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Productivity Inc®

Makino S33-S56 PRE-INSTALLATION CHECKLIST – Rev 02/2009

Installation of your new Makino S33-S56 can be smooth and rapid if preparations are made prior to the delivery of your machine. Any questions regarding machine installation should be directed to our service department for clarification. We hope this checklist will aid in a rapid installation of your new machine. **NOTE: The following must be completed prior to our service technician arriving to install your new machine.**

- Power Requirements for your machine: 230v or 460v, 3 ph, 40 kVa
A 3-phase power source, with stable voltage regulation (+/-10%), a ground of 25 ohms or less and a 125A breaker must be provided. Proper voltage per machine specifications should be ready at machine site. **Do NOT power up the machine.** (See also the Makino Pre-Installation Manual for additional information.)
- Customer should furnish and have available the proper supply and types of lubricants required for machine operation.

ITEM	CAPACITY	FLUID TYPE
Coolant	79.2 gal	Water Soluble, Synthetic
Makino Spindle Oil	12 gal	Mobil Velocite #3

See Makino Lubrication Instruction Chart for details on fluids in the Installation Manual.

NOTE: The machine will come with Makino Spindle Oil in the machine. You will need Coolant on hand at the time of installation. Contact our Service Department if you have any questions

- Air lines should be routed to the machine location and operational for proper air pressure.

72-116 psi @ 14.13 cfm of DRY air supplied through a minimum supply pipe of ½" diameter with no reducers or nozzles.
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- Machine location should be planned to allow enough room for access panels to be opened and serviced with ease. **A minimum of 36" clearance is required around the machine for operator/maintenance access.**
- Weight requirements should be checked to insure that the foundation below the machine will have sufficient strength for support and stability. The machine must be set on a solid, sound and stable, steel bar-reinforced concrete slab poured directly on the grade. In general, the 6" concrete floor on industrial buildings is generally suitable for machine placement.
- **The Makino S33 or S56 are best moved using a Fork Lift. See Makino Install/Delivery documentation for lifting instructions. **NOTE 1: LIFTING EQUIPMENT, ROPES, SCHACKLES, LIFTING BARS, LIFTING BEAMS, ETC. ARE OPTIONAL EQUIPMENT AND ARE NOT PROVIDED WITH THE MACHINE. ITEMS MUST BE PURCHASED PRIOR TO MACHINE DELIVERY IF LIFTING WITH OVERHEAD/Crane. Upon arrival of your machine, uncrate and immediately check for visible damage.**

SHIPPING WEIGHT	SHIPPING DIMENSIONS OF MACHINE
16,090# (S33 mach)	114" L x 90" W x 103" H (S33 Machine skidded/wrapped, w/Chip Conveyor)
661# (accessory)	89" L x 49" W x 43" H (crate/accessory)
330# (accessory)	31" L x 27" W x 36" H (Transformer – ships separately from Makino)
15,873# (S56 mach)	119" L x 91" W x 100" H (S56 Machine skidded/wrapped, w/Chip Conveyor)
827# (accessory)	130" L x 48" W x 72" H (crate/accessory)
728# (accessory)	31" L x 28" W x 31" H (Transformer – ships separately from Makino)
132# (accessory)	53" L x 39" W x 20" H (accessory crate)
860# (accessory)	42" L x 34" W x 70" H (accessory crate)

See Makino Installation Manual for machine layout/floor space requirements.

- Remove as much preservative from the machine as possible without having to power up (tables – slides, pulleys, etc.). We recommend mineral spirits to clean. Apply oil when finished to prevent rust.



VERTICAL MACHINING CENTER

S-Series

INSTALLATION MANUAL

PRO5

V1031I-I1E-XA



WARNING

1. Do not maintain, inspect or repair this machine before carefully reading and understanding this Maintenance Manual
2. Store this manual in a clearly marked location for easy reference when maintaining, inspecting or repairing this machine

MACHINE MODEL S-SeriesCONTROLLER TYPE Professional 5

COMPANY NAME _____

This manual is developed for the use of Makino customers to help and guide in making all necessary pre-installation arrangements for S-Series machine.

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1. Introduction

1.1 Machine Characteristics

S-Series machines are the versatile Vertical Machining Centers with high reliability and rigidity built on proven design concepts to achieve high productivity and high speed machining efficiency both for Part Manufacturing as well as Die and Mold industry.

The main characteristic features of the machine, which contributes to high productivity are achieved by high speed, GI.3 and SGI Control, high axes rapid traverse rates and high axes acceleration, sustainable inter-plane geometrical accuracy, reducing cutting time with high speed and high power machining and also reducing the non cutting time with faster ATC and special Makino Professional 5 Control functions for simultaneous operations

1.2 Components and Machine Function

S-Series machines are 3-axis Vertical Machining Centers of fixed column type, the units of which machine are comprised of bed, column, and the X, Y, Z axes are driven by servomotors:

- The X-Axis, which is an integrated unit, comprises of the Z-axis and the spindle, moves left and right.
- The Y-Axis carries the table and is on the bed, moves back and forth.
- The Z-Axis, which is housed on X-axis moves up and down. The spindle housing is mounted to the Z-axis.
- Optional provision to include 4th and 5th axis is available.
- The spindle is of high speed with a maximum spindle speed of 12000 rpm (optionally 20000 rpm) with power of 22kW.
- Viewed from the machine front, is the NC control panel on the right side and ATC magazine on the left side and the operator door is at the center.
- The chip disposal is at the rear either to a chip bin on the coolant tank or to a chip conveyor.
- The electrical cabinet, oilmatic, hydraulic and pneumatic systems are located at easily accessible locations at the rear and side of the machine.

2. Safety Precautions

2.1 Introduction

This chapter provides general safety guidelines that, if followed, promote a safer working environment.

Safety precautions and special considerations for all machining operations must be thoroughly understood by the operator. Careless use of the machine may result in a personal injury and machine damage. Read this pre-Installation Manual thoroughly in order to install the machine safely. Study all safety precautions and functions before installing this machine.

Designate specific operators of this machine and provide thorough safety training for all personnel involved in the operation, maintenance and inspection of this machine. It is strongly recommended that a copy of this Pre-Installation Manual is easily accessible to everyone and also kept near the machine at all times.

2.2 Danger, Warning, Caution Statements and Symbols

It is important that all employees recognize each safety symbol on the machine and understand the meaning of **Danger**, **Warning**, and **Caution**.

These safety labels must never be removed, covered or painted over, and must be replaced if they are damaged, defaced, or become unreadable. Table 2.1 presents the meaning of each safety statement. It is important that all employees recognize and understand the meaning of the safety symbols. The location of safety symbols for specific hazards on S-Series is shown in Figure 2.1.

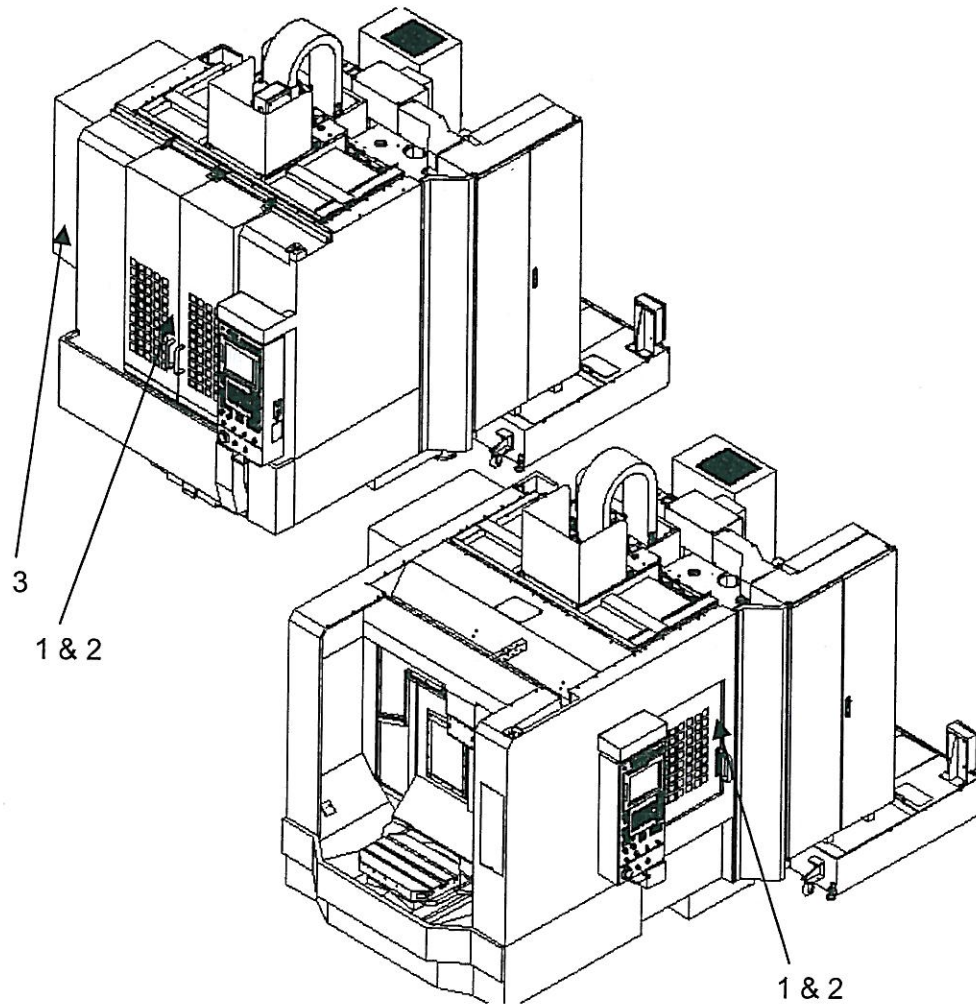


Figure 2.1: Locations of Safety Symbols

Table 2.1: Definitions of Danger, Warning, and Caution statements.

Statement	Meaning
DANGER	DANGER is the most severe safety statement. This statement means that either severe personal injury or death may result if the instruction(s) is not followed.
WARNING	WARNING is the next level of safety statement. It indicates that if the instruction(s) is not followed severe personal injury could result.
CAUTION	CAUTION is the least severe safety statement and indicates that if the instruction(s) is not followed damage to the equipment may result.

2.3 Installation Safety

The following information is related to installation of the machining center:

- Adhere strictly to the installation instructions provided in the Pre-Installation Guide.
- Make a thorough check of the mechanical and electrical units used for machine moving and installation to make sure that they are working in good and safe conditions, before the arrival of the machine.

Lifting Safety

All persons responsible for lifting must follow these lifting safety precautions. This includes, but is not limited to lifting machinery, machine components, and work pieces:

- All lifting equipment must be properly rated for the weight being lifted.
- All lifting equipment must be inspected on a regularly scheduled basis.
- Any lifting device found to be defective must be repaired in accordance with industry standards.

Slings

When using slings:

- Never exceed the lifting capacity of any sling.
- Protect slings with heavy padding when lifting objects with sharp edges.

Chains

Lifting chains must be stored properly to prevent damage when not in use. When using chains:

- Never exceed the lifting capacity of any chain.
- Do not drag chains.
- Do not allow chains to become tangled or kinked.
- Never twist chains in an attempt to shorten their length.
- Use proper devices to shorten a chain's length.
- Use chains equipped with enclosed lifting hooks.

Hooks

When using hooks:

- Never exceed the lifting capacity of any lifting hook.
- Do not repair lifting hooks.
- Destroy and discard bent lifting hooks.

Eye Bolts

To ensure a safe load carrying capacity:

- Never exceed the lifting capacity of any eyebolt.

- An eyebolt must be engaged to at least 90 percent of its threaded portion.
- Never weld or heat an eyebolt to a temperature in excess of 480°C (900°F). Heat exposure can change the physical properties of the stock and create an unsafe eyebolt.
- Never use an inch eye bolt in a metric thread or vice versa.
- Use inch series thread eyebolts in inch series threads.
- Use metric series thread eyebolts in metric series threads.
- Never use a painted or coated eyebolt as this may cover up defects.
- Discard and destroy any defective eyebolts.

Rings

When using rings:

- When possible use a lifting ring or clevis instead of an eyebolt.
- Secure the lifting ring with the correct inch/metric series bolt.
- Never exceed the lifting capacity on any lifting ring or clevis.

Machine Electrical Devices

When a electrical devices is used:

- Use only industry standard approved electrical testing equipments.
- Always replace defective electrical components, like fuses, shunts, overloads, etc., with components of the same capacity and rating as the original equipment.
- If you are unsure of the correct electrical component or part, refer to the machine's electrical drawings or consult Makino.

Machine Grounding

All Makino machining centers must be properly grounded at the time of installation.

- Proper grounding requires an isolated earth ground.
- Ground the machine in accordance with local, state, and federal regulations.

Lifting the Machine or Components

Use only a lifting device and related equipment with rated capacity, to lift the total weight of the machining center (and shipping skid, if the skid is attached during lifting). Always follow the lifting instructions provided in this pre-installation guide. In addition:

- Only qualified riggers should perform machine-lifting operations.
- Never place any portion of your body beneath a suspended object.
- Lift the machining center only at the designated lifting points.
- Never lift the machine higher than necessary.
- Always maintain the center of gravity, by properly adjusting the lengths of lifting device.



Before lifting, refer to shipping documents to obtain the weight of the machine or component being lifted. If the necessary weights cannot be determined, consult Makino.

Lifting Work-pieces and Fixtures

Always use a lifting device and related lifting equipment that is of rated capacity, for the work piece or fixture being lifted.

- Never place hands, arms, feet, or any other portion of your body beneath a suspended work piece fixture.
- Always maintain the center of gravity by properly adjusting the lengths of the lifting device.



Always display the emergency contact numbers near the machines. Keep a certified first Aid Kit available near the machine and easily accessible.

3. Specifications

3.1 Introduction

This chapter contains the specifications for the machine's main components (units), the general arrangement of the machine, floor plan dimensional drawings, Makino Pro 5 control, tooling and various optional features. The outline view of S-Series machine is shown in Figure 3.2.1a and Figure 3.2.1b.

The specifications indicated are subject to change without prior notice as part of continuous design improvement and market requirements.

Information Subject to Change



Every effort is made to ensure the accuracy of the data presented in this chapter at the time of its publication. Machine & control specifications are subject to change without prior notification as part of continuous design improvement and market requirements. For the exact machine specific details please refer to the specifications for which your machine has been ordered and supplied.

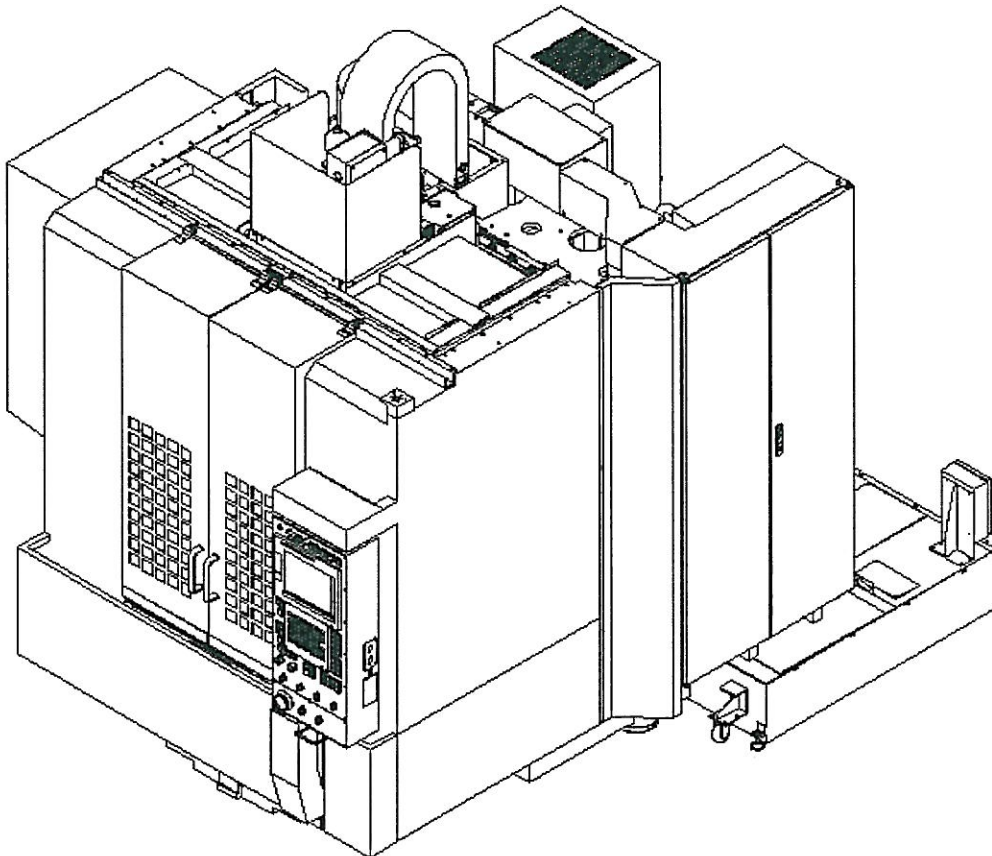


Figure 3.2.1a: S33/S56 Machine General View

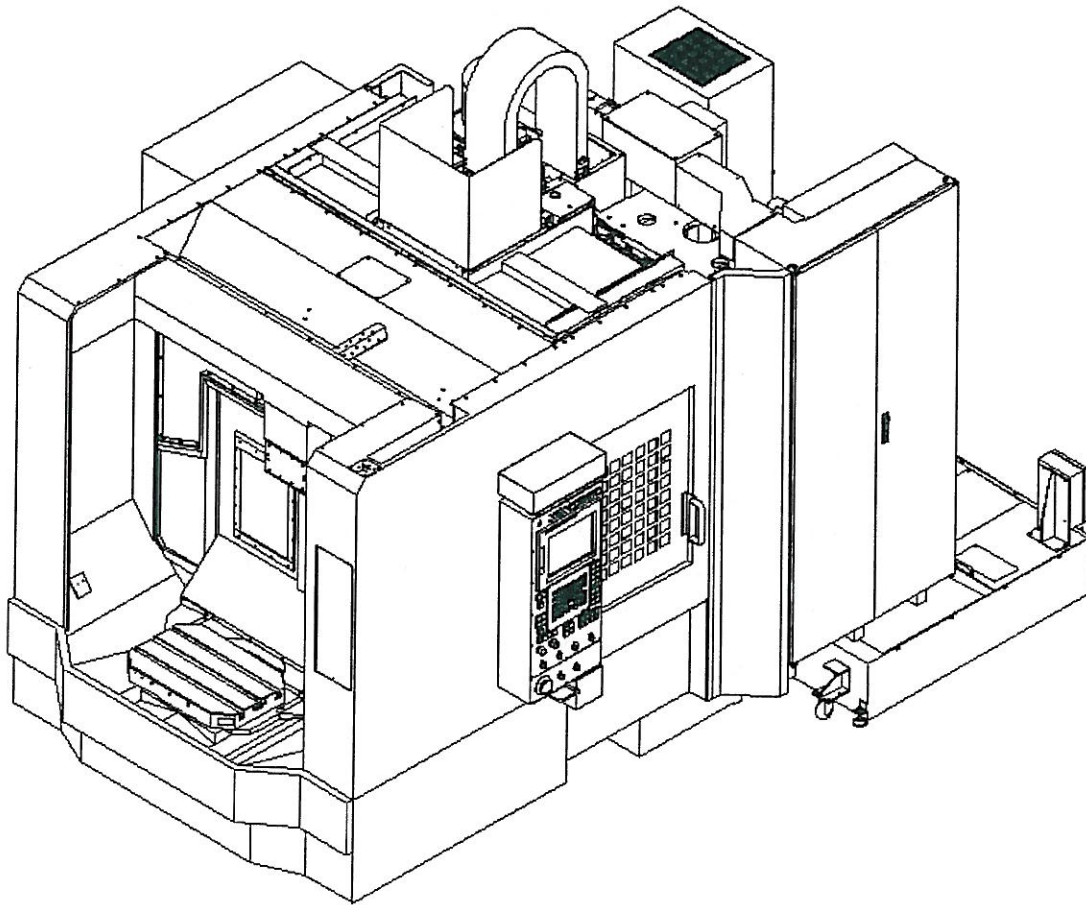


Figure 3.2.1b: S33 APC Machine General View

3.2 Mechanical and Electrical Specification

The table below outlines the brief general machine specification.

MACHINE STROKES				
Axes Travel X, Y, Z (S33 & S33 APC)	650x500x450	mm	25.59x19.68x17.72	in
Axes Travel X, Y, Z (S56)	900x500x450	mm	26.77x19.68x17.72	in
Table Top to Spindle Face	150 ~ 600	mm	5.9 ~ 23.63	in
Pallet Top to Spindle Face (S33 APC)	120 ~ 570	mm	4.72 ~ 22.44	in

MACHINE TRAVERSE RATES				
Rapid Transverse X, Y, Z	40	m/min	1574.8	in/min
Axis Feed Rate	1~40000	mm/min	1 ~ 1574.8	in/min

TABLE/PALLET				
Size of Table (S33)	850x500	mm	33.46x19.68	in x in
Size of Table (S56)	1000x500	mm x mm	39.37x19.68	in x in
Size of Pallet (S33 APC)	600x400	mm x mm	13.23x15.75	in x in
Table Load Capacity (S33 & S56)	650	kg	1433	lbs
Pallet Load Capacity (S33 APC)	400	kg	882	lbs
Maximum Work Size on Table (S33)	850x500x450	mm x mm x mm	33.46x19.68 x17.72	in x in x in
Maximum Work Size on Table (S56)	1000x500x450	mm x mm x mm	39.37x19.68x17.72	in x in x in
Maximum Work Size on Pallet (S33 APC)	600x400x420	mm x mm x mm	26.77x15.75x16.56	in x in x in
T-Slot Size	18H8	mm	0.70866H8	in
T-Slot Pitch	100	mm	3.94	in
Tapped Hole Size	M16		-	

SPINDLE HEAD 12,000 rpm (standard)				
Spindle Speed Range	120 ~ 12000 (ASPAC) / 130 ~ 13000 (US)			rpm
Spindle Power 15min/cont	22/18	kW	29.5/24.14	hp
Maximum Torque (15min/cont)	117/95	Nm	1035.5/840.8	lbf-in
Spindle Nose	MAS 403-BT40 / DIN 69871-A40 / JIS B6339-40T			
Spindle Oil Cooling System	Jacket Cooling			
Tool Clamp Force	8800 ±5%	N	1978 ±5%	lbf
SPINDLE HEAD 20,000 rpm (optional)				
Spindle Speed Range	200 ~ 20000			rpm
Spindle Power (30min/cont)	15/11	kW	29.5/24.14	hp
Maximum Torque (5min/cont)	32/19	Nm	283.2/168.2	lbf-in
Spindle Nose	MAS 403-BT40 / DIN 69871-A40 / JIS B6339-40T / HSK-A63			
Spindle oil cooling system	Core Cooling			
Tool Clamp Force	BT40	8800 ±5%	N	1978 ±5%
	HSK	17600 ±5%		3957 ±5%
				Lbf

ATC		
No. of Tools	20 / 30 (option)	
Tool Change Time	1.3 (tool to tool)	sec
Max. Tool Diameter	114 / 76.2 (ATC20 / ATC30) 130 (with alternate pocket empty)	mm
Max. Tool Length	300	mm
Max. Tool Weight	8	kg

APC		
No. of Pallets	2	
Changing Method	Hydraulic Driven Rotary Arm	
Pallet Change Time	7	sec

PNEUMATIC SUPPLY				
Min. Pressure	5	kg/cm ²	71	lbs/in ²
Consumption	0.4	m ³ /min	106	gal/ min

POWER SUPPLY		
200/220 V	3 phase, 50/60 Hz	40 KVA

EQUIPMENT POWER CHART				
Spindle (12K)	22/18	kW	29.5/24	hp
Spindle (20K)	15/11	kW	20.1/14.7	hp
Axis Feed - X-axis	4.2	kW	5.6	hp
Axis Feed - Y-axis	4.2	kW	5.6	hp
Axis Feed - Z-axis	4.2	kW	5.6	hp
ATC Magazine	0.5	kW	0.7	hp
Spindle Cooler (12K)	1.6	kW	2.1	hp
Spindle Cooler (20K)	3.07	kW	4.1	hp
Coolant Pump - Nozzle Coolant/ Work Washing Gun	0.925	kW	1.2	hp
Coolant Pump - Coolant Flush	0.925	kW	1.2	hp
Coolant Pump - Shower Coolant	0.925	kW	1.2	hp
Coolant Pump - Through Spindle Coolant – 1.5Mpa	2.2	kW	3.0	hp
Coolant Pump - Through spindle Coolant – 3.0Mpa	3.7	kW	4.7	hp
Chip Conveyor - Lift Up Type	1.1	kW	1.5	hp
Chip Conveyor - Central Trough Screw Type	0.25	kW	0.3	hp
Hydraulic Unit	1.5	kW	2.0	hp

CUTTING CHIP DISPOSAL OPTIONS			
Reservoir Capacity		300 l	79.2 gal.
Nozzle Coolant	Pressure	0.2 MPa	29 psi
	Volume	80 l/min.	23.8 gal/min.
Coolant Flush	Pressure	0.2 MPa	29 psi
	Volume	80 l/min.	23.8 gal/min.
Through Spindle Coolant	Pressure	1.5 MPa	217 psi
	Volume	13 l/min.	3.4 gal/min.
Overhead Shower	Pressure	0.2 MPa	29 psi
	Volume	80 l/min.	23.8 gal/min.
Work Wash Gun	Pressure	0.2 MPa	29 psi
	Volume	80 l/min.	23.8 gal/min.

SIZE OF MACHINE				
Machine Height	3063	mm	120.6	in
Size of Required Floor Space:				
Standard (W x D)	2445x3430	mm	96.2x135.0	in
With APC (W x D)	2445x4244	mm	96.2x167.1	in
Machine Weight:				
Standard	7500	kg	16,534	lbs
With APC	8500	kg	18,739	lbs

3.3 Makino Professional 5 and Control Specifications

Axes control
Number of simultaneous controllable axes
Optional max. no. of simultaneous controllable axes
Input command
Automatic recognition of EIA RS244 / ISO0840 tape code
Max. programmable dimension
Absolute/incremental programming G90, G91
Decimal point/calculator type decimal programming
Programming plane selection G17, G18, G19
Least input increment
Inch/metric conversion G20, G21
Interpolation
Positioning G00
Linear interpolation G01
Circular interpolation G02, G03
Exponential interpolation G02.3, G03.3
Polar coordinate interpolation G12.1, G13.1
Cylindrical interpolation (require rotary table) G07.1
Helical interpolation G02, G03
Involute interpolation G02.2, G03.2
Hypothetical axis interpolation G07
Conical/spiral interpolation G02, G03
NURBS interpolation G06.2
Feed
Cutting feedrate clamp : F direct command
Cutting feedrate override%
F 1-digit code feed (F1 ~ F9)
Jog override
Dwell (per second) G04
Feedrate override cancel M48/M49
Program Memory, Edit
Program number search
Sequence number search
Parity check (horizontal & vertical)
Part program storage memory - 160m/320m/640m/1280m/2560m
Number of registerable program - 63/125/200/400/1000

Part program editing
Background editing
Extended part program editing
Operation, Display
Automatic operation (memory)
Machining time stamp
Clock, calendar function
Run-hour and part count display
Dynamic graphic display
DNC operation
MDI unit standard full key
12.1" color LCD
Manual pulse generator on Operator panel
I/O Functions
Data Input/Output interface - Channel 1 (RS-232C) / Channel 2 (RS-232C)
S,M,T Function
Miscellaneous (auxiliary) function M x-digit
Spindle speed direct S-code
Tool function
Tool Compensation
Tool offset pairs – 64/99/200/400/499/999/
Tool offset memory B (Geometry/wear)
Tool offset memory C (Geometry/wear, cutter/tool length)
Tool offset
Cutter compensation B
Cutter compensation C G41, G42/G40
Coordinates
Reference position return G28
Reference position return check G27
2nd reference position return G30
3rd/4th reference position return G30
Floating reference position return G30.1
Machine coordinate system selection G53
Workpiece coordinate system selection G54 ~ G59
Workpiece coordinate system preset G92.1

Addition of workpiece coordinate system - 48 pairs G54.1 (P1 ~ P48)
Addition of workpiece coordinate system - 300 pairs G54.1 (P1 ~ P300)
Automatic return from reference position G29
Coordinates
Local coordinates setting G52
Work coordinate system setting G92
Machine coordinate selection
Manual reference position return
Operation support
Label skip
Additional block skip - 9 blocks
Manual absolute ON and OFF
Auxiliary function lock
Tool length measurement
Help function
Machine lock
Data protection key
Mirror image for X-axis and Y-axis M21, M22/M23
Block skip
Optional stop M01
Program stop M00
Z-axis feed neglect
Follow up
Sequence number comparison and stop
Program restart
Dry run
Single block
Manual handle interruption
Skip G31
High-speed skip
Programming support
Normal direction control G41.1, G42.1/G40.1
Gentle normal direction control
Polar coordinate command G15/G16
Chamfering / corner R
Programmable data input (offset, parameter) G10
Sub program call (4 folds nested)

Custom macro B (82 common variables)
Addition of custom macro common variables #100 ~ #199
Addition of custom macro common variables #500 ~ #999
Interruption type custom macro
Canned cycles for drilling
Small-hole peck drilling cycle
Circular interpolation by R programming
Scaling G51/G50
Coordinate system rotation G68, G69
Programmable mirror image G51.1/G50.1
Rigid tapping G84.2, G84.3, M135
Programming support
Playback
Tapping mode G63
Cutting mode G64
Exact stop mode G61
Exact stop G09
Machine Accuracy Compensation
Backlash compensation
Stored pitch error compensation
Single direction positioning G60
Safety and Maintenance
Interlock
Self-diagnosis function
Alarm history display
Emergency stop
Stored stroke check 1
Professional 5
GI control
GI.3 control
Data server
Super GI control
Adaptive control function (AC)
Spindle load monitoring function (SL)
Tool life monitoring function (TL)
Direct spare tool exchange function

One touch switches
Alarm recovery guidance
Display of LS and SOL position & relevant signals
PMC alarm history display
Scheduled maintenance prompt



The specifications indicated are subject to change without prior notice as part of continuous design improvement and market requirements. For the exact machine specific details, please refer to the specifications for which your machine has been ordered and supplied.

3.4 General View and Dimensional Drawings

Different important views and machine dimensional drawings for different options of S-Series machine are outlined in this chapter. Figure 3.4.1a shows the machine general view and assemblies for S-Series machine without APC (S33 and S56) and Figure 3.4.1b for S33 (APC) machine.

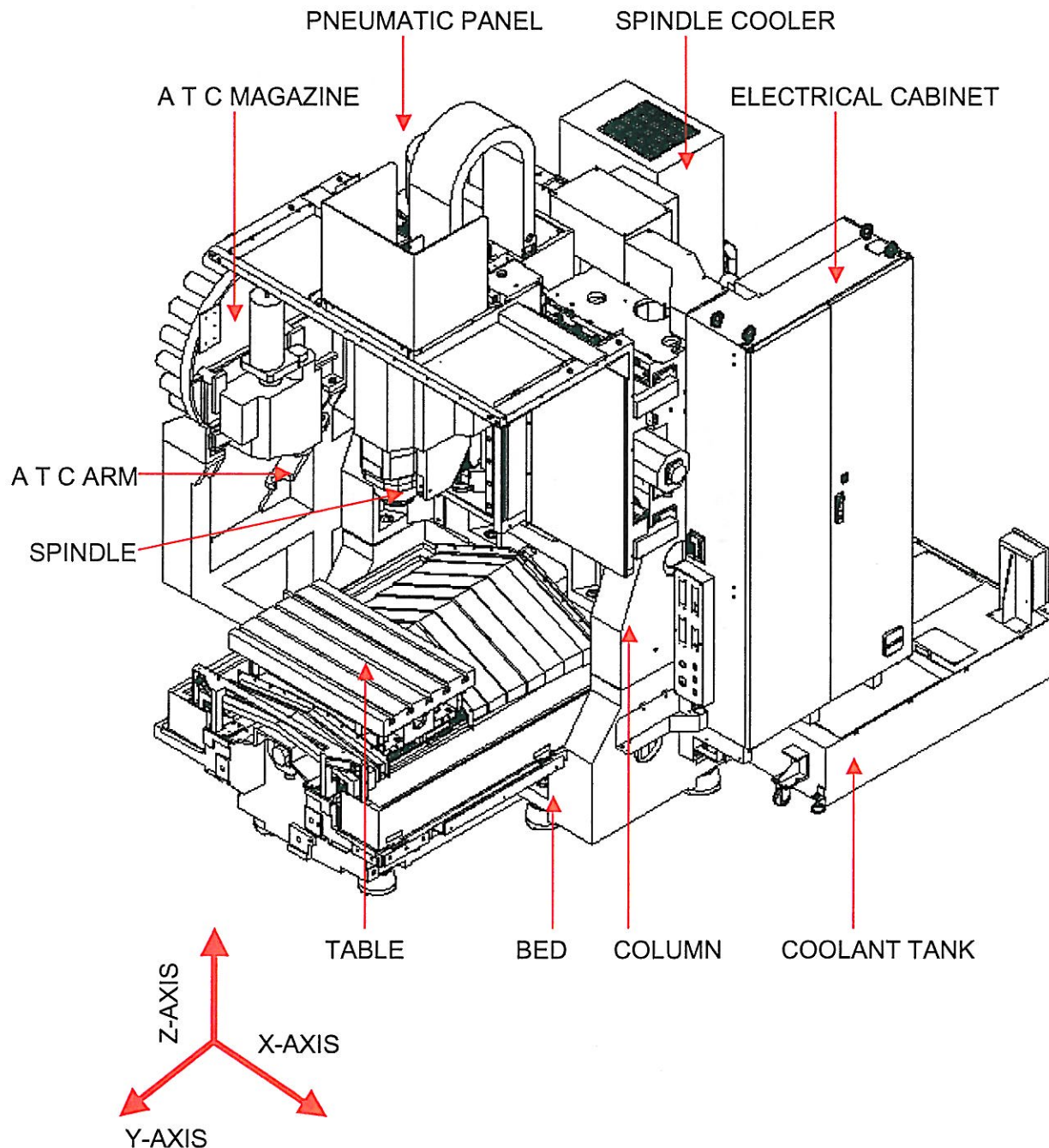


Figure 3.4.1: S33/S56 General View

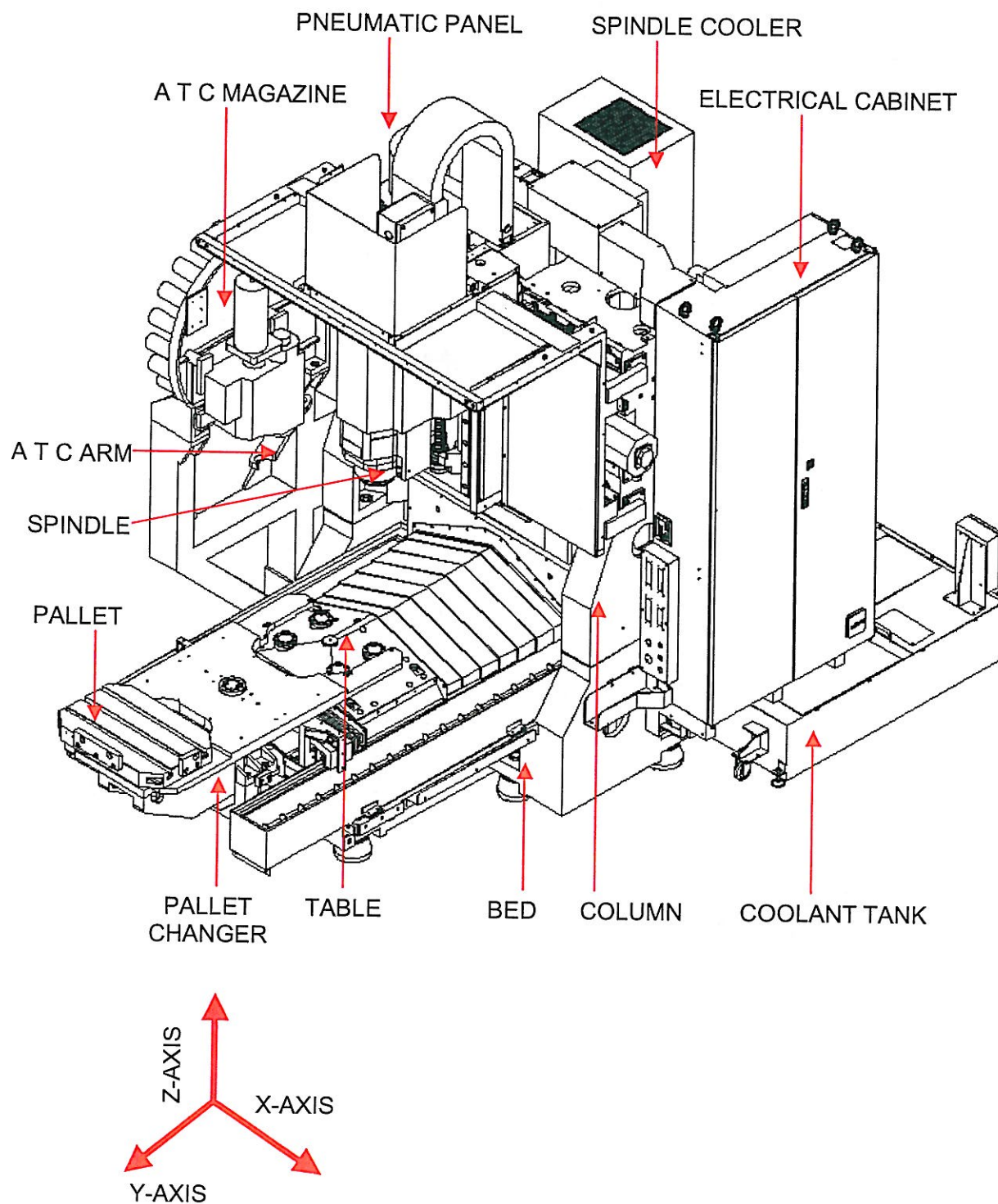
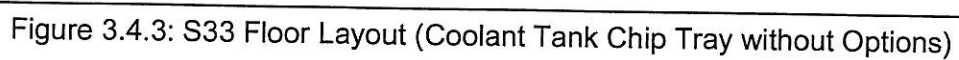


Figure 3.4.2: S33 APC General View

Table 3.4.1 S-Series general view and dimensional drawings for different options

S/N	Description	Figure Number
1	S33 Floor Layout (Coolant Tank Chip Tray without Options)	3.4.3
2	S33 Front and Side View	3.4.4
3	S56 Floor Layout (Coolant Tank Chip Tray without Options)	3.4.5
4	S56 Front and Side View	3.4.6
5	S33 APC Floor Layout (Coolant Tank Chip Tray without Options)	3.4.7
6	S33 APC Front and Side View	3.4.8
7	S33 Floor Layout (Left LUCC without Options)	3.4.9
8	S33 Floor Layout (Left LUCC with Options)	3.4.10
9	S56 Floor Layout (Left LUCC without Options)	3.4.11
10	S56 Floor Layout (Left LUCC with Options)	3.4.12
11	S33 APC Floor Layout (Left LUCC without Options)	3.4.13
12	S33 APC Floor Layout (Left LUCC with Options)	3.4.14
13	S33 Work Area	3.4.15
14	S56 Work Area	3.4.16
15	S33 APC Work Area (2 pages)	3.4.17



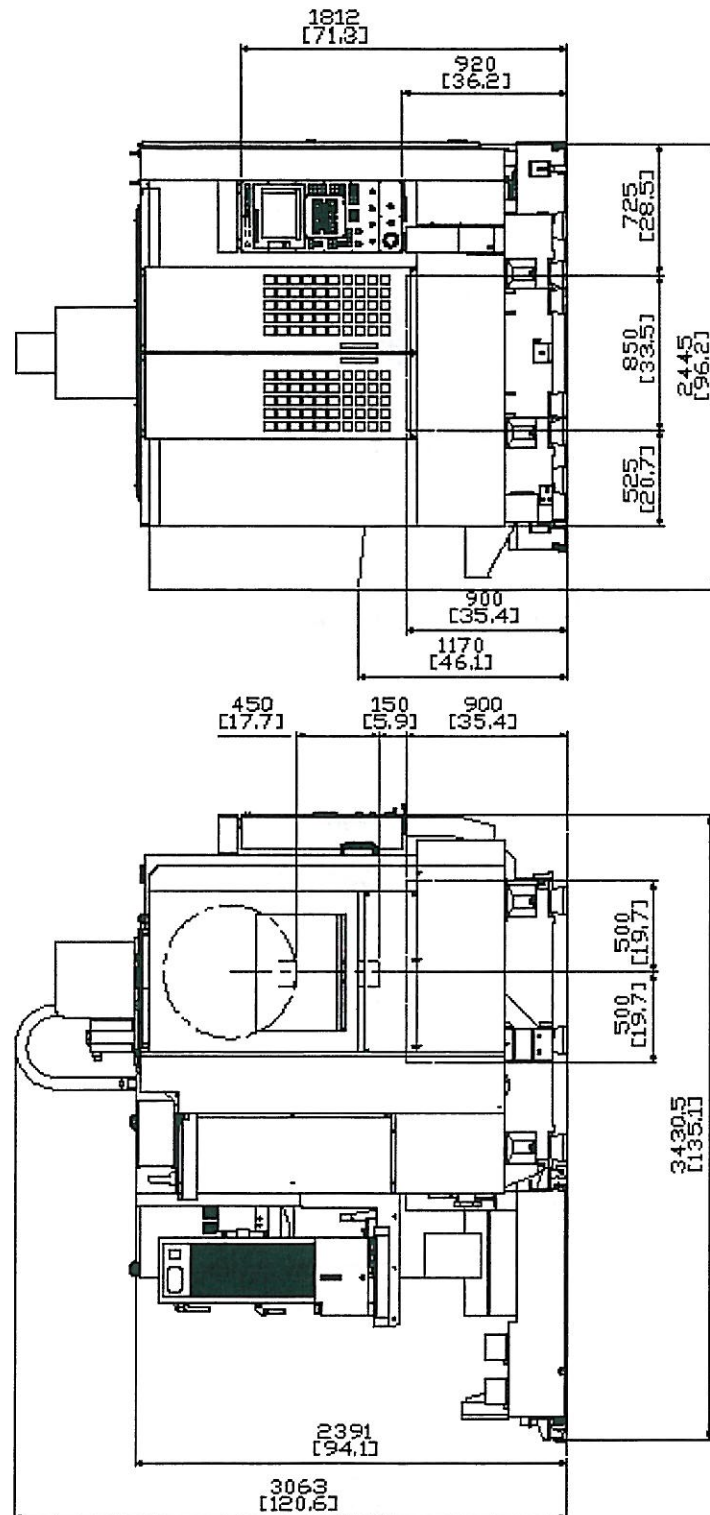


Figure 3.4.4: S33 Front and Side View

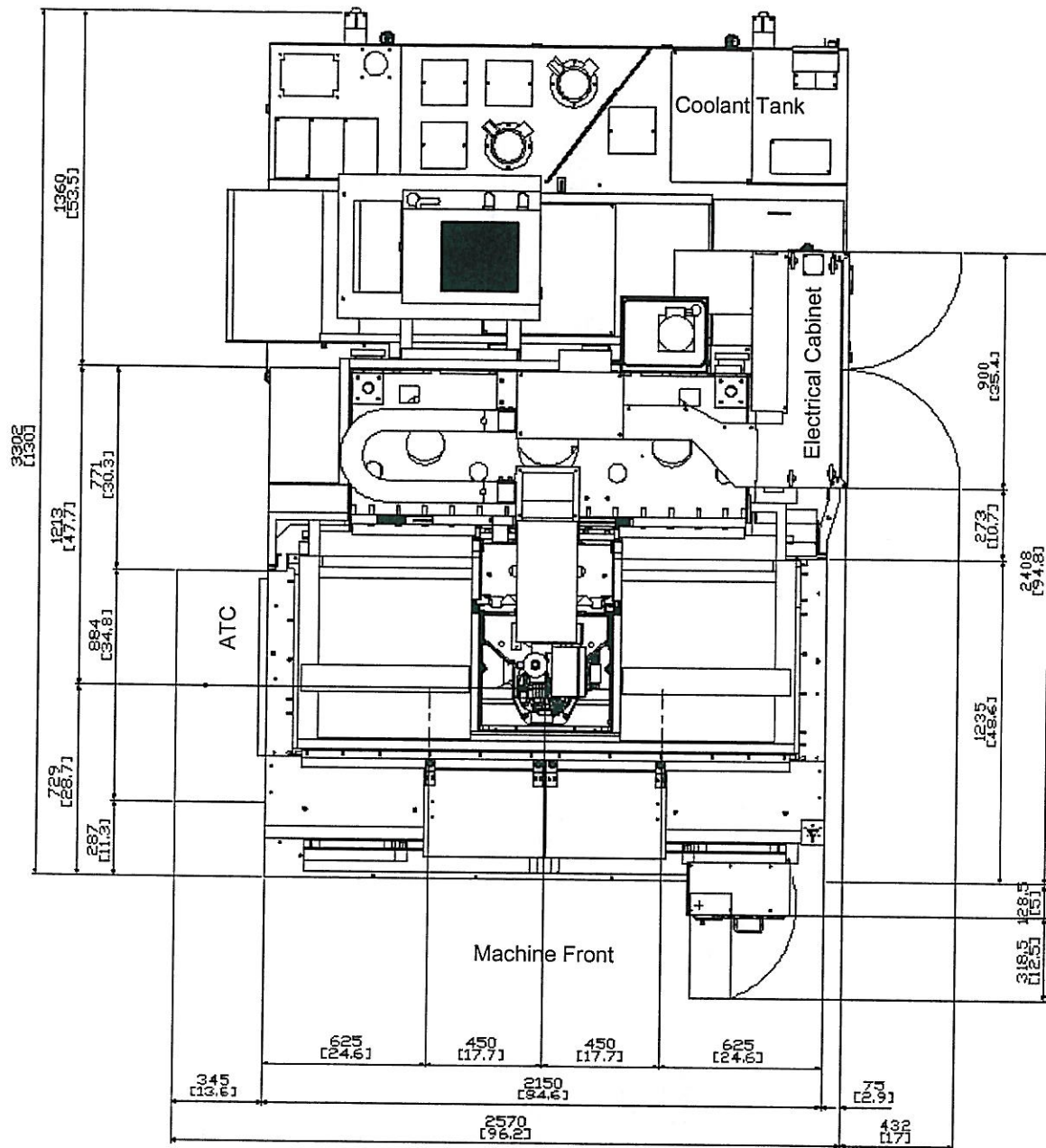


Figure 3.4.5: S56 Floor Layout (Coolant Tank Chip Tray without Options)

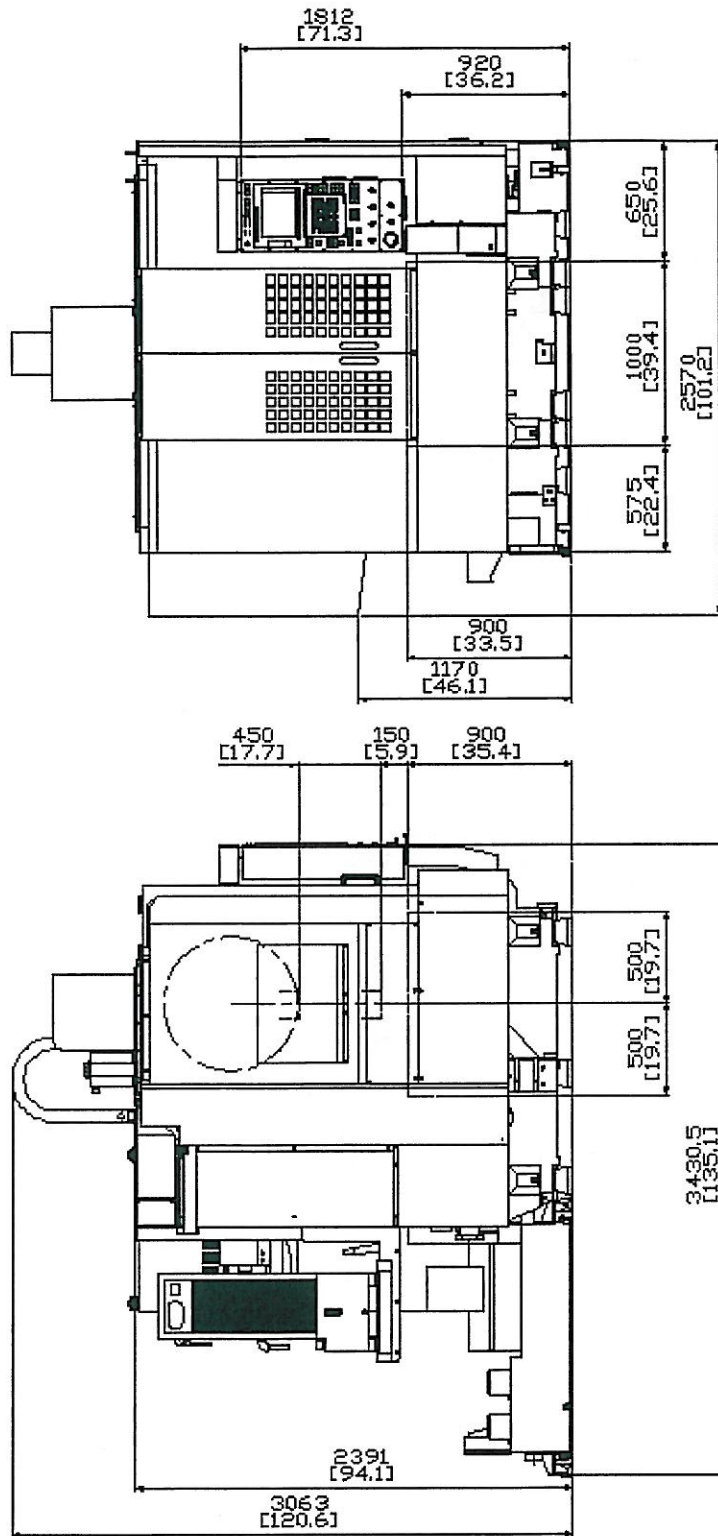


Figure 3.4.6: S56 Front and Side View

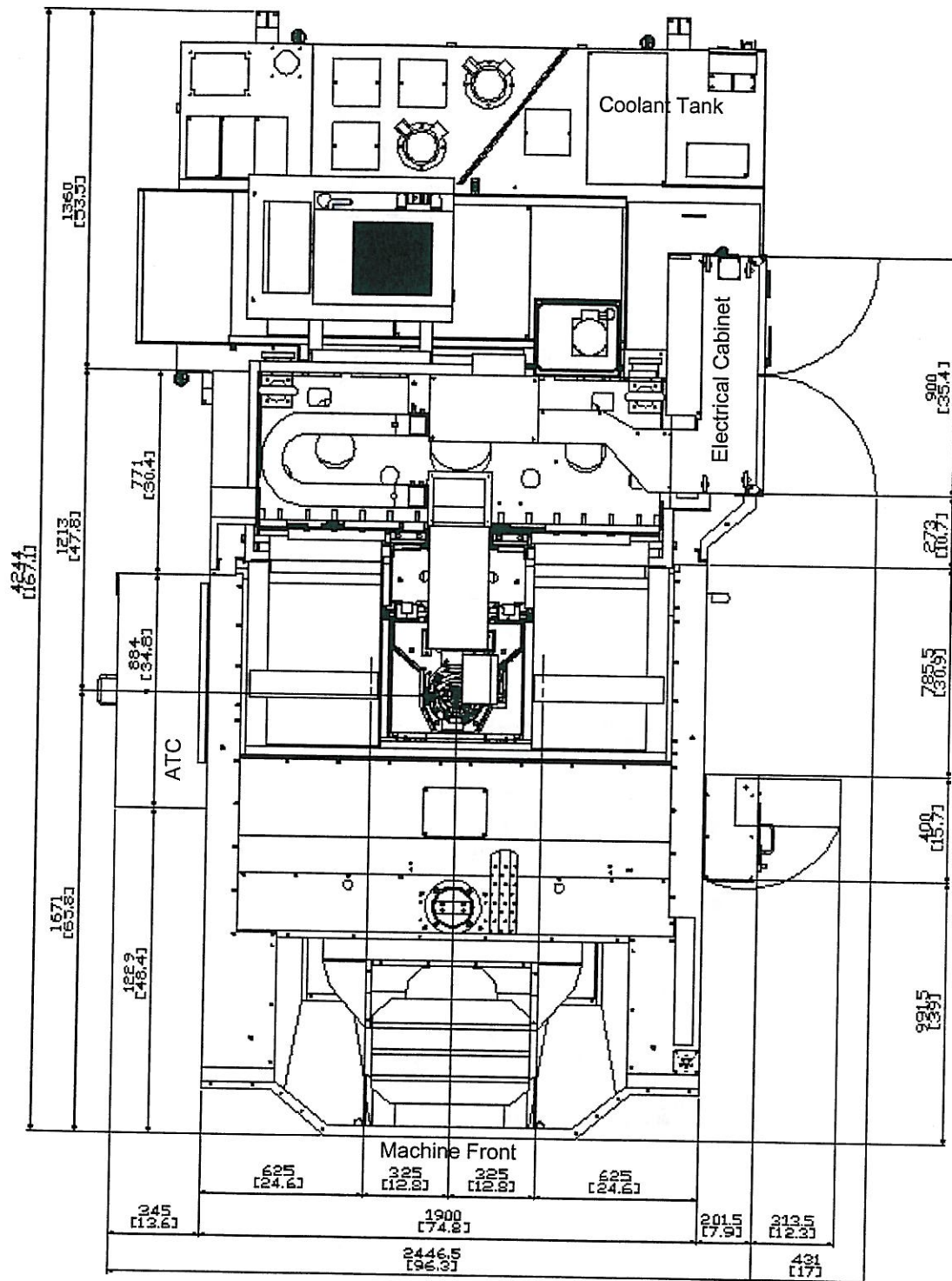


Figure 3.4.7: S33 APC Floor Layout (Coolant Tank Chip Tray without Options)

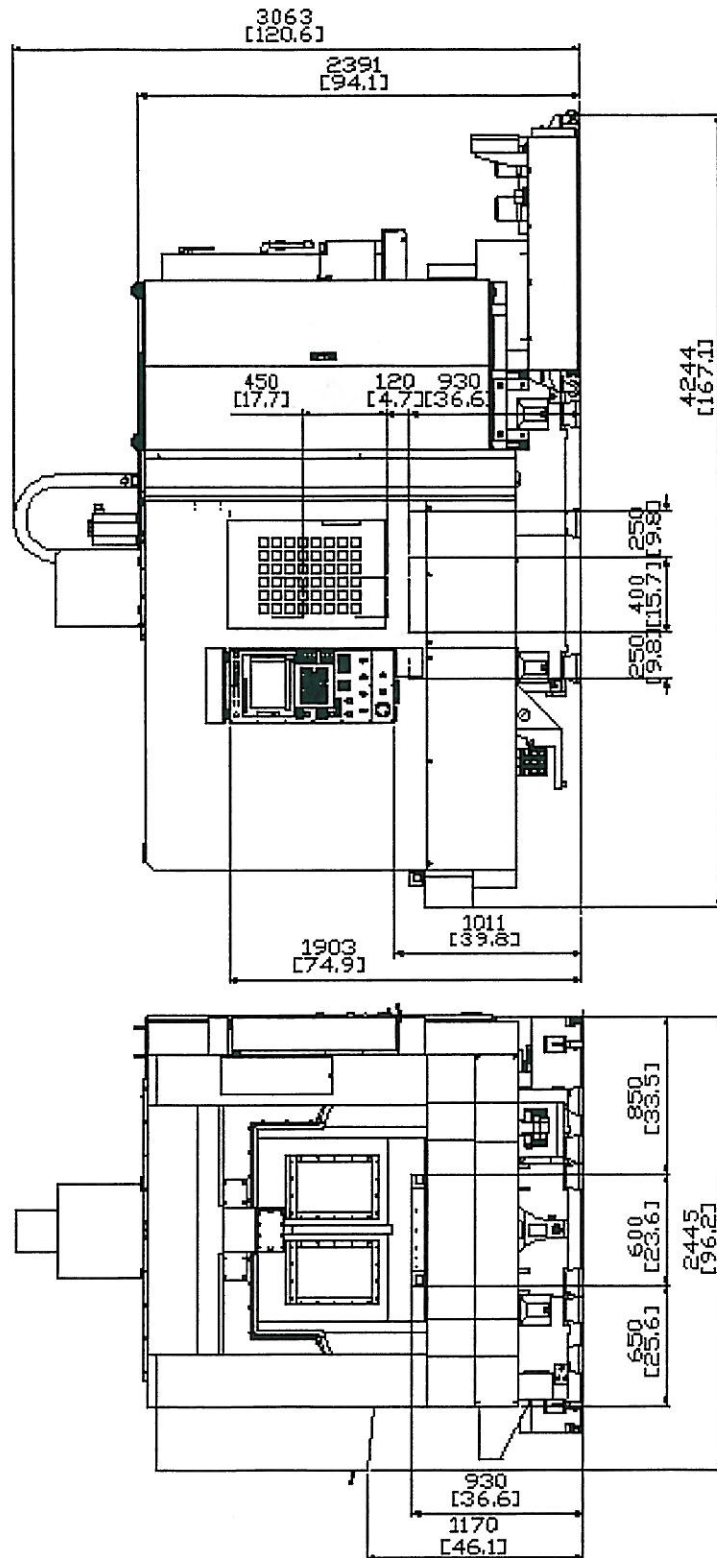


Figure 3.4.8: S33 APC Front and Side View

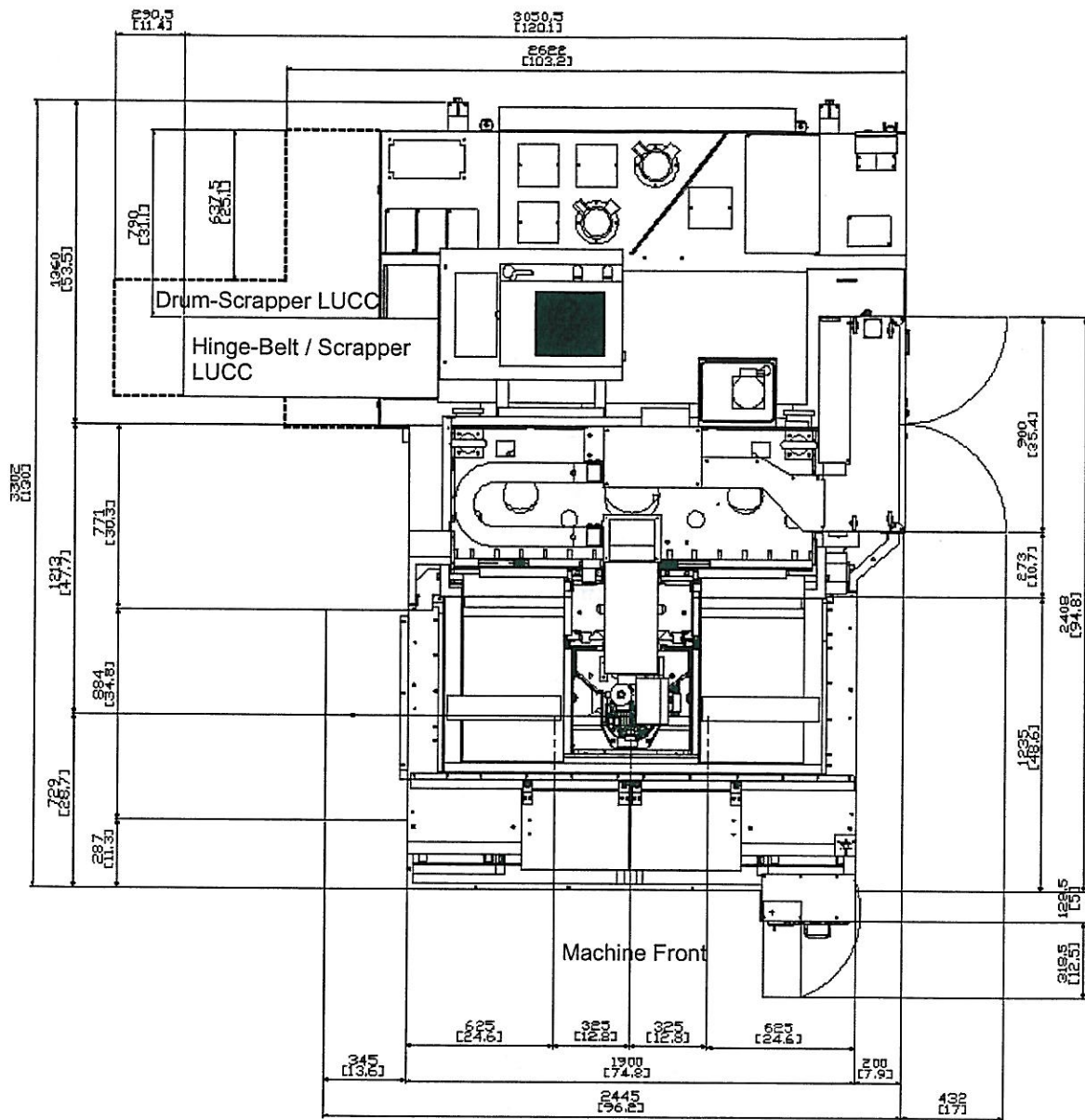


Figure 3.4.9: S33 Floor layout (Left Lucc without Options)

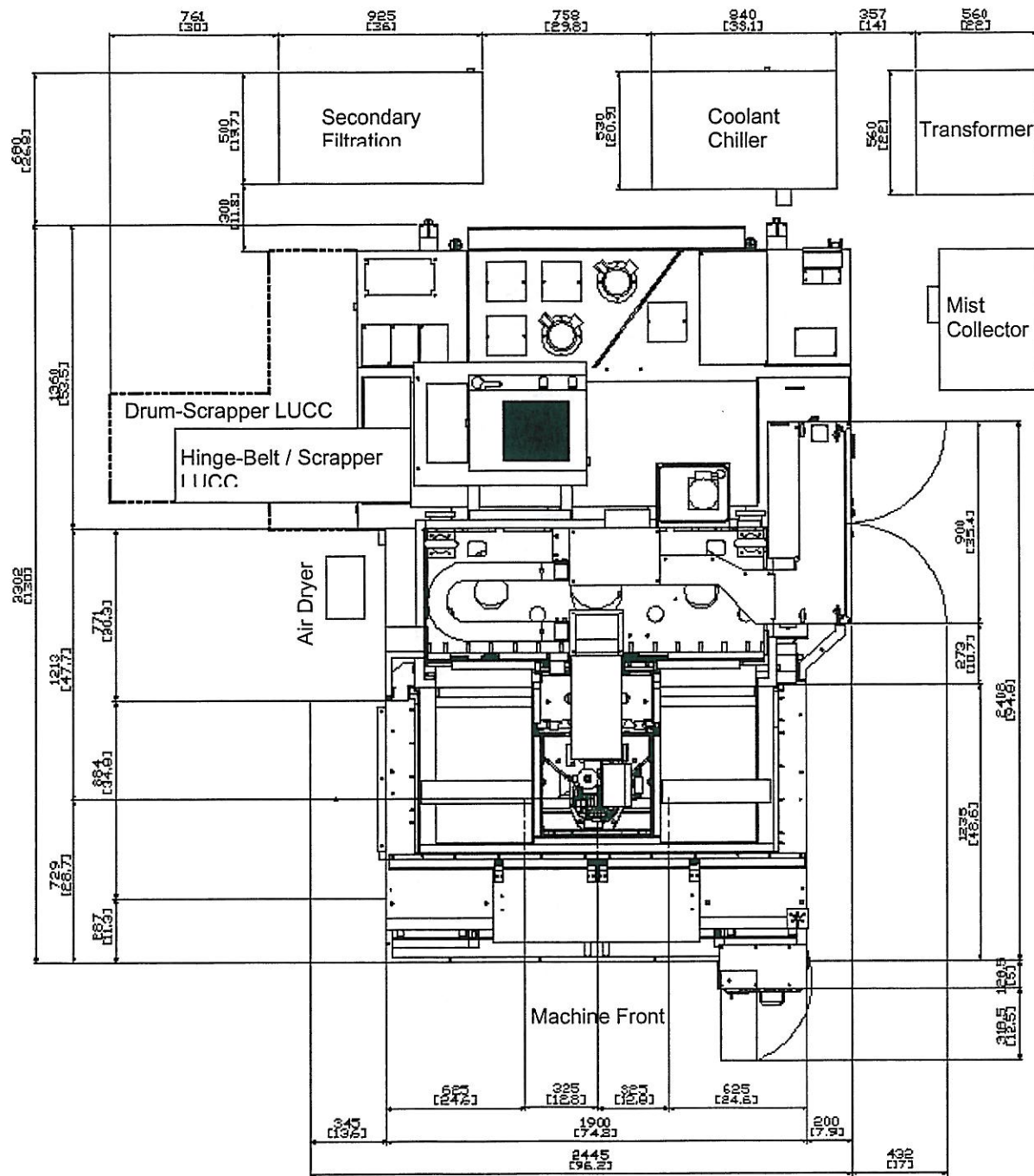


Figure 3.4.10: S33 Floor Layout (Left LUCC with Options)

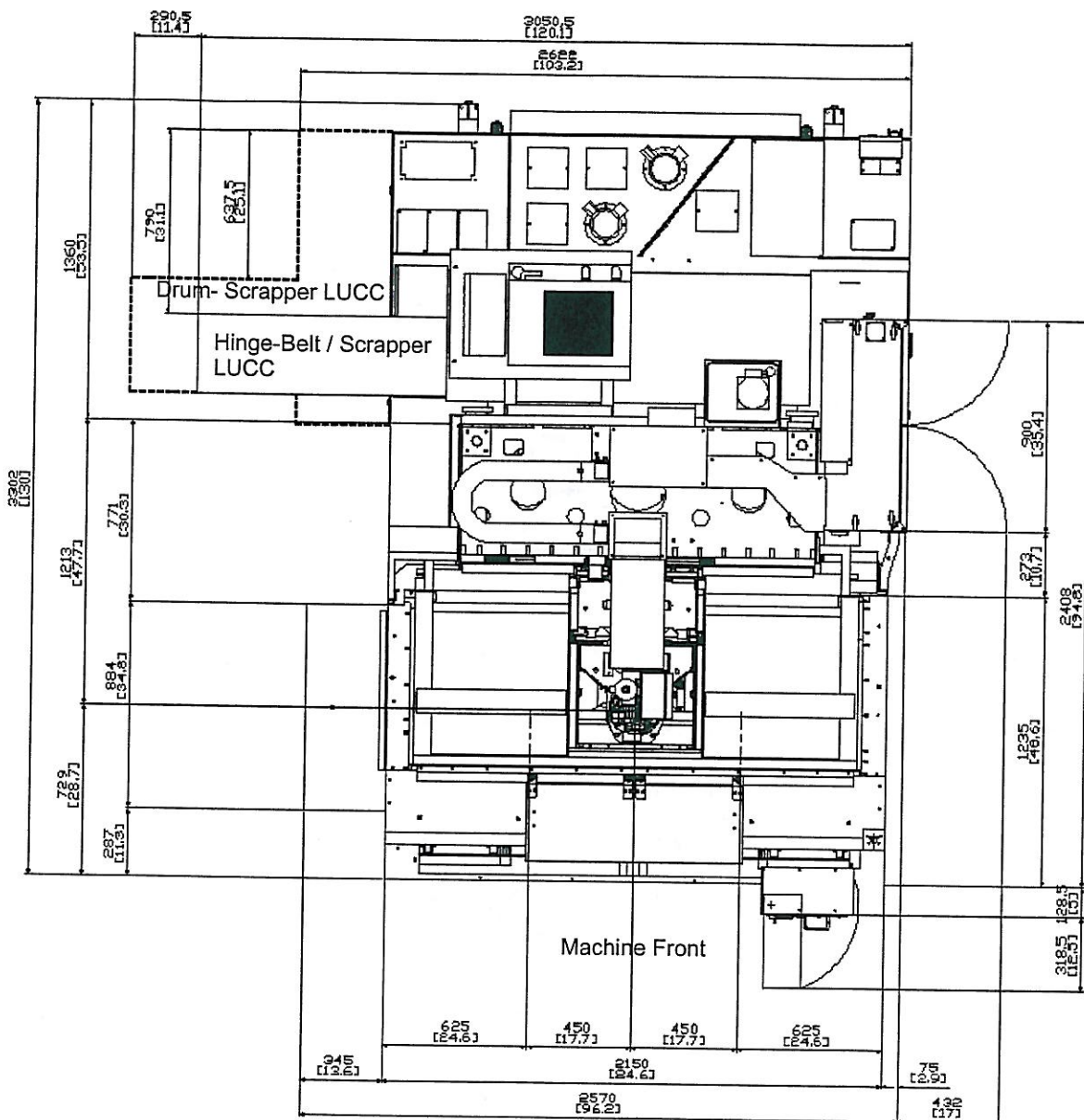
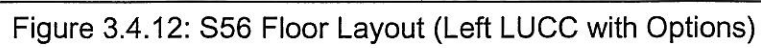


Figure 3.4.11: S56 Floor Layout (Left LUCC without Options)



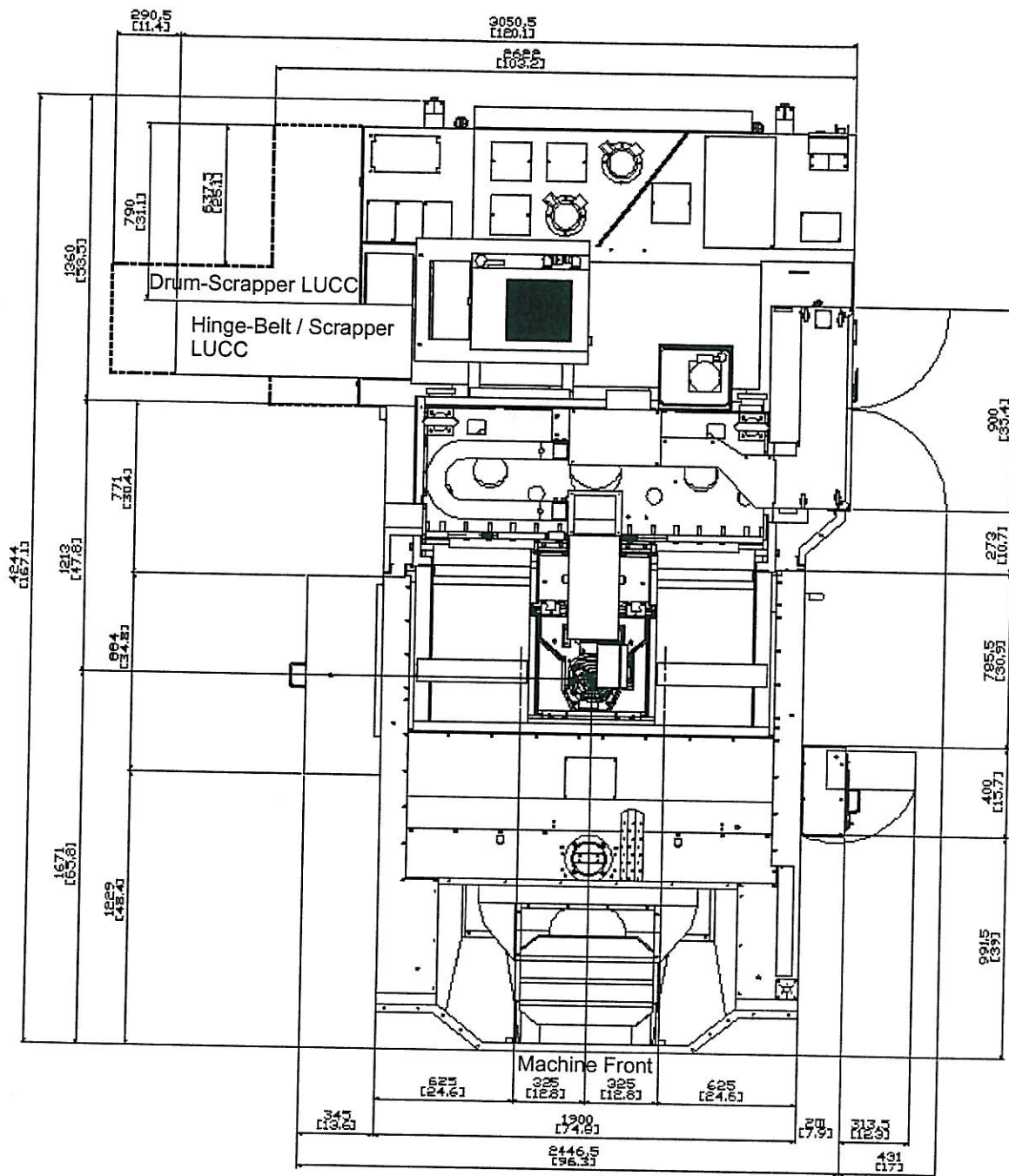


Figure 3.4.13: S33 APC Floor Layout (Left LUCC without Options)

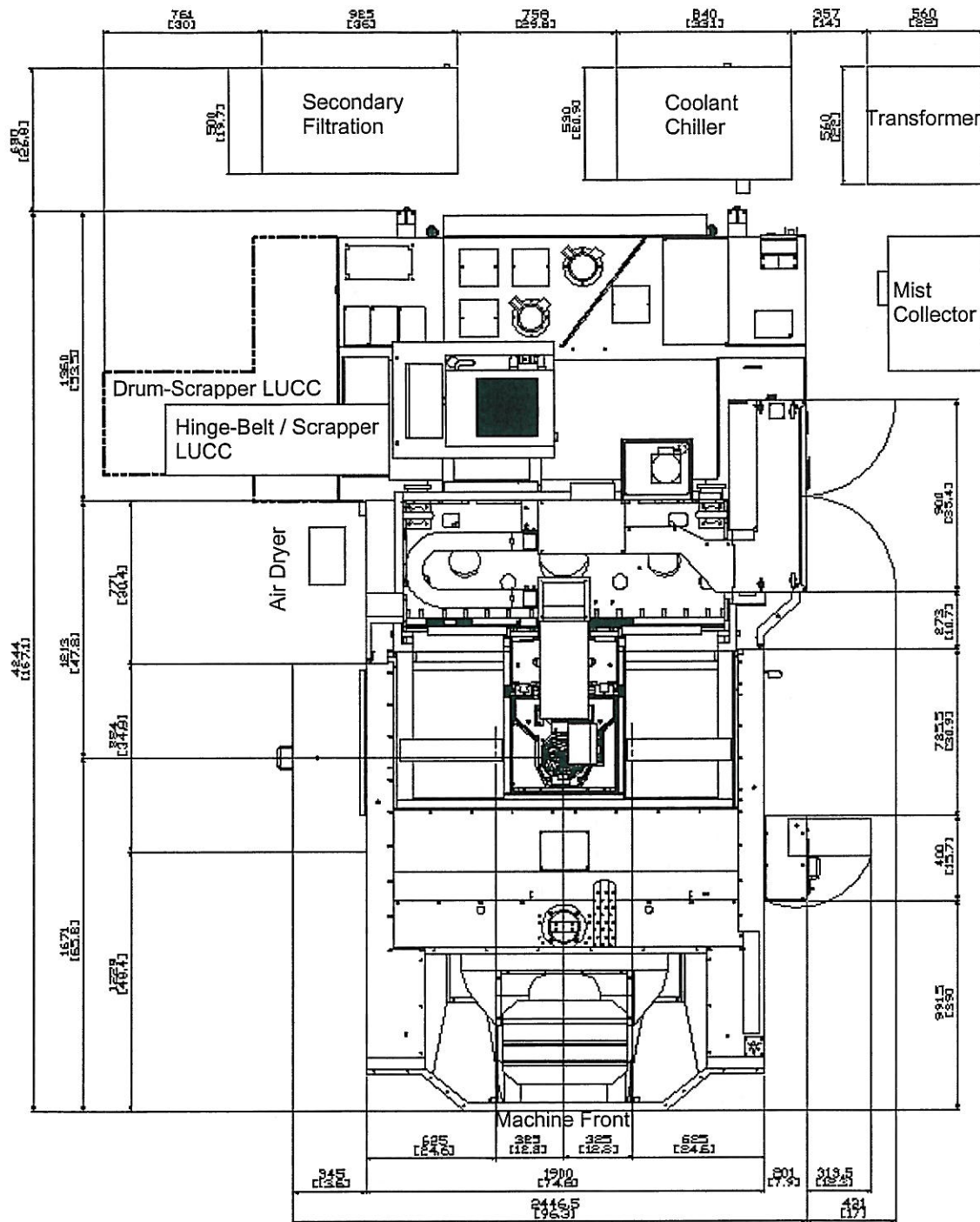
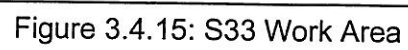


Figure 3.4.14: S33 APC Floor Layout (Left LUCC with Options)



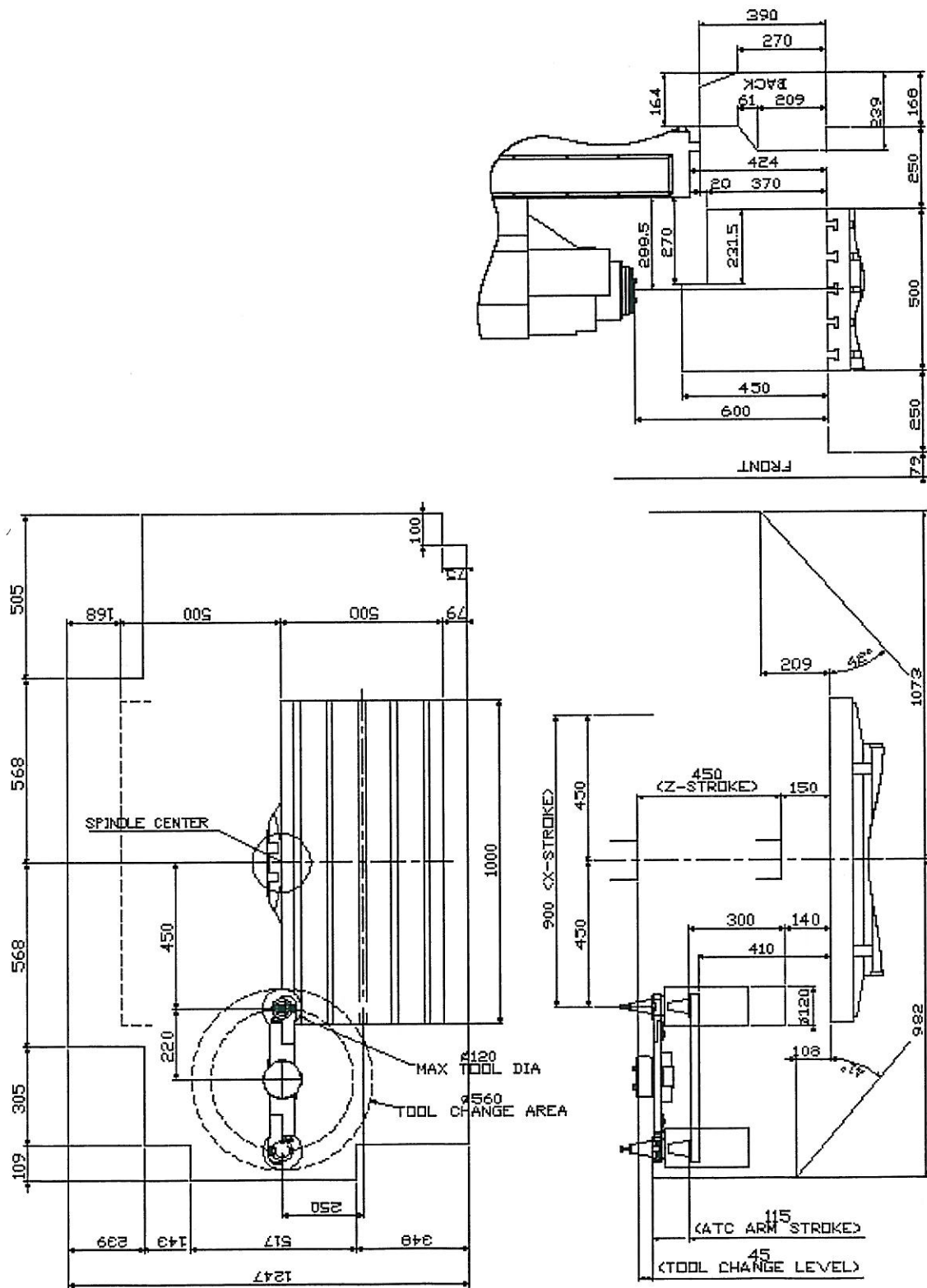
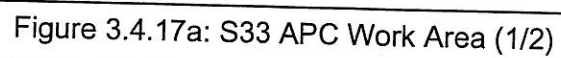


Figure 3.4.16: S56 Work Area



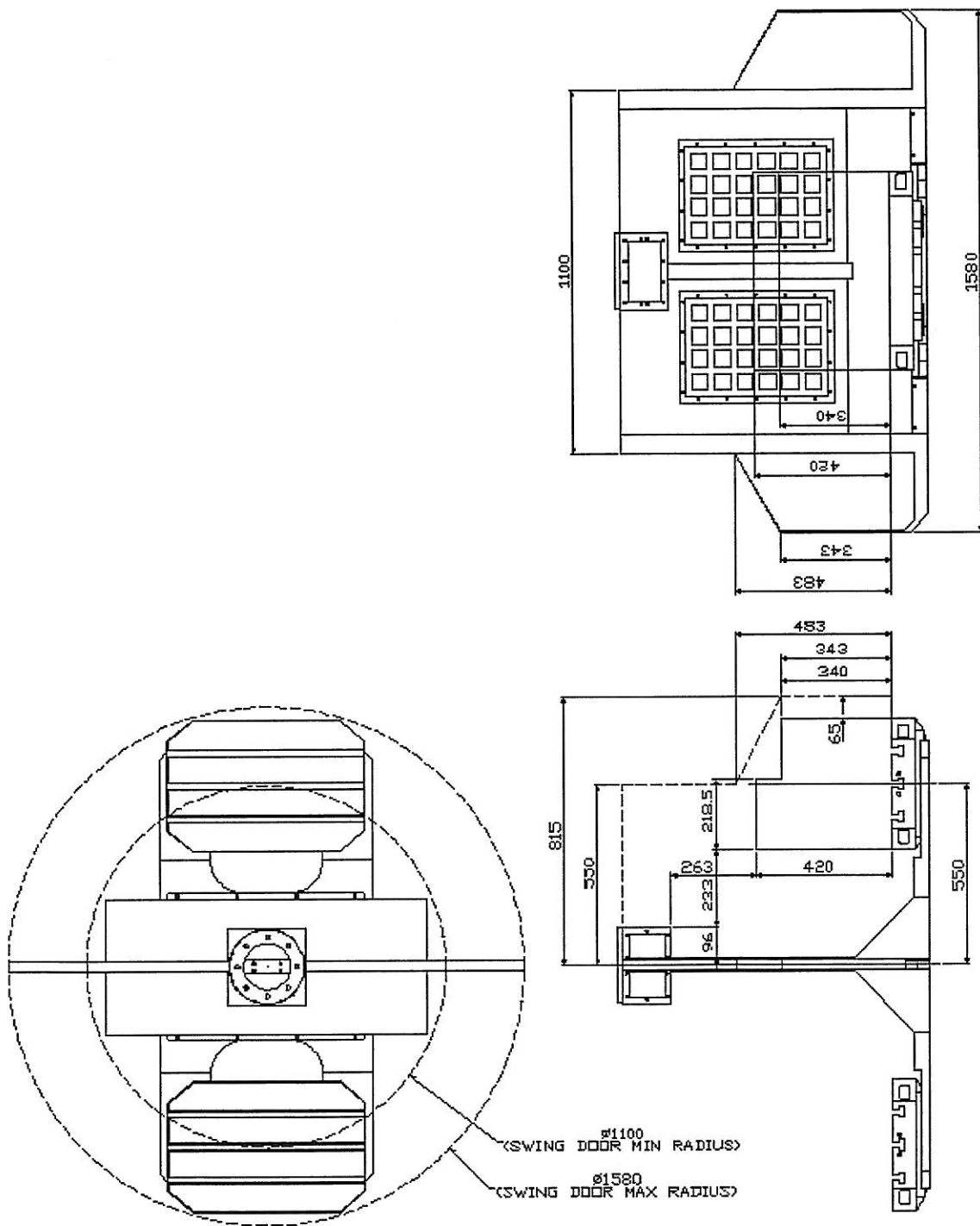


Figure 3.4.17b: S33 APC Work Area (2/2)

3.5 Tooling Specification

Preparation of tooling and fixtures typically require long lead times. These two issues should be addressed before the delivery of the machine. Refer section 4.11 tooling and fixtures for detailed tooling drawing specifications for different options available on S-Series machine.

Fixtures

Consider design and manufacturing time, and co-ordinate completion with the delivery of the machine for a smooth transition into production schedule to avoid unnecessary underutilization of the machine.

Tooling

The three most important factors to understand and consider when selecting tool holders and cutting tools for high-speed machining are balance, concentricity, and rigidity. All high-speed spindles have limitations. Know the spindle design and limitations. Ensuring machining applications are within the spindle's allowable radial load and side thrust, will maximize machine utility, parts production, and machine component and spindle life.

When selecting tooling:

- Tool holders should be designed for the highest rpm available on the spindle. Never exceed the manufacturer's design ratings for the tool.
- Tool holders should be designed for high-speed machining. Look for good tool holding ability, balance, and concentricity.
- Never use Weldon or side lock holders at high rpm.
- Use the shortest possible tool.
- Select the shortest tool holder and cutting tool allowed by the part geometry. Short tools provide better tool life and surface finish while reducing radial load on the spindle.

4. Pre-installation Process

4.1 Introduction

This chapter describes installation process and contains guidelines to prepare customer for the delivery and installation of the S-Series high speed machining center. It establishes clear expectations and responsibilities for all concerned. The success and efficiency of installation rests, in large part on the participation and involvement of customer in the installation process. Fifteen days before the delivery of your Makino machine take time to:

- Review the information and requirements related to pre-installation.
- Establish a time-line and detailed schedule for completion of these items.

The pre-installation checklist outlines key tasks to prepare for machine delivery and installation. The items checked in the "required" column must be completed for an efficient machine installation. Use the resources in this guide to accomplish the pre-installation tasks:

- Selecting machine location (access, environment, and foundation), refer section 4.2.
- Dimensional drawings are provided in section 3.4 to determine required floor space and clearances.
- Electrical, Service, Air requirements and connection details.
- Unloading, moving.
- Preparing tooling and work holding devices.

4.2 Selecting the Machine Location

Key factors in selecting the machine location include:

- Required total floor space
- Required room space
- Easy accessibility
- Manufacturing process
- Environment for machine working

Total Floor Space

The machine foot print area plus the total working area required around the machine for tooling, work piece storing and movement, utilities and also for future maintenance is considered. For the machine footprint refer machine floor plan

Room Space

The total floor space and the total safe height of the room in which the machine is located considered.

Easy Accessibility

The machine placement must have sufficient room for safe access around the machine and for all cabinet doors and panels to swing completely open. Remember to ensure a path from the truck to the machine site that provides sufficient width, height, and swing clearance to accommodate the machine rigging and moving equipment like the mobile crane, forklifts and over-head crane. Failure to ensure sufficient moving room could result in unnecessary delays in machine installation and additional cost. There should also be easy accessibility for safe discharge of chips and used coolant. Refer section 3.4 for machine external dimensions and floor plans, for various machine options.

4.2.1 Manufacturing Process

Ideally the machine should be placed closest to the process it supports. This placement reduces handling costs and improves communication between process steps.

Environment for Machine Working

Proper environment and foundation are of the utmost importance. These two factors, more than any others, ensure machine accuracy and dependability. A sub-standard environment can cause control, machine, and component failures of all types. DO NOT locate the machine:

- In direct sunlight.
- Near a source of heat.
- In a place subject to large temperature variation.
- Near a source of extreme metallic dust, such as grinding machines, etc.
- Near a source of severe vibration, this may affect accuracy and alignments. If the machine must be located in such an environment, we recommend a separate foundation with an expansion strip to absorb the vibration.

The machine location should meet the following conditions:

- Dust-free, well lighted, and free of temperature changes.
- Ambient Temperature : 10 to 40° C, optimum 24±2° C
- Temperature Fluctuation : 1°C/30 minutes or less
- Relative Humidity : 35 to 70% (no condensation)
- Dust Free : 0.3mg/m³ or less
- Freely flowing air.
- Available floor and bench space for storing raw and finished work pieces, tooling, and inspection equipment.
- Enough room for maintenance work. Adequate space around machine and clearance to fully open cabinet doors.
- Adequate and proper sized utilities are available: electrical powers supply, clean and dry air supply, etc.
- A foundation flat and strong enough to support the weight of the machine without appreciable deflection.

4.3 Foundation



To ensure machine accuracy and performance, customers must comply with all installation and foundation requirements. Failure to comply may void the accuracy portion of the warranty. Consistent accuracy can only be guaranteed on a reinforced concrete foundation that meets the minimum specifications for the machine.

A reinforced, isolated, concrete floor is the best foundation to minimize vibration and deflection. Refer figure 4.3.1 for details on foundation drawings. The concrete pad should be continuous, flat, and strong enough to support the weight of the machine without appreciable deflection. DO NOT place machine on separate sections of concrete. As a rule of thumb, the foundation must meet the following specifications:

- Minimum ground resistance of 5 tonne/m².
- (The soil below the concrete medium or large sized crushed stones can be used)
- Minimum thickness of foundation is 300mm.
- Foundation should extend a minimum of 300 mm beyond the machine boundary.
- Minimum anti vibration Isolation around the Foundation is of 100 mm thick and it is also recommended that a 19-mm (3/4-inch) expansion strip be placed at the perimeter of the foundation to absorb some vibration.
- Floor level should be within 3.2mm/m.
- If the floor does not meet these specifications, a special foundation is needed to maintain machine level and alignment. If you are considering a special foundation, contact Makino.
- The steel reinforcement of the steel inside the concrete should be of D10@230
- Type of concrete should be of grade FC180 or more.
- When locating the machine on an upper floor of a building, be sure to:
 - Consult a structural engineer for load bearing capacity.
 - Consult Makino for acceptance or stipulations on this arrangement.
 - Locate the machine over a pillar or supporting beams to provide a minimum vibration environment. If necessary, install one or more pillars under the machine to provide enough support to keep the machine level and maintain alignment.

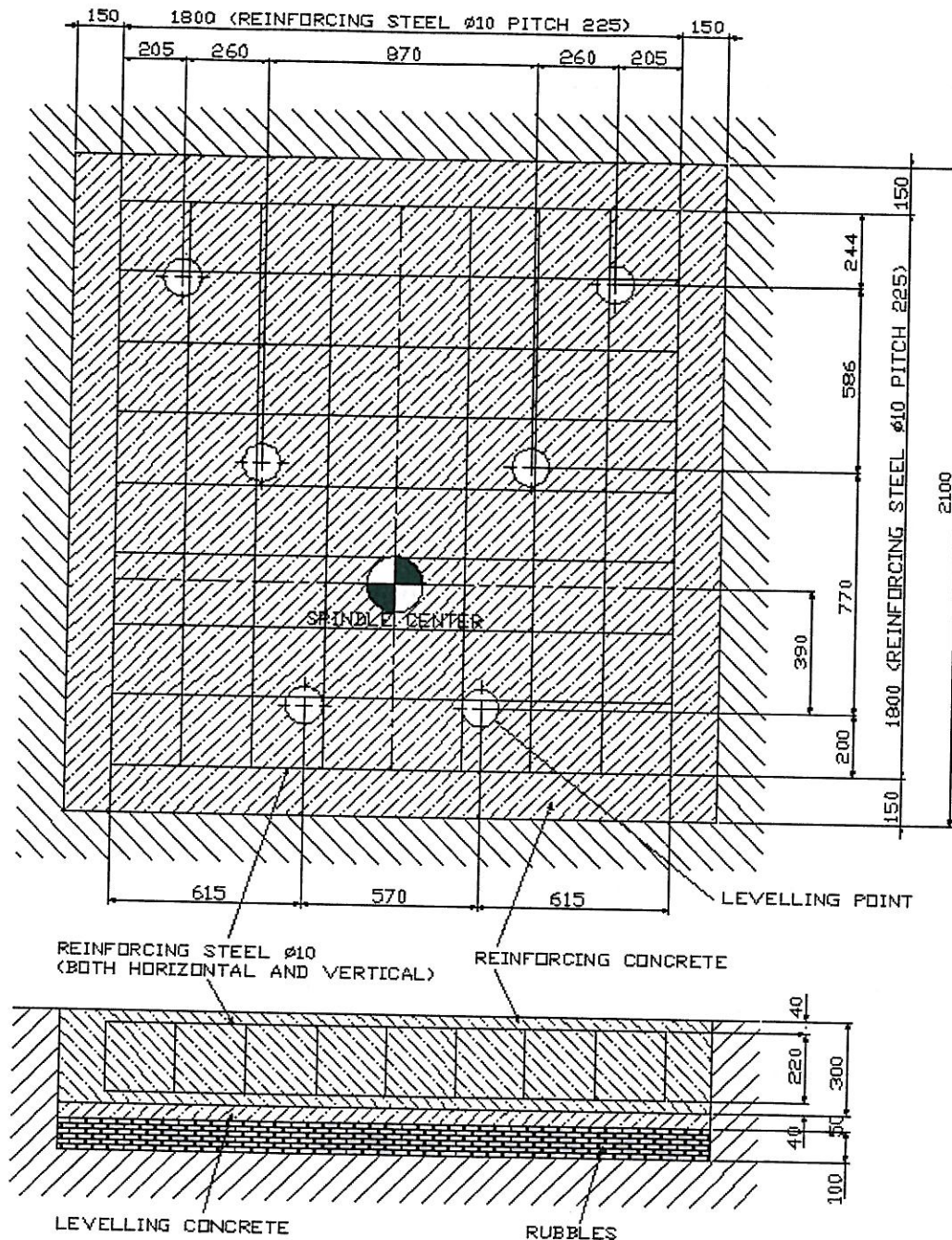


Figure 4.3.1: Foundation of S33, S56 & S33 APC

Note:

- This foundation is an example of reinforced concrete thickness 300mm.
- These data are given, assuming that allowable bearing capacity of soil is 5ft/sq m.
- For the rubbles, medium or large sized crushed stones should be used.
- The concrete more than FC 180 should be used.
- Machine leveling points as indicated in the figure.
- Machine weight, standard 7500 kgf and APC machine 8500 kgf.

4.4 Floor Plan and Marking

Floor plan for S-Series machine is given in section 3.4 describes the location of various machine units and its accessories. After completion of the foundation work, clearly mark on the floor, location of the basic machine, the transformer, and other optional units as applicable to the machine ordered, and as per the layout given.

Markings for the gangway, locations for placing the work piece, toolings, and other intended requirements near the machine are also to be done before locating the machine. Clear marking of the plan layout helps in machine installation and avoids unnecessary problems in locating other intended necessary units around the machine and moving space around the machine.

Clean the floor area completely before marking, and make sure that all factors are considered before marking. Use a bright paint or marker to mark the location.

4.5 Power Supply and Cables

A 3-phase power source, with stable voltage regulation ($\pm 10\%$), a ground of 25 ohms or less and a 125A breaker must be provided. The customer must:

- Provide a properly sized electrical service box for the machine. Use local code and table 4.6.1 to assist in sizing the machine electrical service.
- Ensure the electrical service voltages meet all requirements.
- Install an additional automatic voltage regulator/stabilizer if the required voltage cannot be maintained within $\pm 10\%$ (customer should plan for the location of the stabilizer in case used based on the type and dimensions of the unit).

Table 4.5.1 gives the total power supply, the cable size and type required for S-Series machine.

S/N	Description	Data
1	Main Breaker/Isolator (Customer Plant Side)	125A for 230/346 VAC Input 100A for 415/440/460 VAC Input
2	Cable Size and Type	AWG300MCM (UL1505, Flame-retardant XLPE insulated wire) / SWG
3	Wire Type	Copper
4	Wire Size	35 mm ²
5	Connecting Terminal	M8

Length of the cable is to be decided by the customer based on main supply point and machine layout. Contact Makino Customer support for any clarifications before installing the main circuit breaker and cables for the machine.

4.6 Transformer (Option)

S-Series machine requires an input voltage of 200V, 3Ø AC, 50/60 Hz, for the main servo control and other units. If the incoming voltage is other than 200V, 3Ø AC, an additional external transformer of rating 40 kVA is required with the secondary output being 200 V.

Table 4.6.1 gives the types of transformers with suitably rated cables from transformer to the machine are available as an option along with the machine according to the countries and its power source.

Table 4.6.1: Regional wise main transformer incoming voltage specification

Region	Transformer Voltage
Asia Pacific	Primary: 380/400/420/440V
	Secondary: 200V
U.S.	Primary: 400/460/480V
	Secondary: 200V
Europe	Primary: 380/400/420/440V
	Secondary: 200V
Other Than Above	Primary: 220/230/240V
	Secondary: 200V

Table 4.6.2 gives the specification of the required transformer and should be ready before installation of the machine unless ordered with the machine.

Table 4.6.2 Main transformer specifications

Description	Specification
Primary voltage	According to the local power supply
Secondary voltage	200 VAC
Phase	Ø 3
Frequency	50/60 Hz \pm 1 %
Rating	40 kVA
Sec. voltage tolerance	\pm 5%
Class	Class H
Regulation	\pm 3 %
Type	Isolation
Winding	Copper Winding
Output tapings	200V and 220V

4.7 Earthing / Grounding Preparations

All Makino Machining Centers must be properly grounded at the time of installation. Proper grounding requires an isolated earth ground for the machine:

- Do not use the common earth used in the plant.
- Prepare a separate earth pit in accordance with local regulations near the machine and properly inspect before connecting to the machine.
- Ground of 100 ohms resistance or less, is required.

Contact any certified electrician / Makino Customer Support for any clarifications regarding the grounding preparation before installing the machine.

4.8 Air Supply

Table 4.8.1 gives the details of required incoming air supply specification unless an air dryer is ordered with the machine, which is available as an option. The air supply point to the machine should be near to the machine air inlet. Refer the foundation layout section 3.4 for proper air inlet location. The air supply line should have permanent piping.

A valve for opening and closing the air supply is required at the supply point. A main air pressure gauge and a filter regulator with 0.005mm of filtration are recommended after the main supply valve. Air supply piping drop from the top of the main line is recommended with a connecting port of PT1/2. Keep the air line and pipes clean and free from dust and other free particles, as they will damage the line filters of the air dryer and the machine or cause machine component failure.

Table 4.8.1: Air supply specification

Description	Specification
Supply pressure	0.5 to 0.8 MPa
Inlet air temperature	5° to 35° C
Ambient temperature	5° to 40° C
Relative humidity	Less than 40 %
Machine pressure	0.5 MPa
Consumption (Volume)	400 L / min (1.52 m ³ /min)
Filtration	Water trap and oil mist filter with 5μ and 0.3μ filter
Air dryer	Refrigerated membrane type (Option)
Connection port	PT1/2 female or Ø16mm hose nipple (machine side)
Inner diameter of hose	Over 15mm
Air quality required	ISO8573-1, ISO1.5.1



Incoming Air Supply

Makino considers it the customer's responsibility to ensure that the air supply to the machining center is both clean and dry. Supplied air must not exceed 40% relative humidity.

Please Note: If the incoming air is not good and cannot meet the minimum standards, it is recommended to use an air dryer just before connecting the main air supply.

4.9 Machine Handling Facilities

S33 machine installation requires lifting and moving of some heavy units. Trained and professional riggers only should handle the machine for, unloading, unpacking, lifting and moving. Following facilities at the customer place is very much essential for installing the machine:

- Overhead crane of minimum capacity 10 ton or above.
- Min gap from the crane hook to the top of the machine should be about 500mm.
- Min gap from the crane hook to floor should be about 3000mm.
- Shop floor entry door width should be more than 2800mm.
- Mobile crane capacity :10 ton or above.
- Forklifts capacity :10 ton or above.
- Hydraulic jacks :5 ton (toe type preferable).
- Eyebolts :M6, M8, M12, M16 etc min of 6 each.
- D shackles :Different sizes.
- Crowbars :2.5 to 3 m in length minimum 2 numbers.
- Lifting slings or wire rope of various lengths.

4.10 Service Facilities

During the installation of machine, following facilities are very much essential for installing the machine. Items which customer is requested to arrange for machine installation:

- Cotton cloth type waste (never use thread type cloth waste).
- Soft tissue papers.
- Cleaning brushes of different sizes.
- Cleaning agents like CTC / Acetone / Heptane / Gasoline, soap oil etc.
- Big size clean cardboards and plastic sheets.
- Industrial vacuum cleaner.
- Hand lights or torch lights.
- Helmets for FSE.
- Safety hand gloves.
- First aid kit.
- Set of tool kit.
- Dust bins for waste disposals.
- Temporary power facilities.
- Aluminum ladder of height 6 to 8 ft.

4.11 Toolings and Fixtures

Consider the specification of the machine spindle, which is to be installed. Please refer the table below to select the correct tooling specification that can be used. For tool maximum diameter weight and length please refer Figure 4-11-9 for tool diameter, weight and length specifications.

Consider the machine maximum work piece area that can be accommodated for the machine that is to be installed. Prepare the fixtures accordingly by referring chapter 3 for details.

TOOL SHANK AND PULL STUD DETAILS FOR 12K/13K SPINDLE			
TYPE		DIMENSIONS	TSATSC
TOOL SHANK	PULL-STUD (Retention Knob)		
MAS403-BT40	Without Hole	Figure 4-11-1	NOT APPLICABLE
JIS B6339-40T	Without Hole	Figure 4-11-2	NOT APPLICABLE
	With Hole		TSATSC
DIN 69871-A40	Without Hole	Figure 4-11-3	NOT APPLICABLE
	With Hole		TSATSC
V-CAT - No. 40	Without Hole	Figure 4-11-4	NOT APPLICABLE
	With Hole		TSATSC
HSK-A63	NOT APPLICABLE		

TOOL SHANK AND PULL STUD DETAILS FOR 20K SPINDLE			
TYPE		DIMENSIONS	TSA/TSC
TOOL SHANK	PULL-STUD (Retention Knob)		
MAS403-BT40 (JIS B6339-40T)	Without Hole	Figure 4-11-5	TSA
	With Hole		
DIN 69871-A40	Without Hole	Figure 4-11-6	TSA
	With Hole		
V-CAT - No. 40	Without Hole	Figure 4-11-7	TSA
	With Hole		
HSK-A63	NOT APPLICABLE	Figure 4-11-8	TSA /TSC

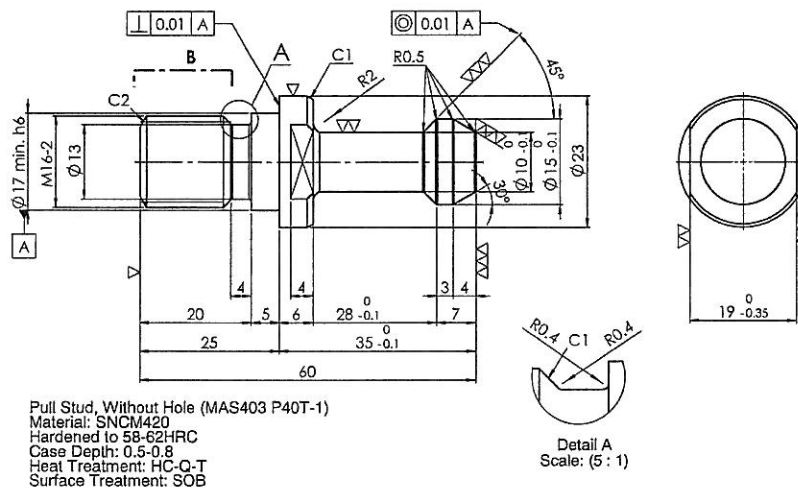
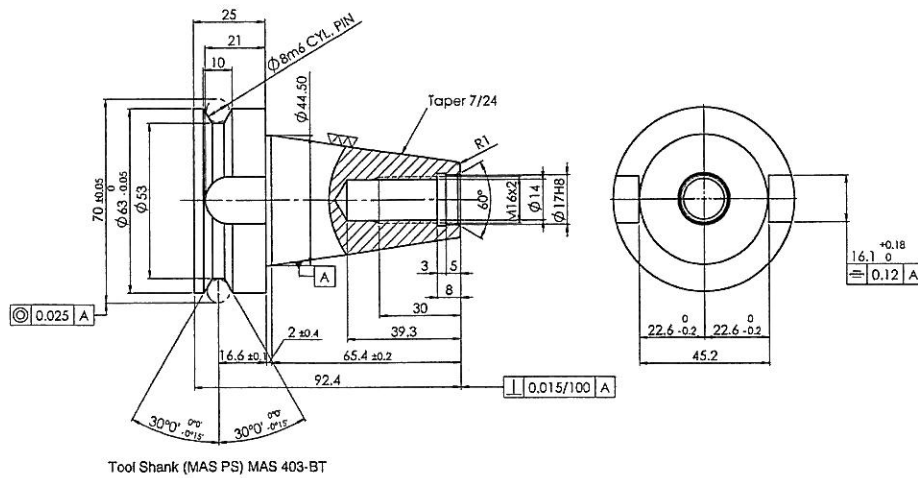


Figure 4.11.1: MAS 403 BT 40 Shank and Pull Stud

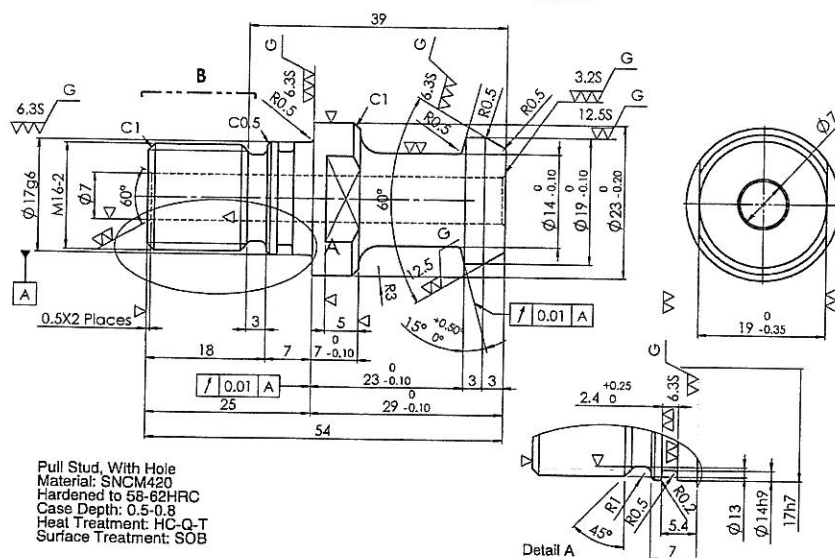
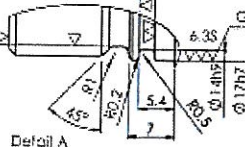
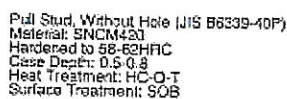
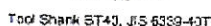
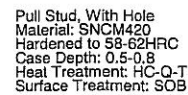
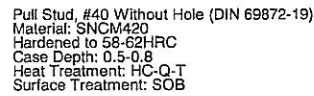
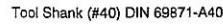
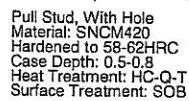
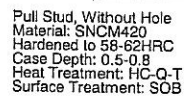
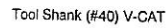


Figure 4.11.2: JIS B6339 40T Shank and Pull Stud



V1031I-I1E-XA



V1031I-I1E-XA

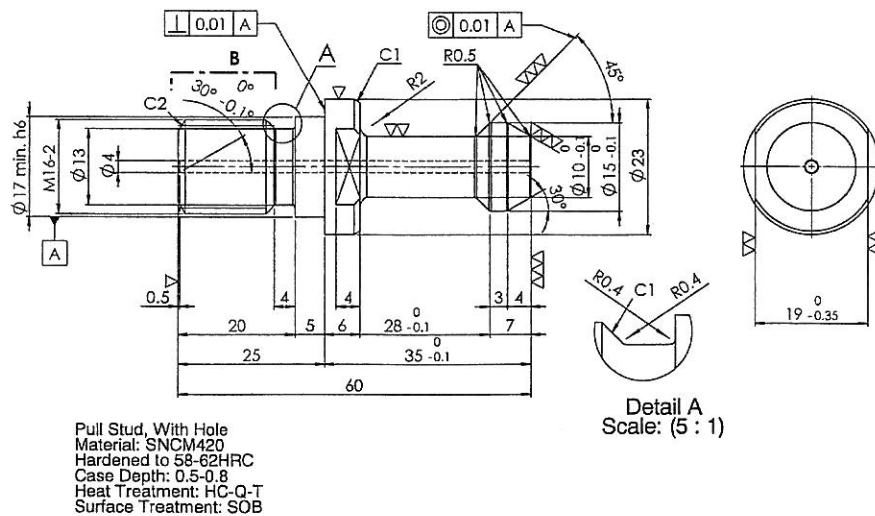
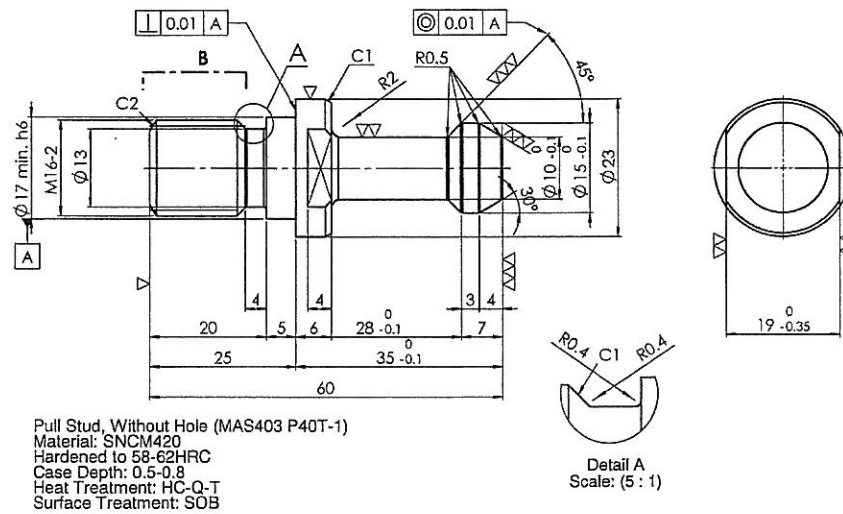
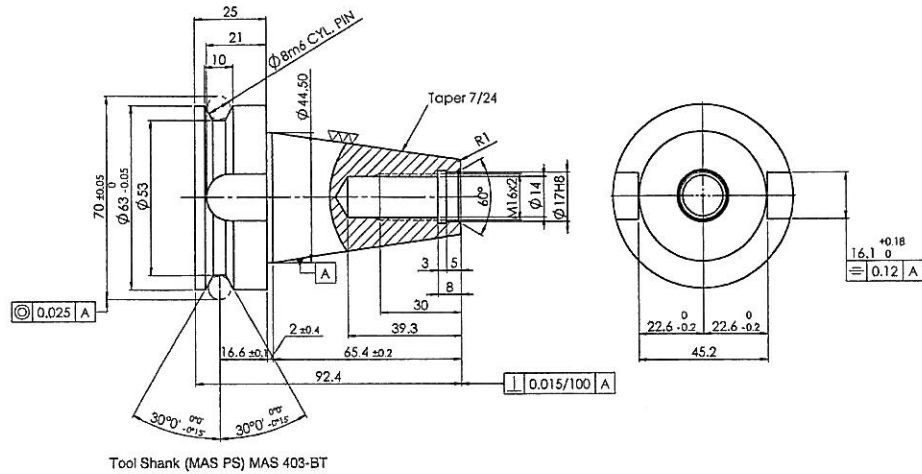
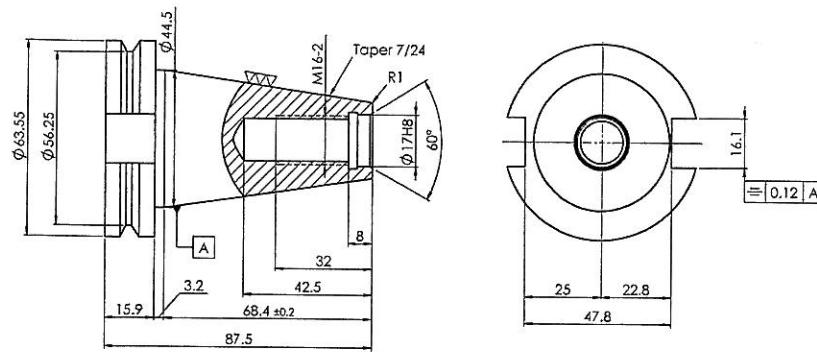


Figure 4.11.5: MAS 403 BT 40 Shank and Pull Stud



Tool Shank (#40) DIN 69871-A40

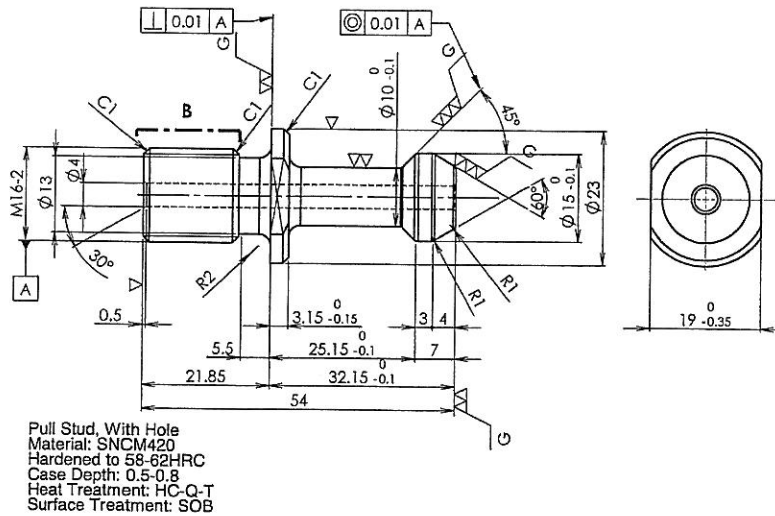
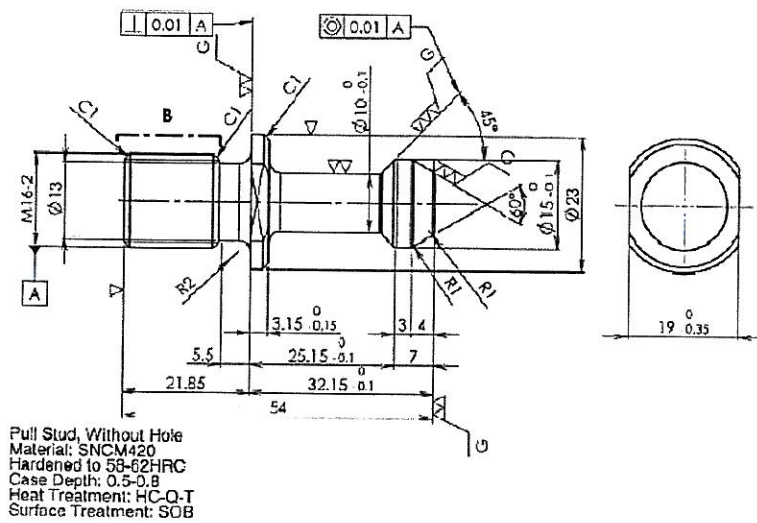
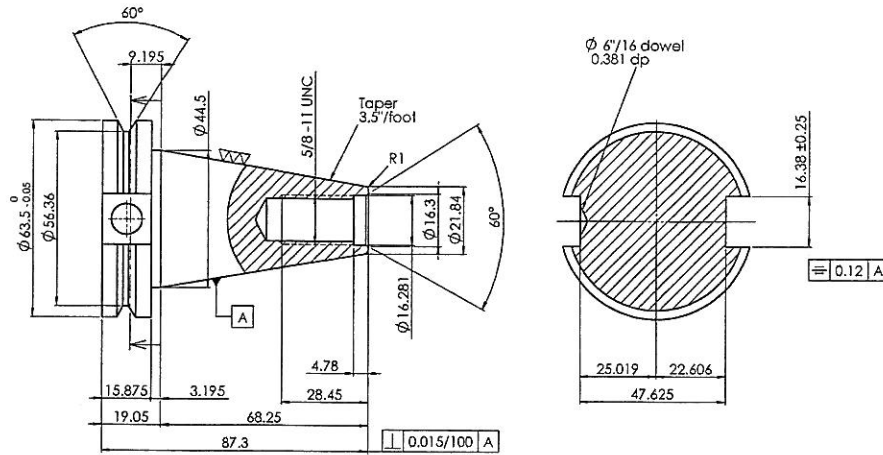
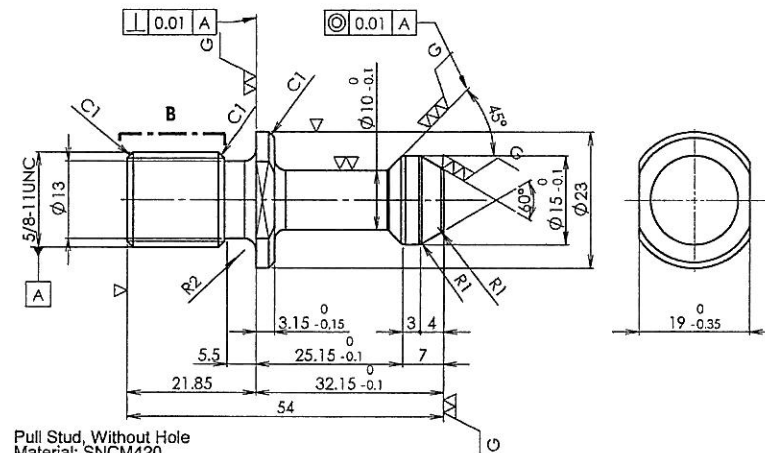


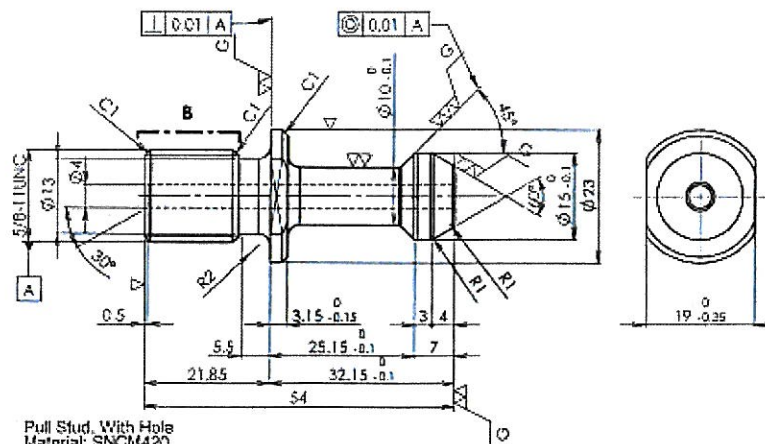
Figure 4.11.6: DIN 69871-A40 Shank and Pull Stud



Tool Shank (#40) V-CAT

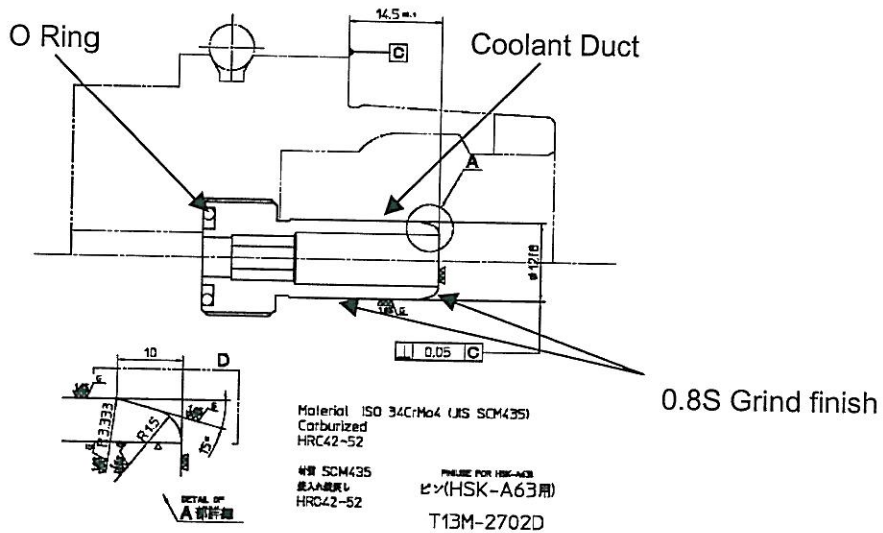
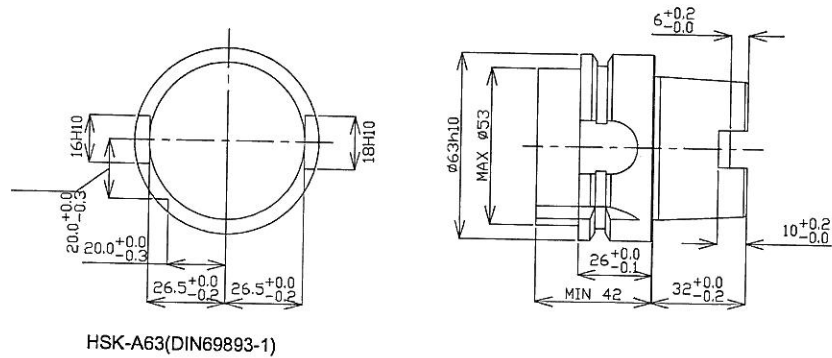


Pull Stud, Without Hole
Material: SNCM420
Hardened to 58-62HRC
Case Depth: 0.5-0.8
Heat Treatment: HC-Q-T
Surface Treatment: SOB



Pull Stud, With Hole
Material: SNCM420
Hardened to 58-62HRC
Case Depth: 0.5-0.8
Heat Treatment: HC-Q-T
Surface Treatment: SOB

Figure 4.11.7: V-CAT NO.40 Shank and Pull Stud



COOLANT DUCT FOR THROUGH-SPINDLE COOLANT/AIR

1. The coolant duct is required for through-spindle coolant/air.
2. 0.8s grind finish is critical to reliability of through-spindle coolant rod o-ring.

Figure 4.11.8: DIN 69893-1HSK A63

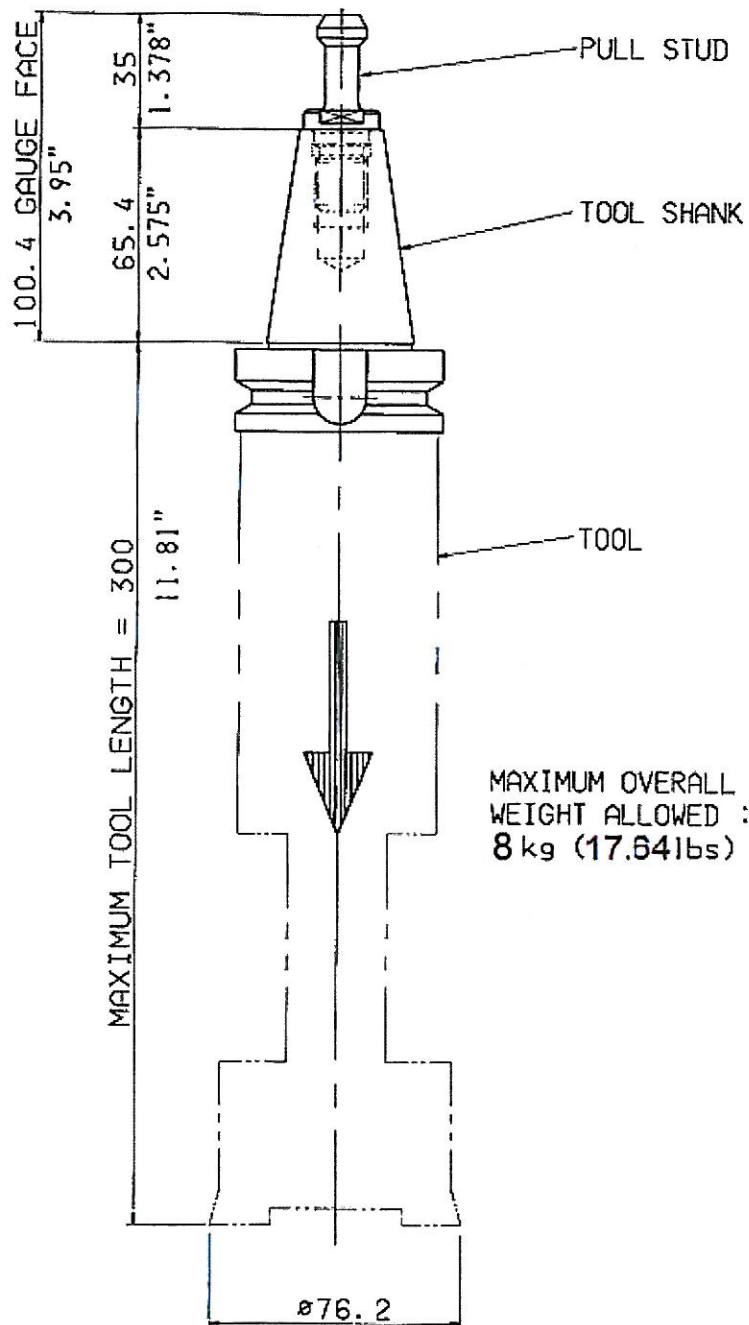


Figure 4.11.9: Tool Diameter, Weight and Length Specification

Tooling and fixtures typically require long lead times. These two issues should be addressed before the delivery of the machine tool.

Fixtures

Consider design and manufacturing time, and coordinate completion with the delivery of the machine for a smooth transition into your production schedule.

Tooling

The three most important factors to understand and consider when selecting tool holders and cutting tools for high-speed machining are balance, concentricity, and rigidity. All high-speed spindles have limitations. Know the spindle design and limitations. Ensuring that your applications stay below the spindle's allowable radial load and side thrust will, maximize machine utility, parts production, spindle life and machine parts. When selecting tooling:

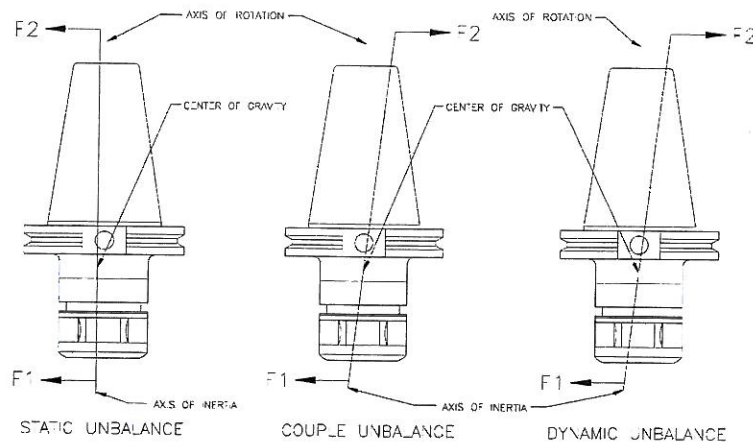
- Tool holders should be designed for the highest rpm available on the spindle. Never exceed the manufacturer's design ratings for the tool.
- Tool holders should be designed for high-speed machining. Look for good tool holding ability, balance, and concentricity.
- Never use Weldon or side lock holders at high rpm.
- Use the shortest possible tool. Select the shortest tool holder and cutting tool allowed by the part geometry. Short tools provide better tool life and surface finish while reducing radial load on the spindle.

Balance

Balancing ensures that an object's center of gravity spins equally around its rotational center and is essential to effective HSM. At speeds of 10,000 rpm and higher, the forces from unbalanced tooling become significant, causing machining and machine tool problems. An out of balance tool:

- Reduces metal cutting capacity, decreases tool life, and degrades surface finish.
- Vibrates, causing chatter and exaggerating eccentricity.
- Transfers excessive load to the spindle bearings, promoting premature wear or catastrophic failure.
- Can generate over 50% of the recommended spindle side thrust.

Out of balance conditions:





Balance the Entire Assembly

The cutting tool is not usually a problem in balancing. Its small mass and typical symmetric shape makes balance almost inherent. To ensure balance, use high quality cutting tools with flutes, pockets, etc. equidistant from center. Balance the entire tool assembly to avoid the possibility of “stacking” tolerances from individual components.

Balance Specification and Calculation

The balance specification establishes a range from which a “target balance” for a tool at a given speed (rpm) is calculated. Tooling is placed on a balancer to measure the out of balance amount or “unbalance” in grams millimeter (g·mm). Most balancers also indicate the area of unbalance.

Material is added or removed to meet the required balance specification. All tooling used on the S33 must meet a balancing specification of G2.5 or lower (the lower the specification the better the balance). If sending tools to a balancing service, have tools balanced to a G2.5 for the maximum spindle rpm, using the following formula.

Balance Formula

$$\text{g-mm} = \frac{M \times G \times 9.549}{\text{RPM}}$$

G: Balance Specification (G2.5)

9.549: Constant of Acceleration

RPM: Max. Safe Spindle Speed

M: Tool Weight in Grams

g-mm: Amount of Unbalance

To find the maximum safe rpm for a known unbalance amount, use the following formula.

Balance Formula

$$\frac{1}{\text{RPM}} = \frac{\text{g-mm}}{M \times G \times 9.549}$$

G: Balance Specification (G2.5)

9.549: Constant of Acceleration

RPM: Max. Safe Spindle Speed

M: Tool Weight in Grams

g-mm: Amount of Unbalance

Balanced Tooling

Tooling manufacturers can supply balanced or balanceable holders. These holders cost more, but the benefit in surface quality alone will offset the cost with reduced time on the finishing bench.

- Order tooling with a G2.5 or lower specification at the machine's maximum rpm.
- Ensure the holder operates safely and well at the required speed.
- Tooling can be sent to a service for balancing. Depending on the cost and delivery for balancing individual tools and the number of tools balanced per year, purchasing a tool balancer may be justified.
- Balancing machine operation is not difficult, but requires training and machinery to properly remove or add material to obtain balance.

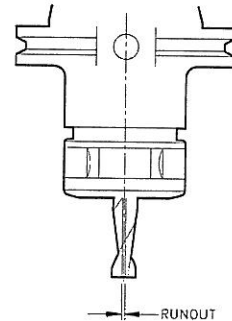
Concentricity

Concentricity is important in all machining applications, but it is imperative for effective HSM, especially using tools with more than one cutting edge. If the tool's cutting edges do not swing through the same arc, they are said to be "eccentric" or "run out". The outside edge of an eccentric tool wears more quickly, resulting in a wider "wear land" and shortening the edge's life. The wider "wear land" on one edge places unequal side pressure on the tool, adversely affecting balance, deflection, radial load, and surface finish. Sources of run out are extensions, bushings, and adapters.

- Do not use extensions at high spindle speeds.
- Use adapters and bushings only when absolutely necessary.

Other sources of run out are dirty tool shanks, unmatched tapers (holder to spindle taper), and a bell-mouth condition in the holder or spindle taper. To protect against run out:

- Do not use extensions and adapters.
- Keep tool holder and spindle tapers clean.
- Purchase high quality tooling.
- Inspect tooling on a comparator.

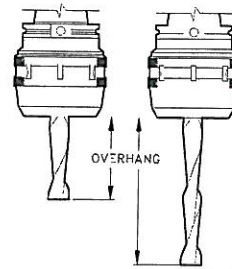


Rigidity

Tool rigidity significantly impacts performance and results of any machining operation. Using the shortest, most rigid tool possible helps ensure repeatability, precision, and reliability. The quality of any milling operation is impacted greatly by the length of the tool. An extended tool flexes, adversely affecting the final tolerance, finish, and tool life. A tool holder is essentially a cantilevered beam. Its deflection under load is proportional to the cube of its length.

($D \propto L^3$), this ratio should underscore the importance of minimizing overhang or length to diameter (L/D) ratio.

- Reducing tool length by 50% makes the tool 8 times stronger or more rigid.
- The greater the tool's rigidity, the greater is its dampening capacity, dynamic stiffness, and integrity.



4.12 Coolant Requirements

Use of a proper coolant is always necessary to achieve the required machining accuracy and maximum tool life. The coolant should also have better chemical properties such that the coolant and the chips do not clog the filter. Selection of the coolant, based on the type of the material to be machined should be decided in consultation with the coolant manufacturer and kept ready before the arrival of the machine.

The coolant capacity is 600L for the coolant tank or the chip conveyor supplied with the machine. Sufficient quantity of coolant is to be stocked considering the tank capacity. Ensure that the coolant preparation procedure suggested by the coolant supplier is clearly understood and adhered. Also all required instruments kept ready to check the properties of the coolant such as concentration and the pH value of the coolant.

Note: It is always better to select an environment friendly semi-synthetic water-soluble coolant.

4.13 Oil and Grease Requirements

Refer Table 4.13.1 for machine oil and grease requirements. The listed are the first use type in the machine before shipping. It is always recommended to continue to use the same type for better and trouble free machine performance.

Machine Unit	Quantity		Type	Vendor
Air lubricator	0.2 L	0.05 gal	Mobil DTE 24	Mobil oil
Hydraulic system * (APC M/C)	20 L	5.3 gal	Hyspin AWS 32	Castrol
Hydraulic system * (20K Tool CL/UCL)	6.5 L	1.7 gal	Hyspin AWS 32	Castrol
Spindle Oilmatic	55 L	14.5 gal	Velocite no 3	Mobil oil
Grease for Axis Linear Guide ways and	5cc/ Port	5cc/ Port	Alvania EP2	Shell
Grease for Ball Screws	5cc/ Port	5cc/ Port	MULTEMP LRL3	KYODO YUSHI
ATC Gear Box	4 L	1.1 gal	Mobil Gear EP 32	Mobil oil
4 th Axis Gear Box	0.65 L	0.17 gal	Daphne Super Gear oil 100	Idemitsu- APPOLO
4 th and 5 th Axis Gear Box	1.25 L	0.33 gal	Daphne Super Gear oil 100	Idemitsu- APPOLO
S33 (20K Spindle) Spindle Oilmatic	40 L	10.6 gal	Makino Spindle Lubricant	Makino

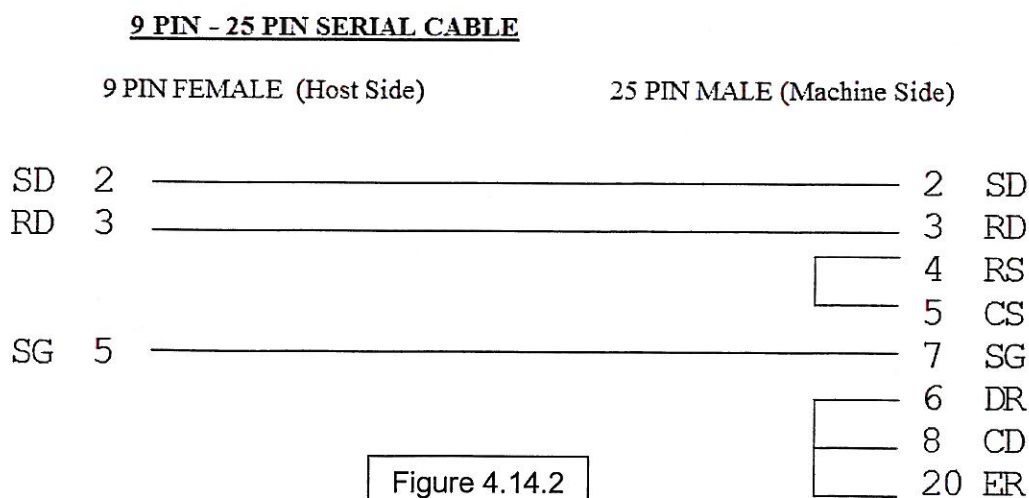
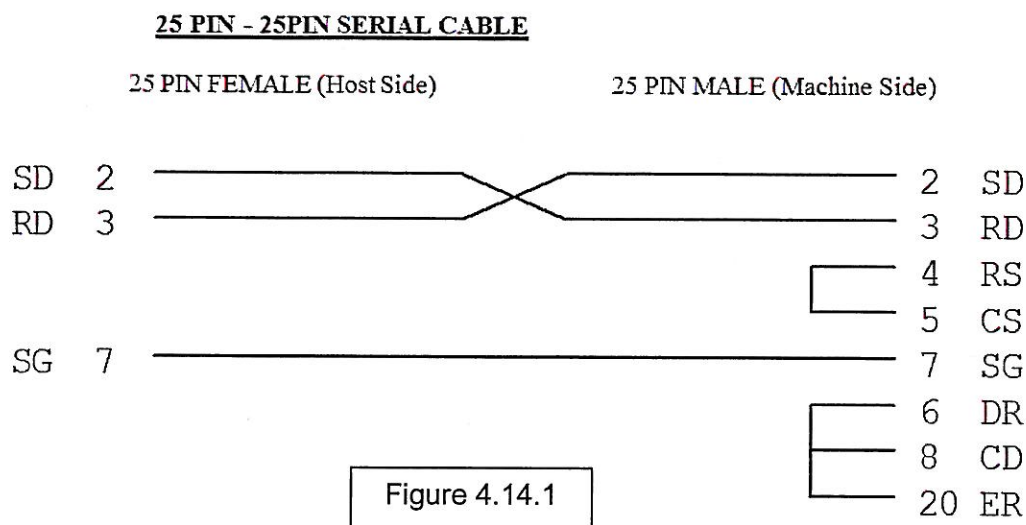
* Around VG 32 for cold regions and Around VG68 for Hot regions.

4.14 Machine and Data Server Communication

This section lists the different cables required for machine communication with a computer for standard RS232C communication and RJ45 cables for direct connection and through a network HUB for machines with optional data server.

Cables for RS232C Communication

Commercially available RS232C communication cable can be used, but we recommend that sealed and shielded type twisted cable be used to minimize the influence of noise, etc. Figure 4.14.1 shows the cable configuration for 25 pin connectors for both host and machine side. Figure 4.14.2 shows the cable configuration for 9 pin 25 pin connectors for host and machine side respectively.



Cables for Data Server Communication

The network interface used with the new data server is 10 Base-T. Shielded twisted pair cable is used for connections with this type of network. Normally, cable provided with the machine is used (straight connection type).

Shielded Twisted Pair Cable (STP)

Twisted pair cable is used to make the Ethernet connection between the data server board and the host computer. Commercially available twisted pair cable can be used, but we recommend that sealed and shielded type twisted cable be used between the data server and hub or computer to minimize the influence of noise, etc.

4.15 Cables for direct connection to a computer without a network HUB

The twisted pair cable is connected to the "CD38M" connector on the CNC unit. Figure 4.15.1 shows the cable configuration for connection to a computer.

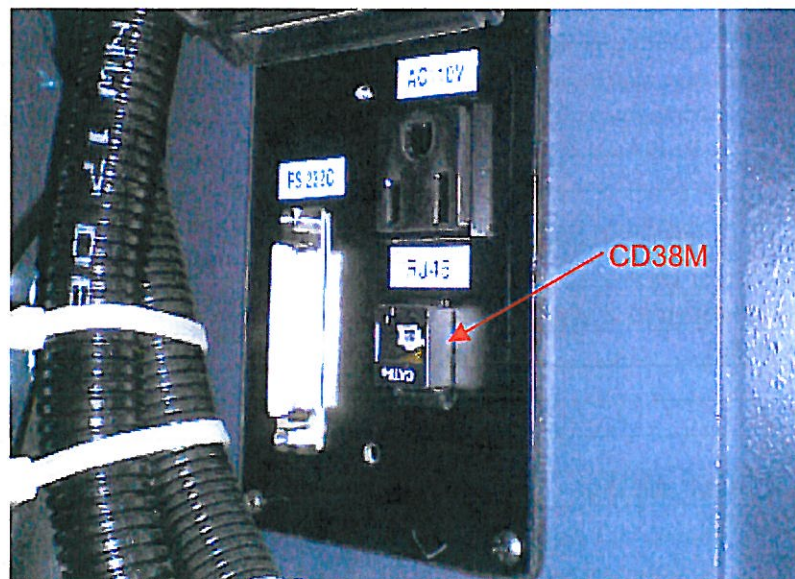


Figure 4.15.1

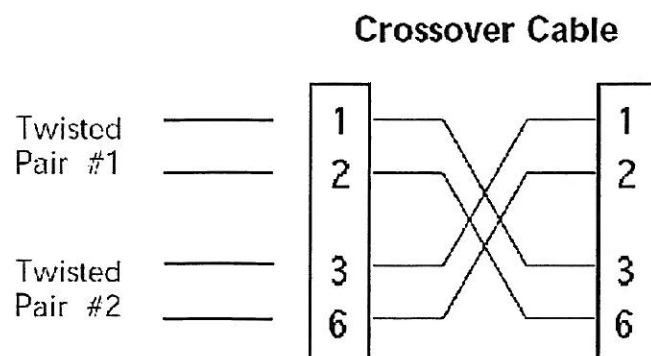


Figure 4.15.2

4.16 Installation Tooling Requirements (By FSE)

The Makino Field Service Engineer (FSE) is responsible for installing the machine and training the customer. The FSE installation process should be completed in the stipulated working schedule.

FSE should be flexible work around unexpected delays or problems and still complete the installation on time. Always reconfirmation reduces the chance of error or accident. FSE is required to carry the following tooling as part of the installation tool kit (see below table) so as to ensure proper installation and avoid unnecessary delays.

S/N	Tooling	Quantity
1	Allen key set (2.0mm to 18mm)	01
2	Spanner set (6mm to 41mm)	02
3	Box spanner set	01
4	Hand hacksaw with spare blades	01
5	Smooth files (flat round and half round)	01 each
6	Needle file set	01
7	Cutting pliers	01
8	Wire cutter	01
9	Nose pliers	01
10	Wire stripper	01
11	Crimping tool	01
12	Soldering gun with lead and flux	01
13	Star screw driver (min 2 sizes)	02
14	Flat screw driver (min 2 sizes)	02
15	Screwdriver set	01
16	Tester	01
17	Ratchet set	01
18	Steel scale	01
19	Hand torch small and big	01 each
20	Magnifying lens	01
21	Tweezers	01
22	Brass / copper rod and flat	01
23	Measuring tape (10 m)	01
24	Adjustable spanner (screw spanner)	02
25	Center punch	01
26	Chisel	01
27	GI or steel pipes 1/4", 1/2", 3/4" (different lengths)	01 each
28	Tap wrench	01
29	Hand taps 5mm, 6mm, 8mm	01 each
30	Drill bits 4mm, 5.1mm, 6.8mm	01 each
31	Drill gun	01
32	Small steel hammer	01
33	Nylon or rubber mallet	01
34	Extension socket head keys (5mm, 6mm, 8mm)	01 each
35	Multi meter with probes	01
36	Clamp meter	01
37	Cable ties (different sizes)	100
38	Permanent marker pens 2-3 colours	01 each

39	Insulation tapes (red, yellow, blue and black)	02 each
40	Teflon tape roll	04
41	Thread lock (locktite 242)	100ml
42	Silicon sealant (200gm tube or gun type)	02
43	Spirit level (02mm/m)	02
44	Dial indicator lever type (0.002mm LC)	01
45	Dial stand	01
46	Dial stand extension rod with mounting plate & screw	01
47	HSK test bar	01
48	Standard test square 800x800x100mm thick	01
49	Feeler gauge set	01
50	Slip gauge set	01
51	ATC setting tool	01
52	Orientation setting tool	01
53	Oil stone (rough smooth, and very fine)	01 each
54	Fine emery paper	02
55	Torque wrenches	01 each
56	Hand gloves	2 to 3 pairs
57	Cleaning Brushes small	02
58	Knife	01
59	Grease gun	01
60	Multi temp LRL 3 / Isoflex NBU15 grease	500gm
61	Fanuc parameter manual 16i series	01
62	Fanuc maintenance manual	01
63	Makino Pro5 parameter list	01
64	Makino Pro5 operation manual	01
65	Machine installation manual	01
66	Machine maintenance manual	01
67	Machine operation manual	01
68	Required service and installation reports	01

4.17 Pre-installation Checklist

The pre-installation checklist (on the following pages) is a request for the customer installation services. To help ensure a smooth installation this checklist allows Makino and your representative to know the status of your preparations and provide additional support where needed.

It is necessary for you to complete or address the items on the checklist before arrival of the field service engineer for the installation of the machine. In special cases and with approval in advance, completion of all checklist items is not mandatory based on the machine configuration supplied; however, it is essential that Makino be informed of the status of your preparations before sending the FSE to your facility.

Checklist Questions

For questions or problems with any of the requirements on the pre-installation checklist or to inform us of your current status or a delay:

- Contact your distributor or Makino sales/service representative.
- Contact Makino Customer Support. Please provide your contact details to simplify service.

Checklist Instructions

The first page of the checklist serves as the cover sheet. This information is required for us to serve you in a better way. The customer contact is the individual from your side whom our FSE should contact at your facility. This person:

- Should be authorized to sign all installation or service reports.
- Should be available to arrange or coordinate any required assistance.
- Will become the first customer contact of record in Makino's customer service database (space is provided for additional contacts).

Completed Checklist Distribution

When the checklist is complete:

- Retain the original for your records.
- Mail or fax a copy to Makino Sales Representative.
- Mail or fax a copy to Makino Customer Support.

PRE-INSTALLATION CHECKLIST		Page 1/3
Machine Model:	Serial:	Control Type: PRO 5
Customer:		Contact Person:
Please indicate the completion of the following items with a "Y" in the space provided. If there is a question or problem with any item listed below, it should be addressed immediately by contacting your distributor, sales representative, or Makino, before a field service engineer is scheduled to supervise installation of the machine.		
<input type="checkbox"/>	Packing list checked. Check that all parts, manuals, keys, tool kit, schematics, etc., have been received (in addition to immediately contacting Makino, note any discrepancies on a separate sheet and include with this document. Take pictures of any shipping damage).	
<input type="checkbox"/>	Machine condition checked. The condition of the machine proper and all system components has been inspected for damage or other unacceptable conditions (in addition to immediately contacting Makino, note any discrepancies on a separate sheet, send to the shipper, and include with this document).	
<input type="checkbox"/>	The machine location is properly selected as per Makino requirements (refer chapter 4.2).	
<input type="checkbox"/>	The foundation where the machine is to be located is as per Makino requirements (refer chapter 4.3).	
<input type="checkbox"/>	The floor is clean and marked as per the layout (refer chapter 4.4).	
<input type="checkbox"/>	Power cables of sufficient length for connecting to the machine mains are available (refer chapter 4.5). WARNING! DO NOT supply power to the machine at this time (the FSE will verify proper wiring before power up).	
<input type="checkbox"/>	If the transformer is not ordered with the machine, a transformer with required specifications is ready for installation (refer chapter 4.6).	

PRE-INSTALLATION CHECKLIST		Page 2/3
Machine Model:	Serial:	Control Type: PRO 5
Customer:		Contact Person:
<input type="checkbox"/>	Proper earth ground is prepared and connected to the ground bus bar of the main isolator supply and another cable be routed via any convenient path with sufficient length to connect to the machine's ground buss inside the MTC (Machine Tool Cabinet) (refer chapter 4.7).	
<input type="checkbox"/>	Air supply to the machine is available. Permanent air lines with proper end fittings should be run to the machine vicinity (refer chapter 4.4 and 4.8).	
<input type="checkbox"/>	Over head crane, forklifts, mobile crane etc., are arranged for moving and installation of the machine and machine accessories (refer chapter 4.9).	
<input type="checkbox"/>	Professional riggers are available for the entire period of installation.	
<input type="checkbox"/>	Service facilities are ready for installation (refer chapter 4.10).	
<input type="checkbox"/>	Proper tools are arranged (confirm that tool holders, tooling, chucks, etc., are as per the proper specification for the machine supplied) (refer chapter 4.11).	
<input type="checkbox"/>	Sufficient coolant (cutting fluid) is available (refer chapter 4.12).	

PRE-INSTALLATION CHECKLIST		Page 3/3
Machine Model:	Serial:	Control Type: PRO 5
Customer:		Contact Person:
<input type="checkbox"/>	Maintenance personnel selected and scheduled to assist the FSE with the installation (this is an excellent opportunity for getting the concerned trained on the machine).	
<input type="checkbox"/>	A part has been selected, and a part program is available.	
<input type="checkbox"/>	Proper fixture and the required cutting tools are available.	
<input type="checkbox"/>	Operators and maintenance personnel selected for training.	

5. Machine Delivery

5.1 Introduction

The installation process gets started when the pre-installation review and preparations completed as in chapter 4. The next phase begins with the arrival of the S-Series machine and the completion of the customer responsibilities described in this chapter.

This chapter describes how to receive, inspect, unload, and move to site, locate, clean, and prepare for installing the new machining center. Performance of these duties:

- Ensures the smoothest and shortest installation time.
- Provides maximum training time for operator and maintenance personnel.

The Installation process



Makino's installation process includes Pre-Installation duties to be performed by Customer. These duties are described in this chapter 3 and chapter 4.

Makino customers must perform these duties to provide the maximum amount of time for proper machine set-up and training. Joint proactive participation and assistance are critical to ensuring an effective installation.

5.2 Container Layout

This section outlines the brief machine layout when packed inside a container for shipping. The figures 5.2.1 shows the out line container layout.

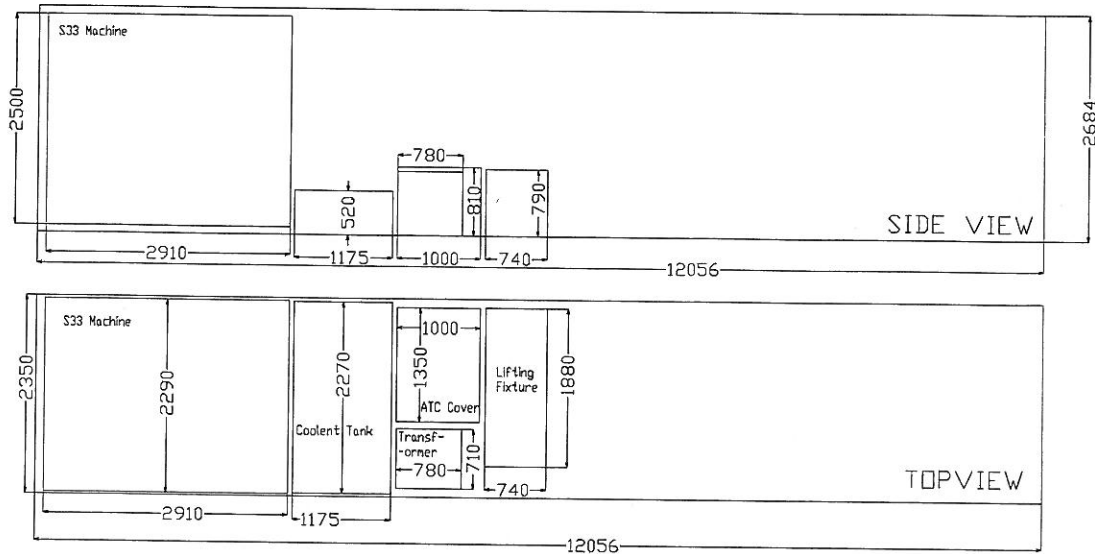


Figure 5.2.1: One Machine per Container

5.3 Inspect the Machine

Safe shipment of the machine is dependent of the shipper. Before dispatch of the machine maximum care is taken to avoid damage during transport, all necessary packing is done to ensure safe handling of the machine. Upon delivery of the machine by the shipper please ensure the following to minimize the potential effects of shipping:

- Inspect the machine and all packages and containers for damage.
- Check each item against the shipper and packing list for shortages (a copy of the packing list will be available in advance at the commercial department).
- Acknowledge the shipper for the correct receipt of the items. With a note mentioning, "Received subject to hidden and concealed damage".
- Inspect all items, soon after delivery.
- Inspect each item in every box, crate, and carton. And confirm the quantity as per the packing list.

If damage or shortage is discovered after releasing the driver, contract the carrier immediately:

- File a claim with the carrier or Insurance Company immediately.
- Leave damaged material exactly as found and take photographs of the damage.
- Inform Makino, Makino distributor and Makino Customer support immediately with company details, contact persons, machine type, and machine serial number. If possible make a brief report with photos of the type of the damage.
- Send a copy of the photographs to Makino.

Proper Information by the customer regarding any shipment damage or shortages before arrival of the FSE is very important. This helps in faster arrangement of the damaged items and avoids delayed installation



Please ensure maximum care while unpacking the boxes. For a simple reason of improper unpacking the items inside should not get damaged.

5.4 Unloading Lifting and Moving

This section describes the safe instructions for unloading, lifting and moving the S-Series machine. Please follow the procedures for safe location of the machine and its accessories after the machine reaches the factory for installation. The figures in sub chapters of 5.4 shows lifting details of the main machine and its accessories.

5.4.1 Lifting the Machine

Confirm there is no physical damage seen on the packing of the Machine. If any damage observed please inform Makino/Insurance agent. Safely unpack the unit and move near to the required location. Carefully lift the unit, follow the hints for lifting and moving:

- The machine is rested flat on a shipping frame and is bolted to it.
- The weight of the machine is about 7.5 tons for standard machine and 8.5 tons for machine with APC.
- Use the overhead crane for lifting the machine.
- The machine can also be moved to its location using fork lifts, when a fork lift is used make sure that the machine shipping skid is not removed and the machine is lifted with the shipping base.
- Lift the complete machine by using wire rope of sufficient length and strength. Use the machine lifting fixtures supplied with the machine.
- Make sure enough that the ropes are correctly and properly used as shown in the machine lifting diagrams Figure 5.4.1a and Figure 5.4.1b.
- Lower the crane hook and lift the machine lifting tackle from the top lifting hole.
- Make sure that all the wire ropes are fixed properly and the D-shackles fixing the rope to the lifting tackle are properly assembled.
- Move the crane so that the lifting tackle is above the machine center, and slightly lower it so that the other end of the ropes can be fixed to the bottom jigs as shown in Figure 5.4.1a and Figure 5.4.1b.
- Slowly start moving the crane upwards and stop when the ropes are loaded, make sure that the ropes are in proper position in the grove, and the position of the crane hook is at the center.
- Ensure all the shipping locks are not disturbed (do not remove the shipping locks of the unit until placing the machine in its final location).
- Lift the machine only to the minimum required height for safe movement.
- Remove the shipping skid bolted to the machine base and move it aside.
- Do not roll the machine or give vibration or impact – the critical assembled parts of the unit could get damaged.

- Do not climb up on the unit or put objects on the unit.
- Make sure that machine does not get damaged during moving.
- Only qualified riggers should perform machine-lifting operations.
- Follow all safety rules.

Refer Figure 5.4.1a for lifting standard machine S33 and S56 and Figure 5.4.1b for lifting machine S33 APC.

Fixture Lifting Point,
Height ~3630mm (min from floor)

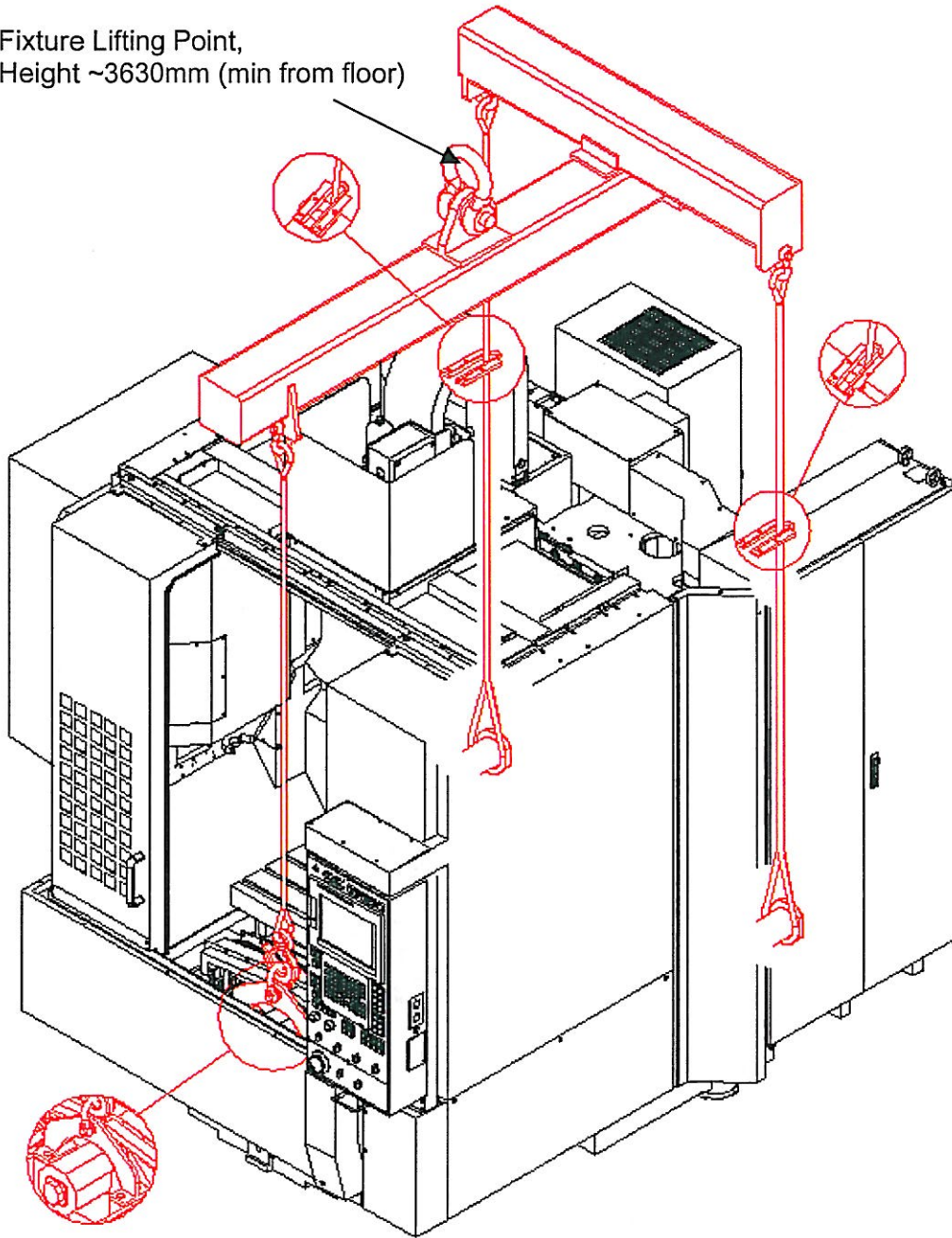


Fig 5.4.1a: S33/S56 Machine Lifting

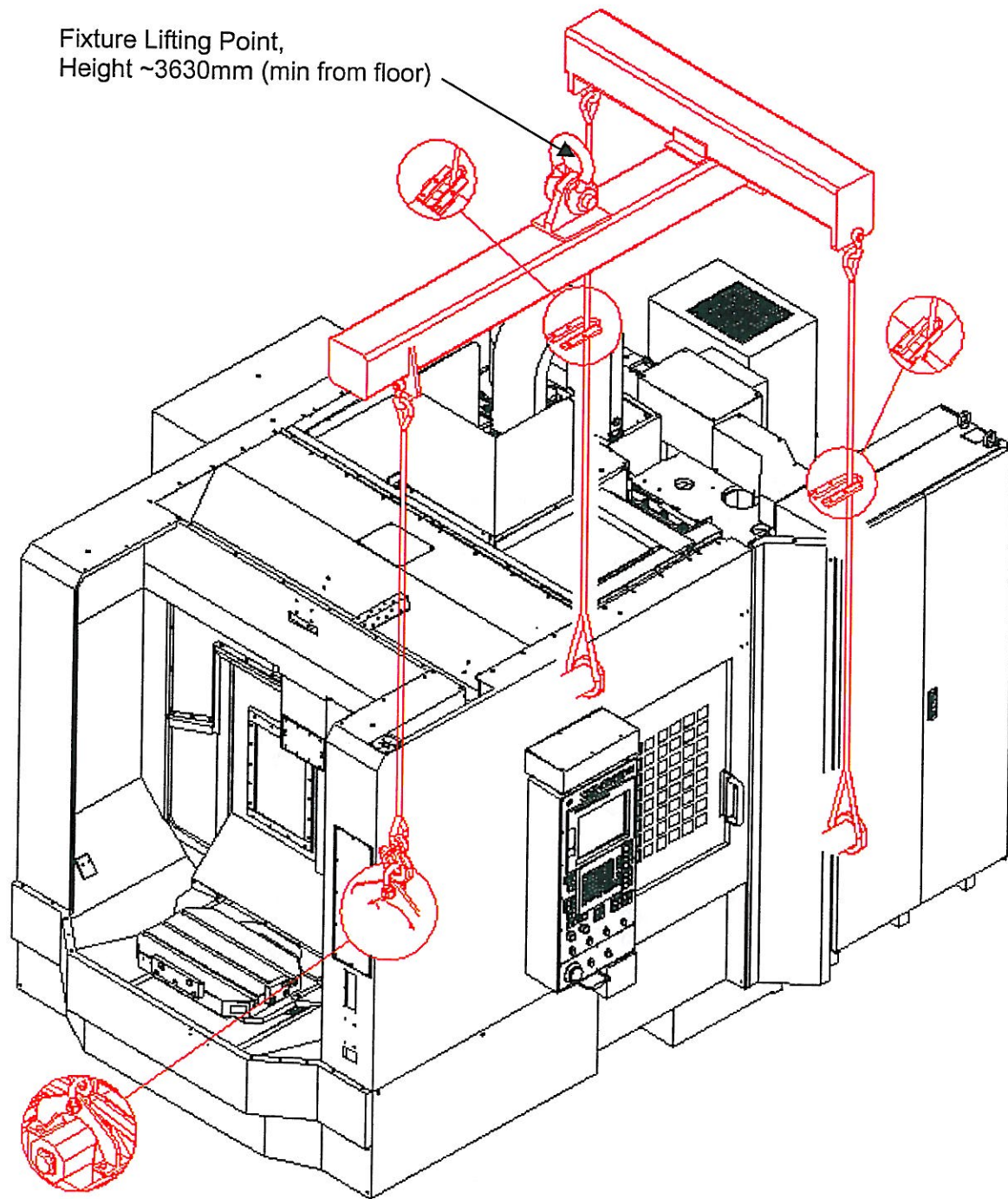


Fig 5.4.1b: S33 APC Machine Lifting

5.4.2 Lifting the Chip conveyor

Confirm there is no physical damage to the chip conveyor or the units mounted on it. If any damage observed please inform Makino/Insurance agent. Safely unpack the unit and move near to the required location. Carefully lift the unit, follow the hints for lifting and moving:

- The weight of the chip conveyor is about 150kg.
- Use the overhead crane/fork lift or a stacker for lifting the chip conveyor.
- If an overhead crane is used, lift the complete chip conveyor by using wire ropes of sufficient strength and lengths. Fix the ropes on the four corner of the chip conveyor as shown in Figure 5.4.2.
- Make sure that the ropes do not damage the units mounted on the chip conveyor when lifted.
- Lift the chip conveyor only to the minimum required height for safe movement. The chip conveyor also had castor wheels, after unloading from the container the conveyor can be rolled to the location.
- Make sure that the bunch of cables from the chip conveyor is not damaged during moving.
- Only qualified riggers should perform machine-lifting operations.
- Follow all safety rules.

Refer Figure 5.4.2 for lifting details.

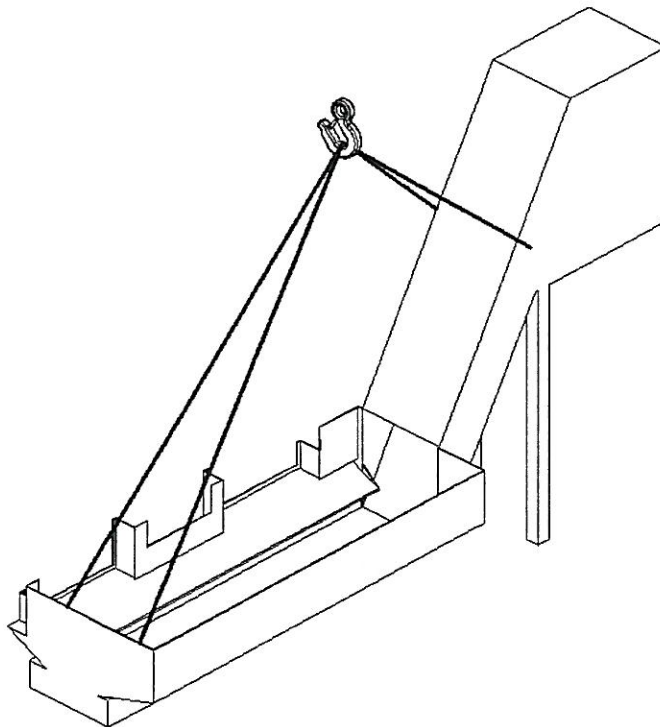


Figure 5.4.2: Lifting the Chip Conveyor

5.4.3 Lifting the Coolant Tank

Confirm there is no physical damage to the coolant tank or the units mounted on it. If any damage observed please inform Makino/Insurance agent. Safely unpack the unit and move near to the required location. Carefully lift the unit, follow the hints for lifting and moving:

- The weight of the coolant tank is about 300kg.
- Use the overhead crane/fork lift or a stacker for lifting the coolant tank.
- If an overhead crane is used, lift the complete coolant tank by using wire ropes of sufficient length and strength. Fix the ropes on the four corner of the coolant tank as shown in the Figure 5.4.3.
- Make sure that the ropes do not damage the units mounted on the coolant tank when lifted.
- Lift the coolant tank only to the minimum required height for safe movement. The coolant tank also had castor wheels, after unloading from the container the tank can be rolled to the location.
- Make sure that the bunch of cables from the coolant tank is not damaged during moving.
- Only qualified riggers should perform machine-lifting operations.
- Follow all safety rules.

Refer Figure 5.4.3 for lifting details.

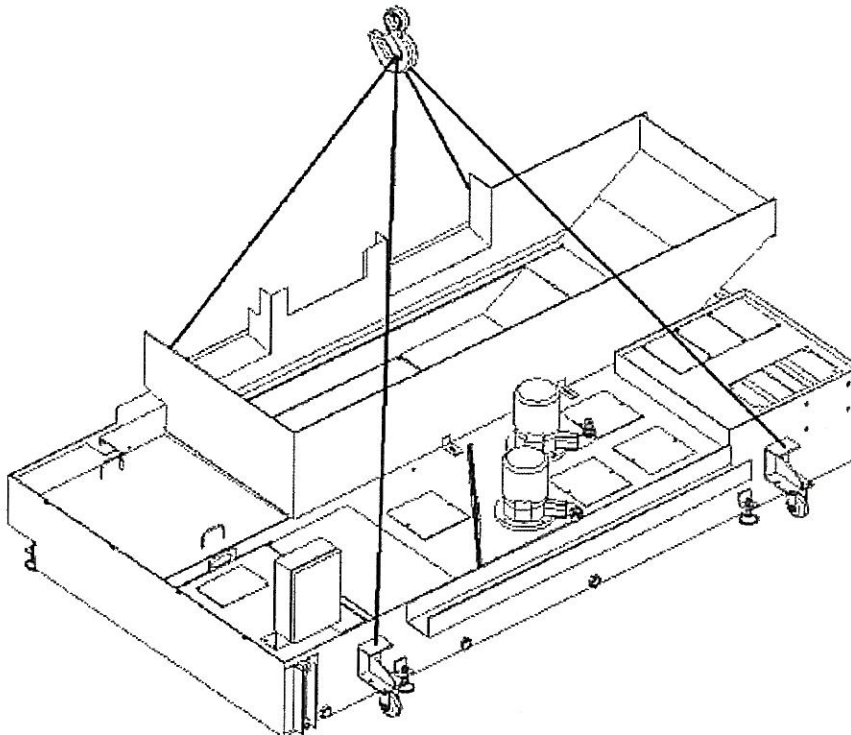


Figure 5.4.3: Lifting the Coolant Tank

5.4.4 Lifting the Transformer

Confirm there is no physical damage seen on the packing of the transformer unit. If any damage observed please inform Makino/Insurance agent. Safely unpack the unit and move near to the required location. Carefully lift the unit, follow the hints for lifting and moving:

- The weight of the transformer is about 200 kg.
- Use the overhead crane/fork lift or a stacker for lifting the transformer.
- If an overhead crane is used, lift the complete transformer unit by using wire ropes of sufficient length and strength.
- Make sure enough that the included angle between the ropes at the point of the main lifting hook is not more than 50° to 60°.
- Lift the transformer only to the minimum required height for safe movement.
- Do not roll the transformer or give vibration or impact – the electrical hardware assembled inside could get damaged.
- Do not climb up on the unit or put objects on the unit.
- Make sure that the bunch of cables from the transformer is not damaged during moving.
- Only qualified riggers should perform machine-lifting operations.
- Follow all safety rules.

Refer Figure 5.4.3 for lifting details.

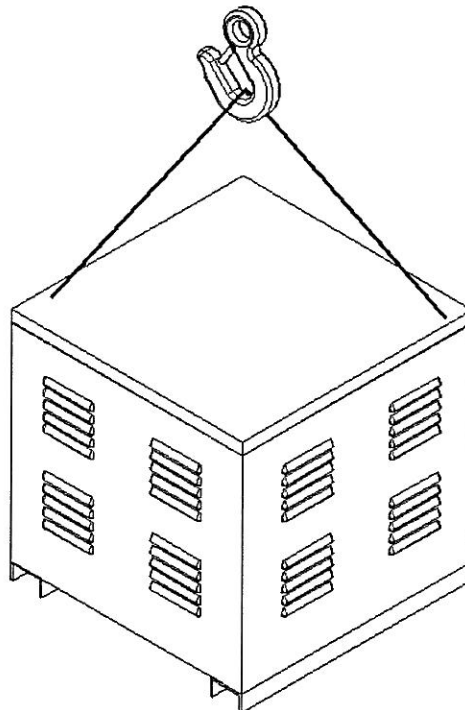


Figure 5.4.4: Lifting the Transformer

5.4.5 Lifting the Pallets

Confirm there is no physical damage seen on the packing of the pallet unit. If any damage observed please inform Makino/Insurance agent. Safely unpack the unit and move near to the required location. Carefully lift the unit, follow the hints for lifting and moving:

- There are two pallets for S33 APC machine.
- The weight of the each pallet is about 115kg.
- Use the overhead crane for lifting the pallet unit
- Lift the complete pallet unit by using wire rope of sufficient length and strength, 2 eyebolts bolts are fixed with T-slot nut onto the pallet as shown Fig 5.4.4.
- Make sure enough that the included angle between the ropes at the point of the main lifting hook is not more than 50° to 60°.
- Lift the pallet only to the minimum required height for safe movement.
- Do not roll the pallet or give vibration or impact – the bottom clamping cones and the assembled parts of the unit could get damaged.
- Do not climb up on the unit or put objects on the unit.
- Make sure that the top and bottom surface do not get damaged during moving the unit.
- Only qualified riggers should perform machine-lifting operations.
- Follow all safety rules.

Refer Figure 5.4.4 for lifting details.

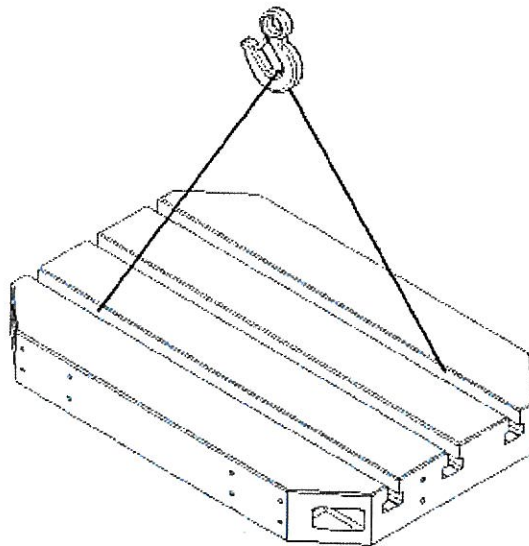


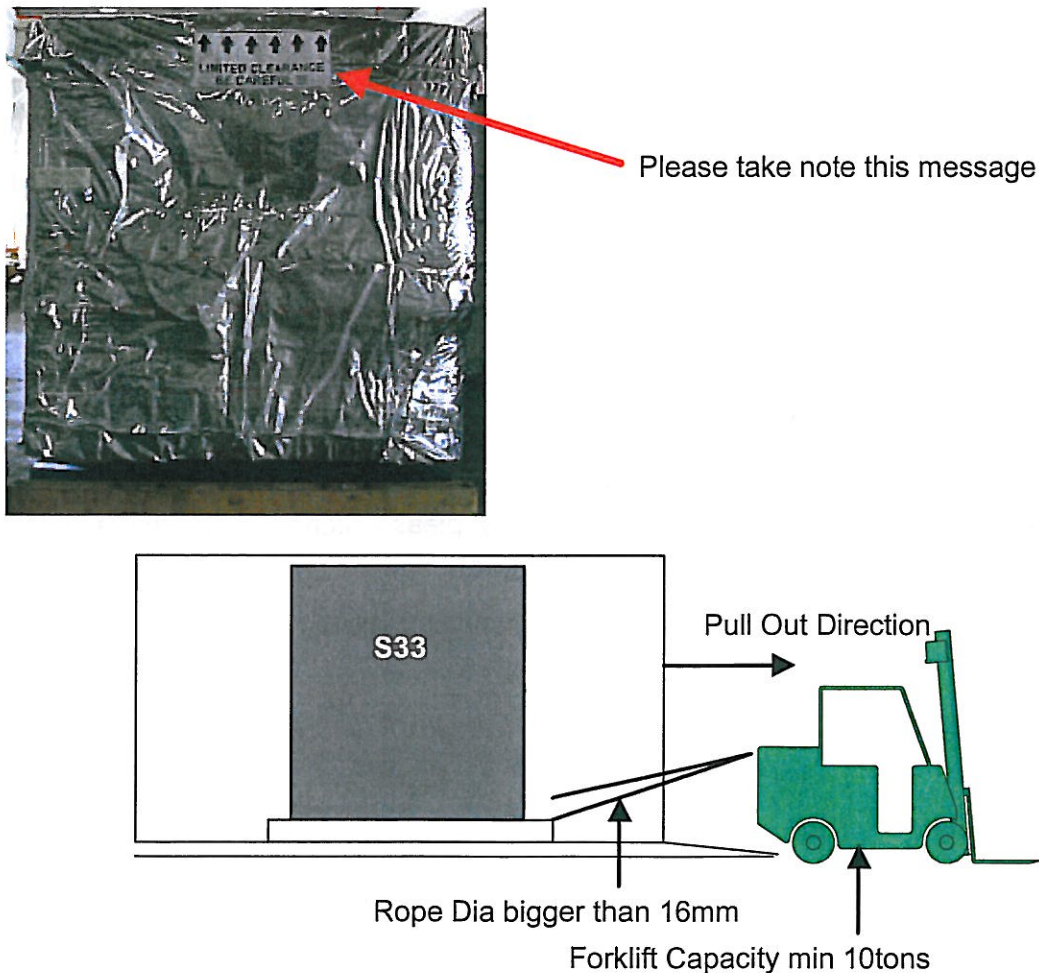
Figure 5.4.4: Lifting the Pallet

5.4.6 Machine Rolling

The S-Series machine when shipped in a container has to be rolled out of the container along with the shipping base. First remove all the wooden strips in front of the machine-shipping base used for locking it to the container so as to prevent from moving during transportation. Use a forklift or a crow bar to slightly lift the machine and insert machine-moving rollers below the shipping base. Do not lift the machine too much as the machine can hit the top of the container and get damaged.

Fix wire ropes to the shipping base and tie to the arm of the forklift as shown in the figure and slowly drag the machine out of the container, make sure that the machine is rolled out straight without damaging the machine.

The machine can also be rolled without a shipping base, use four roller sets below the base at the machine rest pad points. Use toe type hydraulic jacks to life the machine and place it on the rollers. Make sure to lock the rollers so as to avoid unnecessary movement while placing other rollers. Figure 5.4.5 machine unloading.



5.5 Initial Cleaning

As a standard practice maximum caution is taken so that the machine parts do not get rusted during the course of transportation.

Anti rust agents like the rust preventive oil, rust preventive grease etc are applied at all the required areas of the machine, like telescopic covers, pallets, clamping cones, spindle taper, splash guards the coolant tank/chip conveyor etc.

To prevent moisture accumulation on the machine, moisture absorbing chemical (silica gel) packets are placed in various places on the machine and some times tied to machine parts like the handle etc.

Please remove all these packets and throw it into the dustbin. Confirm that there are no packets in the moving areas of the machine. Also during transportation sometimes dust sticks on to the rust preventive oil. Cleaning of this rust preventive can be done using a mild cleaning solvent with tissue.

Cleaning of the machine guards and the coolant tank is very important, as the oil on these surfaces get mixed with the coolant and spoil the coolant and filter blocking may occur. More care is to be exercised during cleaning of spindle taper, ball screws, and linear guide ways, as these are high accuracy parts of the machine.

The outer surface of the machine should be cleaned thoroughly free from stains, such that the outer appearance of the machine is bright and neat. Be cautious while cleaning higher areas of the machine.

The transparent covers of the machine are covered with papers to prevent scratches during assembly neatly peel off these papers.

5.6 Machine Packing list

Please refer to the machine-packing list attached to the machine invoice for the details of the machine-packing list. In case of any discrepancy, please inform the shipping agent, the insurance and also your Makino Contact immediately.

Should you require additional information please contact Makino.