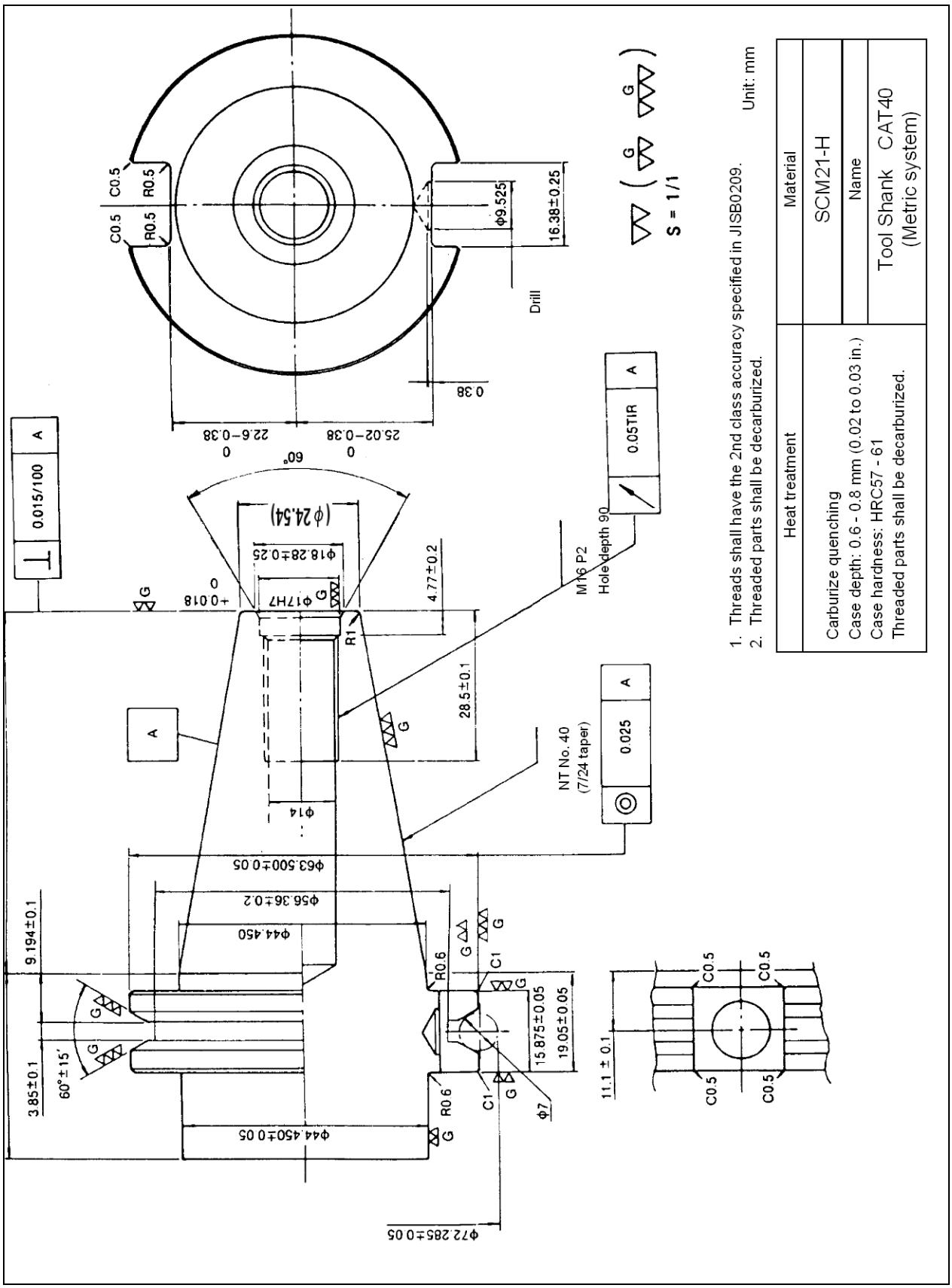


12-1-2 Pull stud dimensional drawing (MAS BT 40) for JPN/Asia

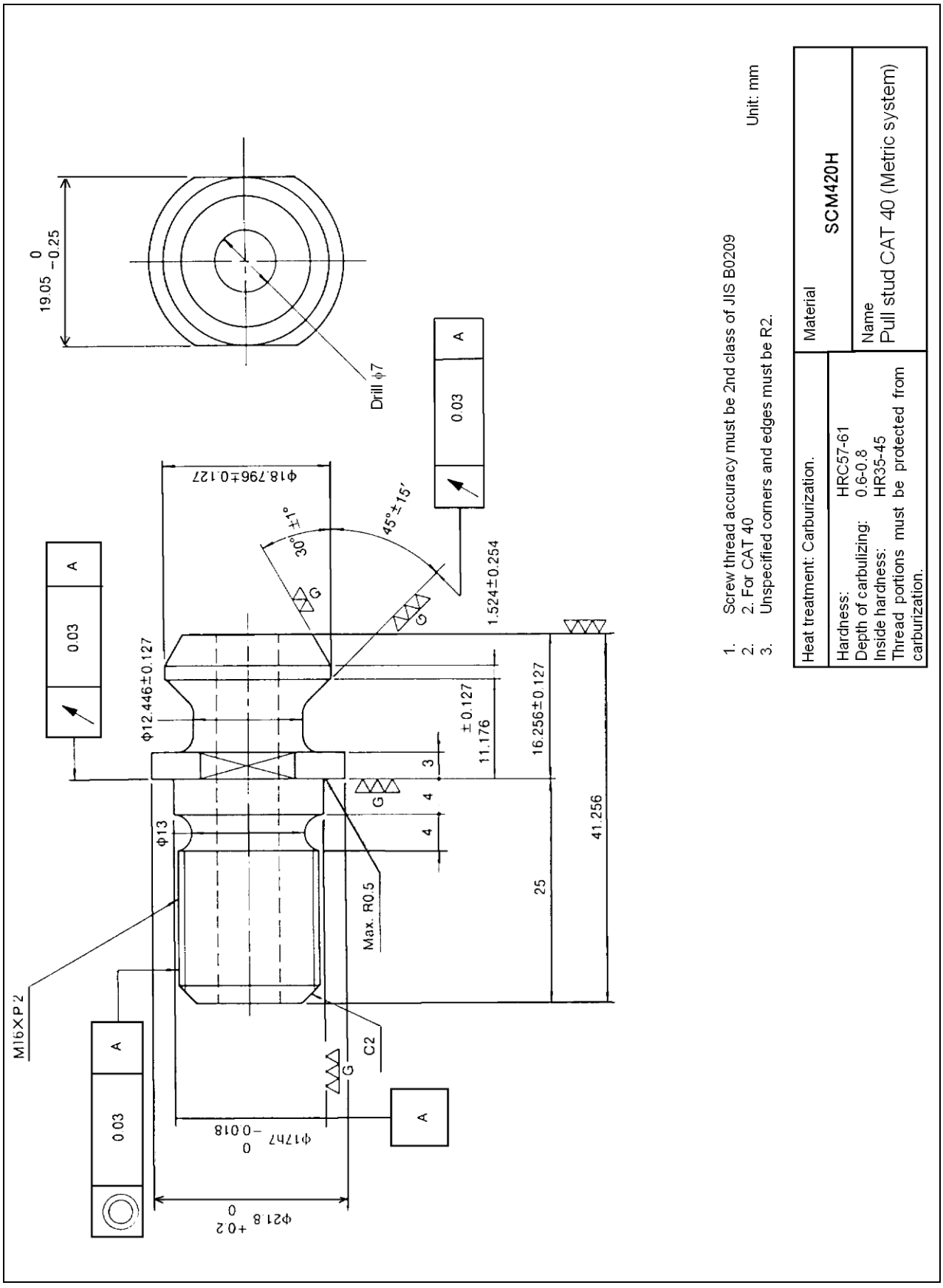


12-2 CAT Metric System

12-2-1 Tool shank dimensional drawing for EU

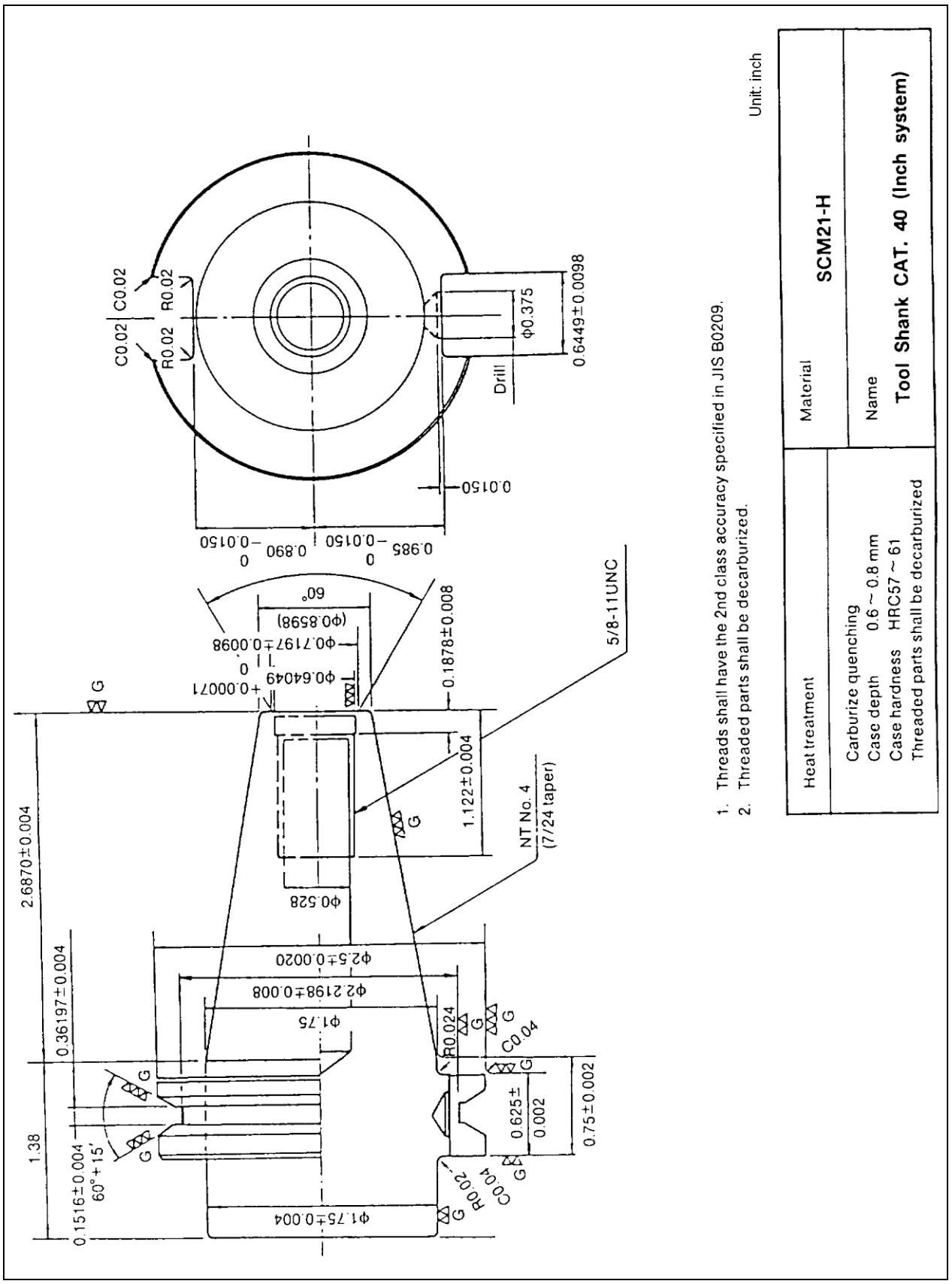


12-2-2 Pull stud dimensional drawing (CAT 40) for EU

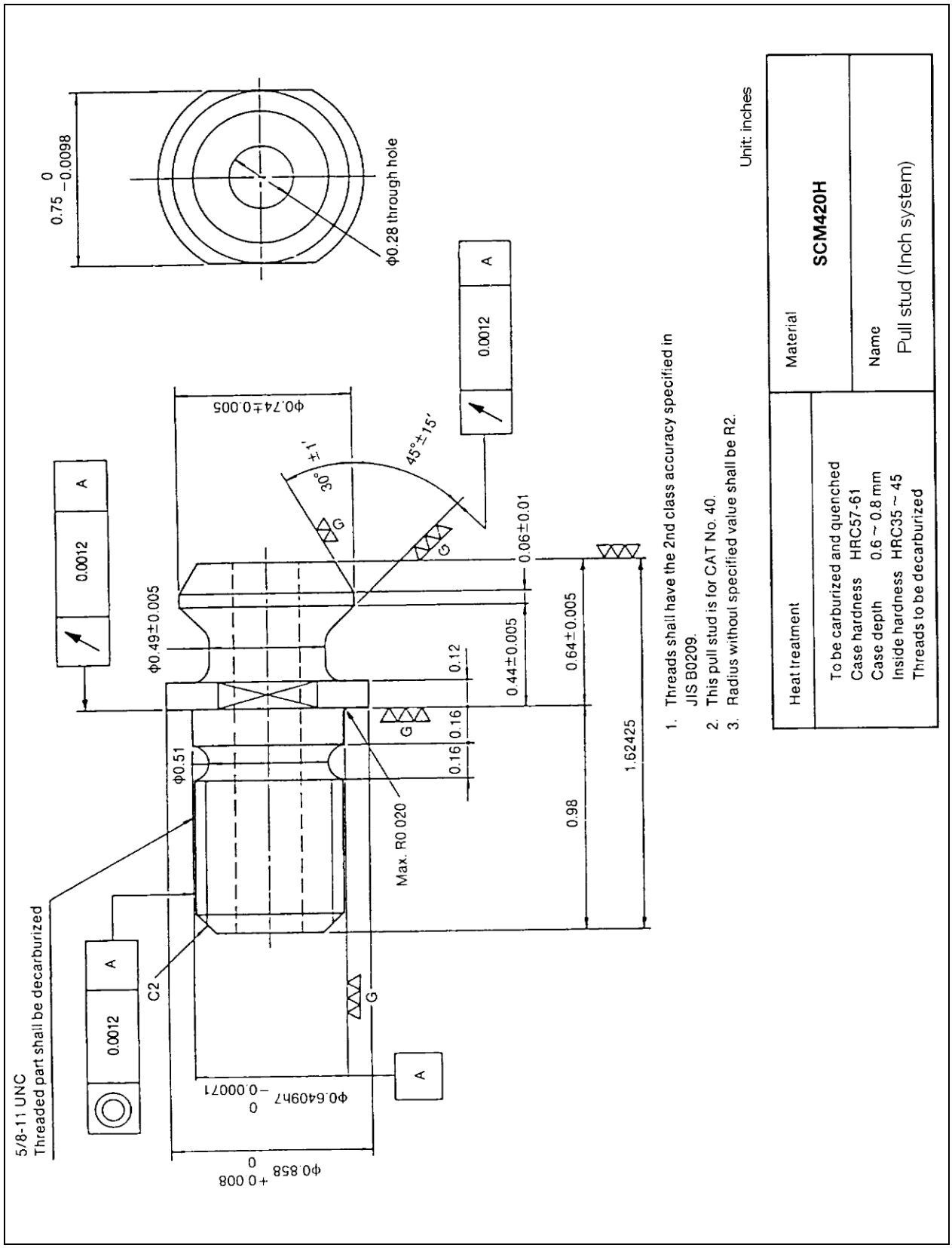


12-3 CAT Inch System

12-3-1 Tool shank dimensional drawing for U.S.A.

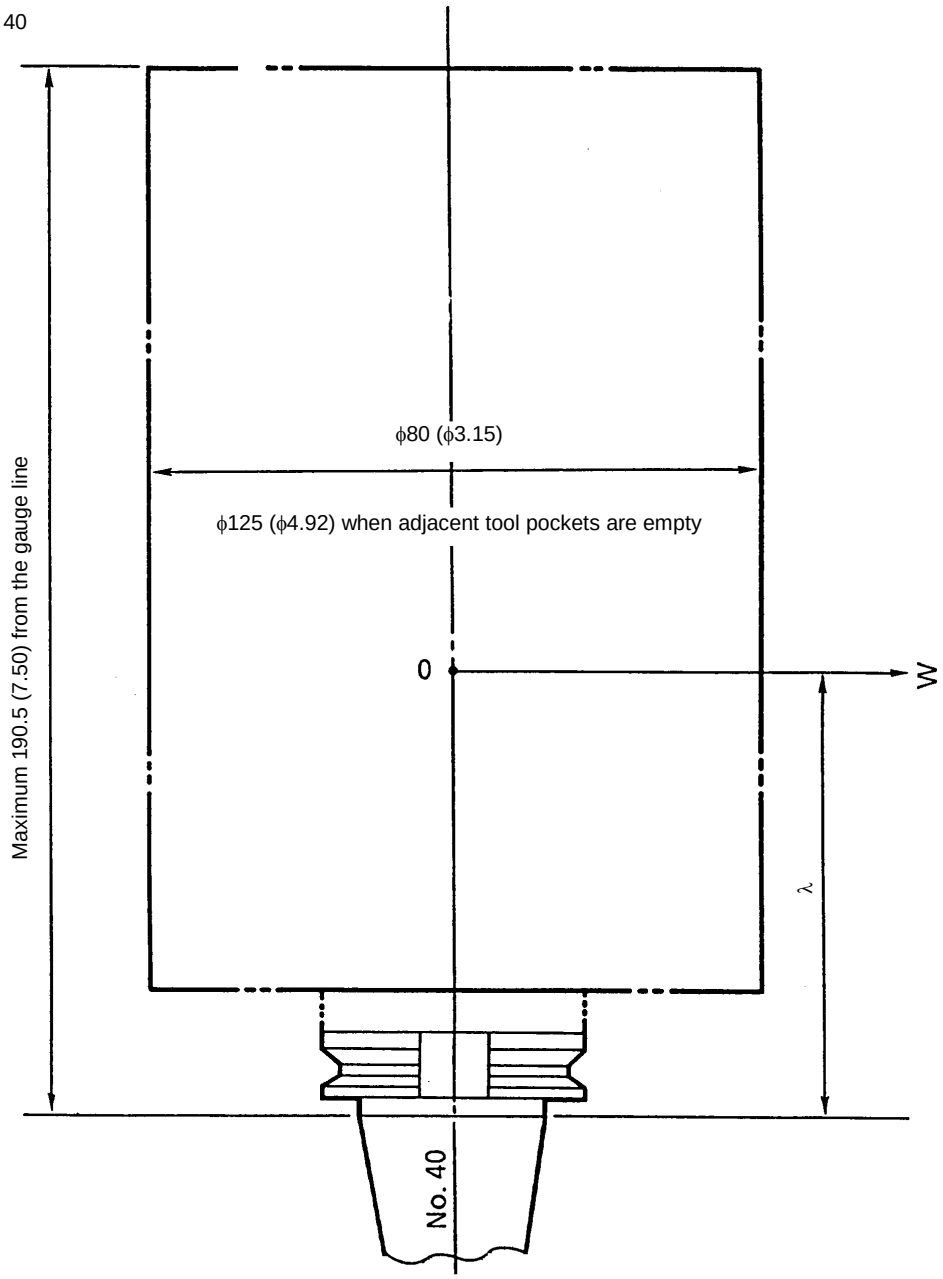


12-3-2 Pull stud dimensional drawing (ANSI type) for U.S.A. (34931900670)



12-4 Tool Limit

MAS BT 40



Unit: mm (in)

1. Total maximum mass 8 kg (17.64 lbs)
2. Maximum moment: 5.9 N·m (4.35 ft·lbf) (W x λ)

13 CODE TABLES (M-, S-, T- AND G-FUNCTIONS)

13-1 Miscellaneous Function (M-Codes)

M code	Function	M code	Function
M00	Program stop	M50	Air blast ON (option)
M01	Optional stop	M51	Through-spindle coolant (option)
M02	End of program	M52	Tap coolant ON (option)
M03	Spindle forward rotation	M58	Tool life check
M04	Spindle backward rotation	M70	Pallet 0 selected (option)
M05	Spindle stop	M71	Pallet 1 selected (option)
M06	Tool change	M72	Pallet 2 selected (option)
M07	Mist coolant ON (option)	M90	Mirror image cancelled
M08	Flood coolant ON	M91	Mirror image X-axis active
M09	All coolants OFF	M92	Mirror image Y-axis active
M10	Tool is clamped. (option)	M93	Mirror image B-axis (4th axis) active (option)
M11	Tool is unclamped. (option)	M98	Sub-program call-out
M15	ATC cover close (option)	M99	Main program returned
M16	ATC cover open (option)	M120	Automatic power shut-off
M17	Tool holder up	M132	Air through spindle ON (option)
M18	Tool holder down	M139	Heavy tool cancelled
M19	Spindle orientation stop	M140	Heavy tool specified
M23	Error detection ON	M149	Magazine rotation
M24	Error detection OFF	M152	Setup function
M30	Reset and rewind	M160	M161 and M162 cancelled
M33	Tool length measuring table out (option)	M161	Spindle top speed 70% set
M34	Tool length measuring table in (option)	M162	Spindle top speed 50% set
M35	Tool breakage detection (Effective with only Mazatrol language) (option)	M169	M170 cancelled
M43 M44 M45	Index table command (option)	M170	AFC function cancelled
		M195	Starting tool breakage detection (option)
M46	4th axis table unclamped (option)	M196	Full automatic tool length measuring mode valid (option)
M47	4th axis table clamped (option)	M197	Full automatic tool length measurement mode invalid (option)
M48	M49 (override cancelled) cancelled	M198	Semi automatic tool length measurement (option)
M49	Override cancelled	M199	Full automatic tool length measurement (option)

13-2 Spindle Speed Function (S-Code)

The spindle speeds are commanded by a 5-digit S-code (Max. value: 65000) following M03 or M04.

Example: S90 M3 (M4) 90 min^{-1}
S2000 M3 (M4) 2000 min^{-1}

13-3 Tool Function (T-Code)

Selection of the tools is commanded by 2- or 3-digit T-code.

Tool selection	TxxM149 ·····	Performs tool select.
		01 to 30 (40, 60)
Tool change	Txx ·····	Rotates the magazine to index Txx tool and loads it to ATC arm.
	M06 ·····	Mounts the tool specified preceding M06.

13-4 Preparatory Function (G-Codes)

G-code	Group	Function	G-code	Group	Function
*00	01	Positioning	34		
*01	01	Linear interpolation	35		
02	01	Circular interpolation CW	36		
03	01	Circular interpolation CCW	37	00	Automatic tool length measurement
02.1	01	Spiral interpolation CW	38	00	Tool diameter offset vector selection
03.1	01	Spiral interpolation CCW	39	00	Tool diameter offset corner arc
04	00	Dwell	*40	07	Tool diameter offset cancel
05	00	High-speed cutting mode	41	07	Tool diameter offset left
06.1	01	Spline interpolation	42	07	Tool diameter offset right
07		Virtual axis interpolation	43	08	Tool length offset (+)
08			44	08	Tool length offset (–)
09	00	Exact stop check	45	08	Tool position offset, extension
10	00	Program parameter input	46	00	Tool position offset, contraction
11			47	00	Tool position offset, double extension
12			48	00	Tool position offset, double contraction
13			*49	08	Tool length offset cancel
14			*50	11	Scaling cancel
15			51	11	Scaling ON
16			*50.1	19	G-command mirror image cancel
*17	02	Plane selection X-Y	51.1	19	G-command mirror image ON
18	02	Plane selection Z-X	52	00	Local coordinate system setting
19	02	Plane selection Y-Z	53	00	Machine coordinate system selection
*20	06	Inch command	*54	12	Workpiece coordinate system 1 selection
*21	06	Metric command	54.1	12	Additional workpiece coordinate selection
22	04	Pre-move stroke check ON	55	12	Workpiece coordinate system 2 selection
*23	04	Pre-move stroke OFF	56	12	Workpiece coordinate system 3 selection
24			57	12	Workpiece coordinate system 4 selection
25			58	12	Workpiece coordinate system 5 selection
26			59	12	Workpiece coordinate system 6 selection
27	00	Reference point check	60	00	Unidirectional positioning
28	00	Reference point return	61	13	Exact stop check mode
29	00	Starting point return	61.1	13	Shape compensation function
30	00	No. 2 - 4 reference point return	62	13	Automatic corner override
31	00	Skip	63	13	Tapping mode
31.1	00	Multiple-stage skip 1	*64	13	Cutting mode
31.2	00	Multiple-stage skip 2	65	00	User macro simple call
31.3	00	Multiple-stage skip 3	66	14	User macro modal call A
32			66.1	14	User macro modal call B
33		Thread cutting	*67	14	User macro modal call cancel

G-code	Group	Function	G-code	Group	Function
68	16	Program coordinate rotation	85	09	Fixed cycle (reaming)
69	16	Program coordinate rotation (cancel)	86	09	Fixed cycle (boring)
70			87	09	Fixed cycle (back boring)
71.1		Fixed cycle (chamfering cutter 1)	88	09	Fixed cycle (boring)
72.1		Fixed cycle (chamfering cutter 2)	89	09	Fixed cycle (boring)
73	09	Fixed cycle (step)	*90	03	Absolute value command
74	09	Fixed cycle (reverse tap)	*91	03	Incremental value command
75	09	Fixed cycle (boring)	92	00	Machine coordinate system setting
76	09	Fixed cycle (boring)	93	05	Inverse time feed
77	09	Fixed cycle (back facing)	*94	05	Asynchronous feed (feed per minute)
78	09	Fixed cycle (boring)	95	05	Synchronous feed (feed per revolution)
79	09	Fixed cycle (boring)	96		
*80	09	Fixed cycle (cancel)	97		
81	09	Fixed cycle (drill/spot drill)	*98	10	Fixed cycle, initial level resetting
82	09	Fixed cycle (drill/counter boring)	99	10	Fixed cycle, R-point level resetting
83	09	Fixed cycle (deep hole drill)	01 through 999		User macro G-code call (10 instructions at the maximum)
84	09	Fixed cycle (tapping)			

Note: The codes marked with * are to be selected or have already been selected.

14 ITEMS TO BE PREPARED BY CUSTOMER BEFORE MACHINE DELIVERY

14-1 Environment for Machine Operation

Install a machine tool under the machine operational environment that meets the following conditions:

1. Ambient temperature

The ambient temperature for machine operation must be 5 to 40°C (41 to 104°F) and the average temperature for over 24 hours must be 35°C (95°F) or less.
The NC starts working even in low temperatures (0°C or 32°F) due to employment of the hard disk (tolerant of temperature changes) that can be mounted on an automobile.
Do not install the machine tool at the place affected by the direct sunlight or near a heat-generator.

2. Relative humidity

The relative humidity while the machine tool is running must be 30 to 75% and free from condensation.
High-temperature causes insulation deterioration and hastens component deterioration. Special dehumidification is unnecessary, however, do not install the machine tool at a place that is affected by a considerable change of humidity or by high-humidity or that is likely influenced by humidity.

3. Dust, misty organic gas or corrosive gas

Do not install a machine tool at a place that is affected by considerable amount of dust, misty organic gas or corrosive gas.

4. Vibration

During machine run: 4.9 m/s^2 (16.08 ft/s^2) or under
During transportation: 34.3 m/s^2 (112.53 ft/s^2) or under
Do not install the machine tool at a place near a vibration generation source. If installation near a vibration generation source is unavoidable, take a proper measure such as construction of vibration proof drain.

5. Ground

Do not install a machine tool on a soft ground. If installation on a soft ground is unavoidable, reinforce the bearing capacity of soil by piling for preventing the ground from sinking or inclining.

6. Altitude

Install a machine tool at a place under 1000 m (3280 ft) or less from the sea level.

Note: Conditions to maintain the guaranteed machining accuracy

- Foundation
  Install a machine tool on a hard ground away from a vibration source.
- Atmosphere (air condition)
  Ambient temperature: 22 ± 1°C (71.6 ± 1.8°F)
  Relative humidity: 75% or less
- Use an accurate measuring kit for measurement.

7. Breaker

For the breaker at the shop power supply board, use the one for AC inverters. Otherwise, the breaker may trip to shut off the power due to high-frequency leak current specific to AC inverter.

14-2 Power Requirements

If the power supply capacity in your shop is insufficient for the machine, it will cause unexpected malfunctions and result in shorter service life of electrical parts. In addition to these problems, insufficient power capacity might result in hazardous machine operation conditions. Therefore, great care should be taken for the power facilities in your shop so that the machine can operate under the rated power conditions.

1. Power source capacity

If the power supply capacity in your shop is insufficient for the machine, it will cause unexpected malfunctions and result in shorter service life of electrical parts. In addition to these problems, insufficient power capacity might result in hazardous machine operation conditions. Therefore, great care should be taken for the power facilities in your shop so that the machine can operate under the rated power conditions.

Frequency	50/60 Hz ±1%
Voltage	Three-phase (3 lines) 200/220/230/240 V
	Three-phase (3 lines) 380/400/415 V
	Three-phase (3 lines) 440/460/480 V
Voltage regulation	±10%
Total power capacity	See the next page. **(Note)** Provide a transformer having more capacity (kVA) than total power in continuous rating.
Required electric wire	Depends on the table below. **(Note)** Grounding (metallic tube wiring) of its resistance 10 Ω or under is required. Grounding standard: Class C (previously Class 3) for Japan

The primary lead-in power line size is selected from the specifications of insulating material (equivalent to MLFC) at the highest permissible temperature 110°C (230°F).

	Input voltage	(1) 200/220/230/240 V	(2) 380/400/415 V	(3) 440/460/480 V
Primary lead-in cable (12000 min^{-1} spindle)	Power cable	38 mm^2 (0.059 in^2)	22 mm^2 (0.034 in^2)	22 mm^2 (0.034 in^2)
	Earth wire	22 mm^2 (0.034 in^2)	22 mm^2 (0.034 in^2)	22 mm^2 (0.034 in^2)
Primary lead-in cable (18000 min^{-1} spindle)	Power cable	60 mm^2 (0.093 in^2)	38 mm^2 (0.059 in^2)	38 mm^2 (0.059 in^2)
	Earth wire	38 mm^2 (0.059 in^2)	22 mm^2 (0.034 in^2)	22 mm^2 (0.034 in^2)

A. VCN Compact 12000 min^{-1} spindle (20000 min^{-1} spindle)

Item		VCN Compact		Remarks
		Capacity (kVA)	Output (kW)	
NC unit…1		0.2	0.2	
Spindle motor and servomotor	Spindle motor	10.67(32.11) 15.65(43.78) 21.35 26.33	7.5(22) 11(30) 15 18.5	(Cont. rating) (30-min rating) (10-min. rating) (5-min. rating)
	X-axis servomotor	- (**Note 1**)	1.8	
	Y-axis servomotor	- (**Note 1**)	1.8	
	Z-axis servomotor	- (**Note 1**)	3.0 (with brake)	
	Optional 4th axis servomotor	- (**Note 1**)		
Total power requirements…2 (Option not included)		16.15(37.59) 21.13(49.26) 26.83 31.81	13(27.5) 16.5(35.5) 20.5 24	(Cont. rating) (30-min rating) (10-min. rating) (5-min. rating)
Total power requirements…2' (Options included)		17.15(38.59) 22.13(49.26) 27.82 32.80	14 17.5 21.5 25	(Cont. rating) (30-min rating) (10-min. rating) (5-min. rating)
Auxiliary motor (standard spec.) (**Note 2**)	tool change drive motor	0.65	0.8	Servomotor
	Magazine rotation motor	0.65	0.5	Servomotor
	Hydraulic pump motor	1.57	1.2	
	Standard coolant pump	0.68	0.52	
	Circulating pump (chiller)	0.52	0.4	
	Compression pump (chiller)	0.98	0.75	
	Fan (chiller)	0.16	0.12	
Total power requirements…3		4.56 (**Note 3**)	3.49 (**Note 3**)	
Auxiliary motor (option) (**Note 2**)	Through-spindle coolant pump	1.36	1.04	
	Chip conveyor	0.26	0.2	
Total power requirements…4		1.62	1.44	
Control circuit, etc….5 (**Note 4**)		1.5	1.5	
Grand total power requirements (Option not included) 1 + 2 + 3 + 5		22.41(43.85) 27.39(55.52) 33.09 38.07	18.19(32.69) 21.69(40.69) 25.69 29.19	(Cont. rating) (30-min rating) (10-min. rating) (5-min. rating)
Grand total power requirements (Options included) 1 + 2' + {3 - (standard coolant pump)} + 4 + 5		24.35(45.79) 29.33(57.46) 35.02 40.00	19.91(34.41) 23.41(42.41) 27.41 30.91	(Cont. rating) (30-min rating) (10-min. rating) (5-min. rating)

Note 1: Since the axis servomotor is of the integrated amplifier specification, the total of each axis capacity is added to the total capacity 2 and 2'.

Note 2: The auxiliary devices are calculated on the base of power factor 0.85 and efficiency 0.9.

Note 3: Since the tool change drive motor and the magazine rotation motor do not operate at the same time, only output of single side is added.

Note 4: The power for the guideway lubrication, fan, solenoid valve and control relay is

included.

Note 5: Specifications are subject to change without notice due to design improvement.

14-3 Required Air Pressure and Consumption

1. Required air pressure

0.5-0.9 MPa (72.5-130.5 PSI)

2. Air consumption

A. VCN Compact

(1) Standard specifications

200 L/min (ANR) [7.06 ft^3/min (ANR)] or more

Conditions: Tools are changed once per minute and air is not blown to a workpiece.

Air consumption is calculated by dividing the total air consumption at each location by 0.9 (allowance).

Location	Air consumption L/min (ANR) [ft^3/min (ANR)]
Tool holder up/down	1.2 [0.04]
Air blast to spindle (**Note 1**)	Max. 14.7 [0.52] per tool change
Oil & air to spindle bearing (**Note 2**)	160 [5.65] (40 × 4 places)

Note 1: This is consumption amount per tool change. Every tool change time is 1.5 seconds.

Note 2: Oil & air are supplied to the spindle bearing when the spindle starts rotation. They stop in 15 minutes after the spindle stops rotation.

..

3. Additionally required amount when air blast is used

Location	Air consumption L/min (ANR) [ft^3/min (ANR)]
Workpiece air blast	310 (10.9)

4. Dew-point temperature

–17°C (62.6°F) or under (atmospheric pressure)

Note: Use clean air free from moisture and oil mist.
Also, avoid taking air directly from a compressor into the machine via short pipeline.
In case of failure to observe these precautions, since hot air is cooled inside the machine, the moisture and oil components contained in the air condenses and this may not only clog and corrode the valves and the piping, but also thermally damage the spindle bearings. If the air contains a great amount of moisture or is hot, use an auxiliary unit such as an air dryer.

14-4 Conditions for Maintaining the Guaranteed Accuracy

1. Conditions for foundation

Installation must be done on a place with firm ground and with no vibration generator in the vicinity.

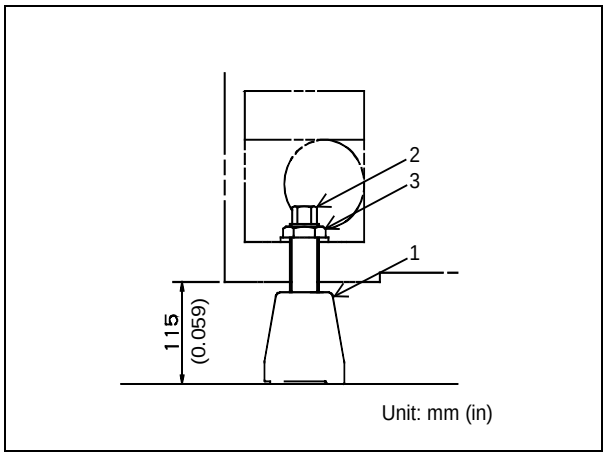
2. Environmental conditions (air conditioning)

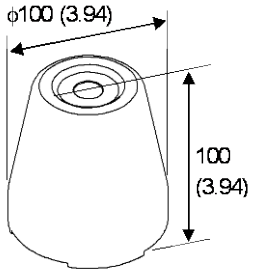
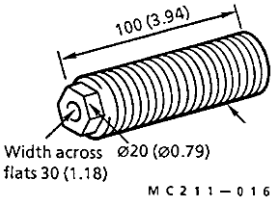
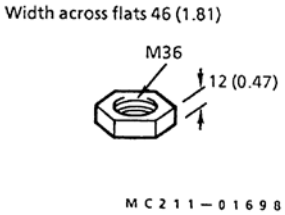
Ambient temperature: 22 ± 1°C (71.6 ± 1.8°F)

Relative humidity: 75% or under

14-5 Foundation Parts

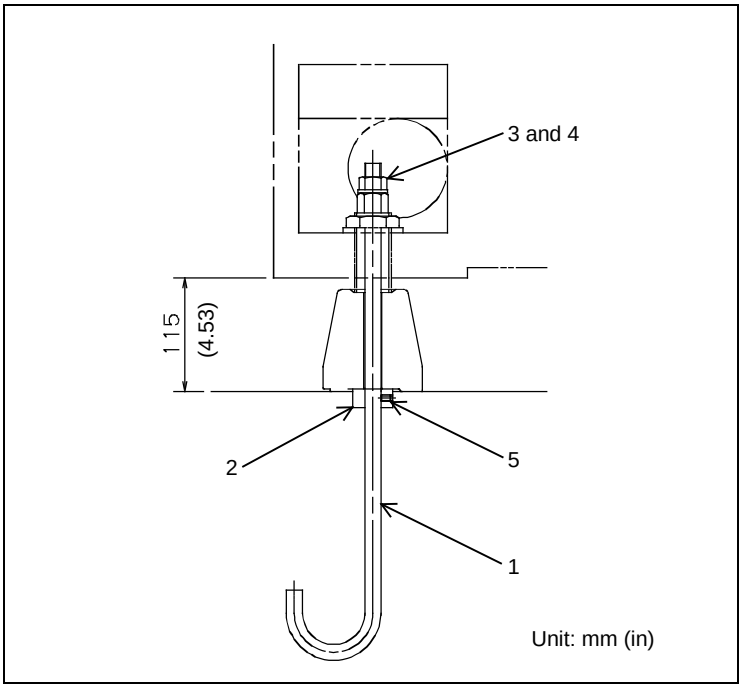
1. Standard



No.	Part name	Part No.	Figure	Quantity
				VCN Compact
1	Plate (block)	31276624280		7
2	Jack bolt	34710400020		7
3	Hexagonal nut	34710400030		7

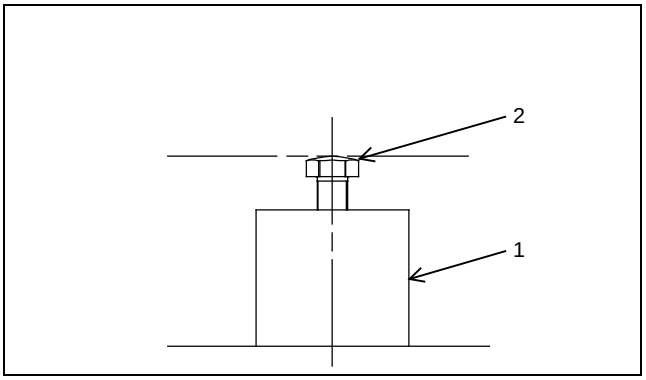
2. Anchor bolt specification

A. Anchor bolt



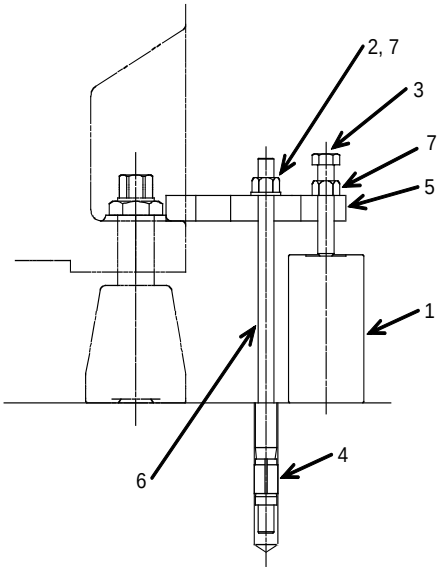
No.	Part name	Part No.	Quantity
			VCN Compact
1	Foundation bolt	34236110710	7
2	Collar	44946110060	7
3	Lock nut	A40JJ00M160	7
4	Washer	A41JJ00M160	7
5	Hex. socket set screw	A15B06X0100	14

B. Jack (4 places)



No.	Part name	Part No.	Quantity
			VCN Compact
1	Block	44296111430	4
2	Bolt	44966111020	4

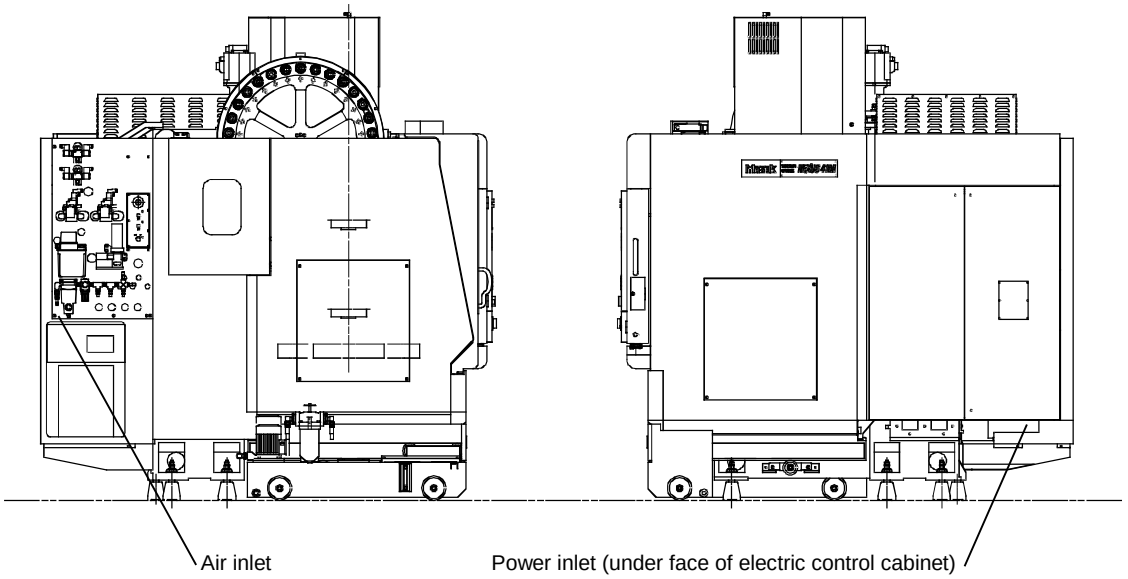
3. Dry pit specification



4 place

No.	Part name	Part No.	Quantity
			VCN Compact
1	Block	45276111860	4
2	Washer M16	A41JJ00M160	7
3	Hex. socket head cap screw M16 x 80	A17HF160800	4
3	Anchor bolt NSB-1625	A05UJ007860	4
5	Plate	34266111690	4
6	Bolt M16 × 330	44236110460	4
7	Hex. nut M16	A40JJ00M160	11

14-6 Power and Air Inlets



Note : Coupler connected to air import is a standard accessory.

Part	Type	Quantity
	Coupler Manufacturer: Nitto Kohki Co.,Ltd Type: 30SH Mazak part No.: H15NU000070 (Gauge 3/8 inch)	1

14-7 Working Fluids and Lubricants to Be Prepared by Customers

No.	Lubrication point		Qty	Recommended oil		Remarks
1	Spindle lubrication (only 20000 rpm)		1.8 L (0.06 ft^3)	SUPER MULPUS DX32 DAPHNY SUPER MULTI OIL 32 MOBIL DTE24	(Nippon Oil) (Idemitsu) (Mobil)	Automatically lubricated. Replenish oil as needed. Clean the filter elements every year.
2	Spindle chiller	12000 min^{-1}	16 L (0.57 ft^3)	SUPER MULPUS 2 DAPHNY SUPER MULTI OIL 2 MOBIL VELOCITE OIL No. 3 NEW MIGHTY SP2	(Nippon Oil) (Idemitsu) (Mobil) (COSMO Oil)	Change oils every 12 months. Clean the filter elements every month.
		20000 min^{-1}	72 L (2.54 ft^3)			
3	Guideway ball screw		260 cm^3 (15.86 in^3) <GREASE>	DUPLEX EP1 MOBILUX EP1 MULTINOC GREASE 1	(Kyodo Yushi) (Mobil) (Nippon Oil)	Automatically lubricated. Replenish oil as needed.
4	ATC arm cam box		4.5 L (0.16 ft^3)	SUPER MULPUS DX68 DAPHNY SUPER MULTI OIL 68 MOBIL VACTRA No. 2	(Nippon Oil) (Idemitsu) (Mobil)	Change oils every 6 months.

Note : Use only recommended oil/lubricant to achieve the best performance and to prolong the machine's service life.
MAZAK is NOT responsible for any machine trouble, malfunction and/or accident caused by using oil other than those described above.

14-8 Coolant to Be Prepared by Customers

In selection of coolant, confirm the following points with the coolant supplier:

(1) Use water-soluble coolant liquid.

If oil-soluble coolant is used, coolant discharge rate drops and the coolant temperature excessively rises, and as a result, the machine becomes vulnerable to thermal deformation.

Furthermore, oil-soluble coolant has a risk of catching fire, and therefore its use requires measures to counter fire, such as the provision of a fire extinguisher.

(2) Consider lubricity, preservability and anti-formability.

(3) Confirm there is no adverse effect of coolant to human bodies.

Since water-soluble coolant may cause rashes to human bodies, good hygienic control must be directed to operators.

(4) Confirm there is no hardening or inflating of rubber, resin and other chemical products.

Seals containing NBR (nitrile-butadiene rubber) as a main ingredient are used for this VCN Series. Some types of coolant contain an ingredient which may deteriorate NBR. Contact the coolant supplier and confirm no possibility of deteriorating NBR before using the selected coolant.

(5) Confirm there is no problem of coolant mixture with recommended lubricant.

Rarely, coolant is discolored or solidified as a result of chemical reaction when it is mixed with lubricant.

14-9 Customer's Facilities Check List

Before installing the machine, please make sure to check the following items.

	Check item	Refer to	Check
Environment	Ambient temperature of the machine is 5 to 40°C (41 to 104°F) (average temperature of over 24 hours is 35°C (95°F) or less.)	14-1	
	The machine is not exposed to direct sunlight and air, and not installed near heat generating equipment.	14-1	
	Humidity is 30 to 75%.	14-1	
	The machine is not installed in dusty, concentrated organic gas or corrosive gas.	14-1	
	The machine is installed below 1000 m (3280 ft) above sea level.	14-1	
Foundation	There is no ground vibration.	14-1	
	Floor space is enough for installation.	5	
	The foundation of factory is stable enough.	14-1	
Power source	Breaker for AC inverter is used as the main power breaker of the factory.	14-1	
	Power capacity is appropriate.	14-2	
	The grounding is in accordance with individual national standards.	14-2	
Air source	Air pressure is appropriate (0.5 to 0.9 MPa (70 to 130 psi)).	14-3	
	Air does not contain a lot of moisture or oil mist.	14-3	
Items to be purchased by customer	Standard tool shank and pull stud bolt are used.	12	
	Tools meet restrictions.	12-4	
	Recommended hydraulic oil and lubricant oil are used.	14-7	
	Proper coolant is used.	14-8	
	Other items prepared by customer have no problem.	-	

15 INSTALLATION

15-1 Dimensional Requirements (Standard)

15-1-1 Space required for unloading and loading

In order to load this standard machine into your plant, the entrance of your plant must be bigger than the dimensions indicated below:

1. Standard specifications

Unit: mm (in)

*: Without Z-axis servomotor

Model	Status	Application	Dimensions
VCN Compact	Normal dimensions (Z-axis lowest position)	These dimensions are the same when transporting by truck.	Total width: 1500(59.06) Total height: 2550 (107.09) Depth: 2580 (101.57)

15-1-2 Maximum space required for operation

Description		Total width × Total height × Depth [unit: mm (in)]
Dimensions including a height for the bottom board and when the head is in the highest position	VCN Compact	1500(59.06)× 2803 (107.09) × 2580 (101.57)

Note: For the optional raised column specification (200 mm (7.87 in) raised), total machine height is 200 mm (7.87 in) higher than the height of a standard specification machine.

15-1-3 Mass list

Unit: kg (lbs)

	VCN Compact
Machine tool without coolant tank (standard)	4000 (8810)
Coolant tank (standard)	110 (243)
Hinge type chip conveyor (option)	190 (418)

15-1-4 Slinging

A machine is slung as shown in Fig.15-1. Observe the following without fail.

(1) Before slinging the machine, fix all the structures with fixtures as directed in Fig.15-1 without fail.

(2) For slinging, use a special sling as shown in Fig.15-1.

(3) Use wire rope strong and safe enough for slinging and free from looseness and damage.

(4) Protect the part of the rope which contacts with the machine by applying cloth or wooden blocks and watch that the rope would not touch a weak part of the machine.

(5) Watch carefully so that the wire rope does not touch pipes, hydraulic unit, cables, controllers,

sheet metal covers, so forth.

(6) Re-connect the disconnected cables and hoses of the chiller unit before operating the machine.

(7) Check that drains or the like are closed well so that coolant does not leak out.

(8) When the machine is carried b rollers, be cautious as much as possible so that the machine does not get a big shock.

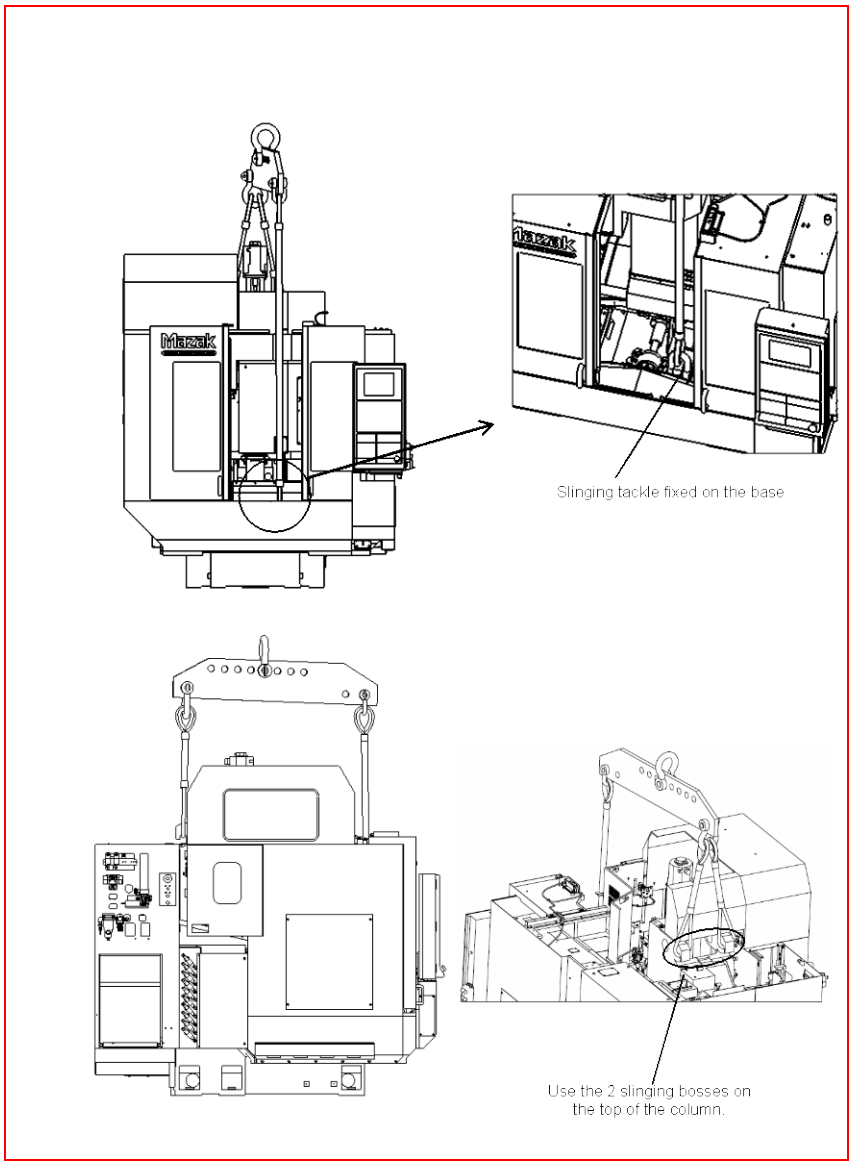


Fig. 15-1 How to sling the machine tool

15-1-5 Where to Mount Fixtures

In order to transport the machine tool, fix the four places Fig.15-2 with fixtures and put a wooden blocks between the spindle and the table.

After the machine is settled, release the transportation tools without fail. In addition, keep the released and removed plates, bolts, etc. without fail.

Tools to be used: Hexagonal wrenches (6 mm and 10 mm)

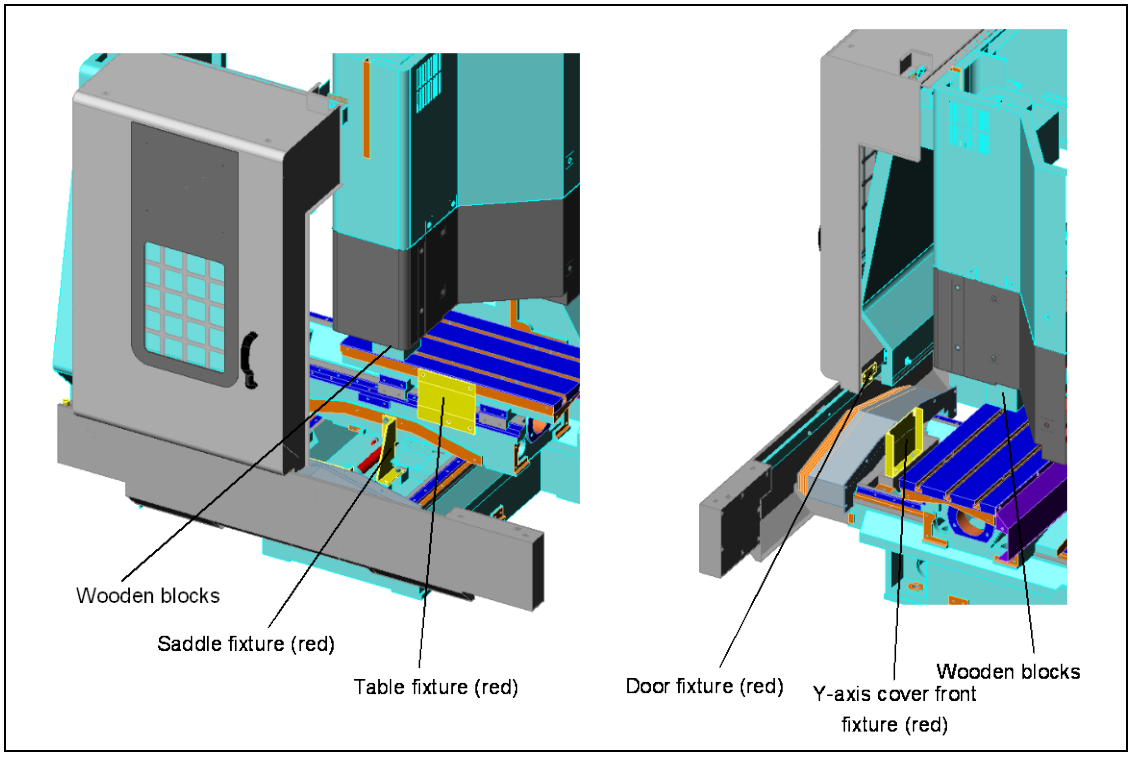


Fig. 15-2 Fixture positions