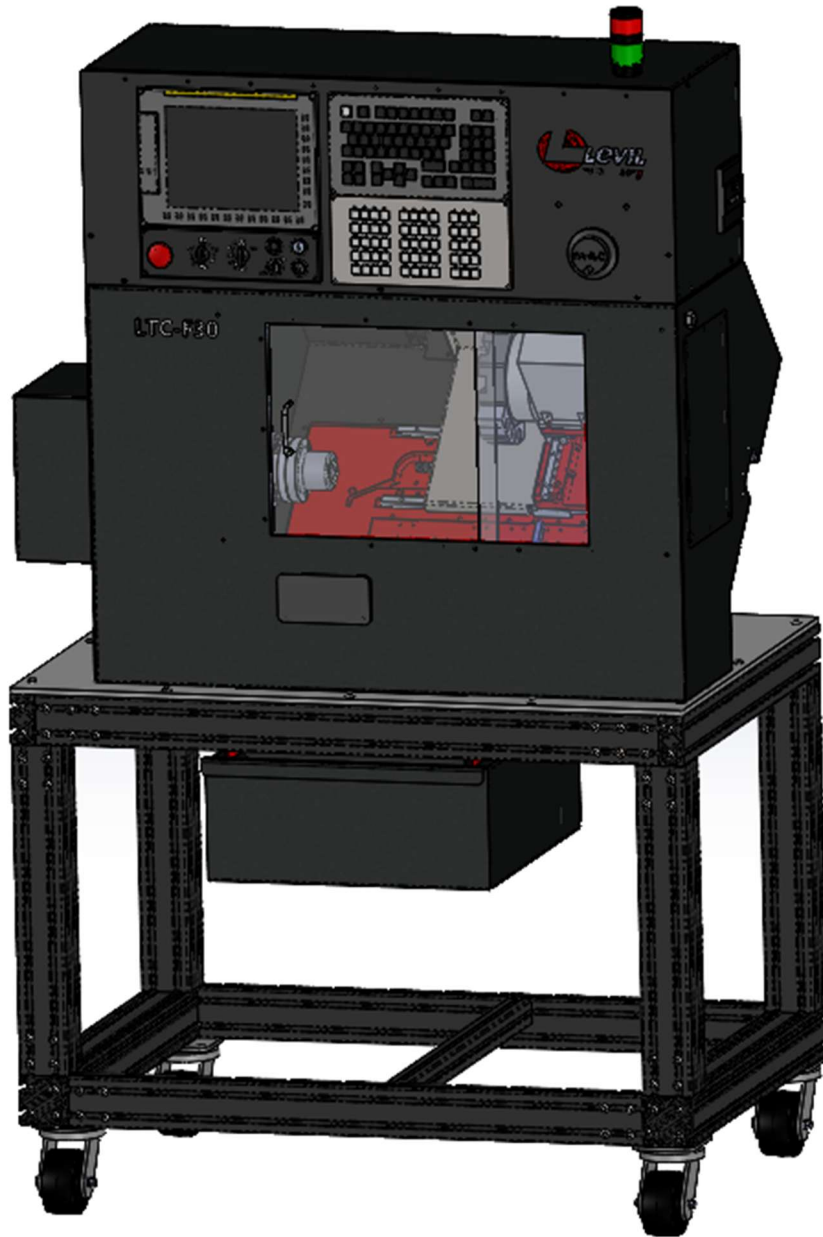




LTC-30

User Manual

This manual is the property of Levil Technology Corp.

No part of this manual or its accompanying documents may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the express written permission of Levil Technology Corp.

No part of this manual or its accompanying documents may be altered, nor may the Levil Technology Corp name be removed from the document.

Levil Technology Corp. reserves the right to alter any specifications and documentation without prior notice.

Contact Information

Address:

1704 Kennedy Point
Ste 1124
Oviedo, FL 32765

E-mail:

cncsupport@levil.com

Website:

www.leviltechnology.com

Telephone:

(407) 542-1252

Technical Support Hours:

Mon - Fri 10:00am – 5:00pm EST

Version Information

Version 3.0

Notes:

Table of Contents

1	Safety Information.....	7
1.1	General Safety Precautions.....	7
1.2	Caution Labels on the Machine	9
1.3	PPE Requirements.....	11
1.4	Emergency Procedure	12
1.4.1	Emergency Stop Button Locations	12
2	Introduction.....	13
2.1	Introduction to the LTC-30.....	13
2.2	Machine Limitations.....	14
2.3	Operator Qualifications	15
3	Technical Specifications	16
3.1	Dimensional Drawings	16
3.2	Utility Requirements	17
3.3	Power Specifications	18
3.4	System Specifications	19
3.5	Coolant	20
4	Machine Overview	21
4.1	Labeled Components	21
4.2	Key Components and Functions.....	24
4.3	Axis Movement	25
5	System Installation and Setup.....	26
5.1	Operating Environment	26
5.1.1	General Preparation and Selecting Location	26
5.1.2	Foundation and Layout.....	26
5.1.3	Working Space Required	27
5.2	Installation procedure	28
5.3	Checkups during the Test Run	30
5.4	Relocation of the Machine	31
6	System Controls & Interface.....	32

6.1	Overview of the Operator Interface	32
6.2	Overview of Machine Operator Panel Functions.....	33
6.3	G-Codes and M-codes	40
6.4	Keep Relays	45
7	Operation Instructions	46
7.1	Machine Start Up Procedure.....	46
7.2	Loading Files into the CNC using a USB Drive	47
7.3	Outputting Programs from the CNC into the USB Drive.....	49
7.4	Deleting Programs from the CNC Memory	50
7.5	Automatic Operation.....	51
7.6	Spindle Operation.....	54
7.7	Setting the Work-piece Coordinate System	57
7.8	Tool Change Operations	59
7.8.1	Safety Precautions	59
7.8.2	Required Tools.....	60
7.8.3	Tool Change Operations	60
7.8.4	Final Checks	61
7.9	Setting Tool Length Offsets	62
7.10	Coolant System Operation	63
7.11	Automatic Door Operation.....	64
7.12	Tailstock Operation	66
7.13	Automatic Chuck Operation	67
7.14	Pats Catcher Operation.....	68
7.15	Machine Shut Down Procedure	69
7.16	Emergency Stop & Reset Procedure.....	70
7.16.1	E-Stop Activation	70
7.16.2	E-Stop Reset	71
8	Maintenance.....	72
8.1	Maintenance Schedule.....	72
8.2	Cleaning Instructions.....	73
8.2.1	Treatment of Waste	73

8.3	Lubrication Guide.....	74
8.3.1	Ball Screw Lubrication Procedure.....	74
8.3.2	Linear Guide Way Lubrication Procedure	74
8.4	Part Replacement Schedule	75
8.5	Calibration Procedures.....	77
8.5.1	Servo Adjustment	77
8.5.2	Aligning the spindle head and the tool turret	78
9	Troubleshooting.....	79
9.1	Basic Errors	79
9.2	Mechanical Issues	81
9.2.1	Safety Precautions	81
9.2.2	Checking for Backlash	82
9.2.3	Checking for a Stuck or Binding Axis.....	83
9.2.4	Spindle Motor Not Operating	84
9.2.5	Summary Table.....	85
9.3	APC warning and “DS0300 APC alarm: Need Ref Return”	86
9.4	MTB Alarms and Messages	88
10	Spare Parts & Accessories	90
10.1	Spare Parts.....	90
10.1.1	Overview	90
10.1.2	Mechanical Components	91
10.1.3	Lubrication and Fluid System	92
10.1.4	Tooling and Consumables.....	93
10.1.5	Control System Components	94
10.2	Accessories	95
10.2.1	Standard Accessories.....	95
10.2.2	Optional Accessories	95

1 Safety Information

1.1 General Safety Precautions

The following precautions should always be taken when operating the system.

1. Operators should not touch any high-voltage terminals such as those found in control panels, transformers, motors, or junction boxes. Severe electric shock will be sustained otherwise. Electric shock may also result from touching a switch with wet hands.
2. The emergency stop button's location should be well known so that it can be pressed as soon as possible in case of a critical situation.
3. Power off the machine before switching a fuse.
4. Do not operate this machine during violent thunderstorms. Lightning can cause equipment failure
5. Do not work with long hair that can be caught in the machine, keep it out of the way with a net or by tying it at the back.
6. Provide enough working space around the machine to avoid falls.
7. Since water and oil can make the floor slippery, all floors should be kept clean and dry.
8. Never touch a switch accidentally. If operating a switch, make sure it is the right one.
9. Do not handle coolant with bare hands since it may cause some irritation.
10. Do not remove or tamper with safety devices such as stop dogs, limit switched, or interlocks to increase the range of axis travel.
11. Keep a fire extinguisher at hand in case of fire or explosion due to cutting flammable materials. Please ask your material provider for safety guidelines when cutting volatile materials.
12. Hold work-pieces securely with a clamp.
13. To remove a workpiece from the machine, stop the spindle and provide plenty of space from the work-piece to the tool.
14. Do not operate the machine with the safety front door open.

15. Stop the machine before installing or removing a tool.
16. Never wear loose or baggy clothing when operating the machine.
17. Never operate the machine under the influence of alcohol or any other drug.
18. The operator should wear safety glasses to avoid flying debris or coolant from contacting his/her eyes.
19. Keep the machine clean. Do not let too many chips accumulate in the work area.
20. Before leaving the machine at the end of the day, press the emergency button, turn off the power button, and the main switch on the back of the machine.

1.2 Caution Labels on the Machine

Caution labels provide the operator with safety-related information that must be strictly observed. These labels are found in key areas of the machine, visible without the need to remove any covers.

Sticker	Description
 A warning sticker with a black and white icon of two hands being pinched by a vertical bar with a downward arrow. The text reads: WARNING Pinch point. Keep hands clear during operation.	WARNING: Pinch Point. Keep hands clear during operation.
 A warning sticker with a black and white icon of a hand near a rotating cutter. The text reads: WARNING Rotating Cutter. Keep hands clear. Disconnect power before servicing.	WARNING: Rotating cutter. Keep hands clear. Lockout/tag-out before servicing.
 A warning sticker with a black and white icon of a hand near two interlocking gears. The text reads: WARNING Moving parts can crush and cut. Keep hands clear. Do not operate with guard removed.	WARNING: Moving parts can crush and cut. Keep hands clear. Do not operate with guard removed.
 A warning sticker with a black and white icon of a person wearing safety glasses with arrows indicating flying objects. The text reads: WARNING Flying objects. Wear approved eye protection when operating this equipment.	WARNING: Flying objects. Wear approved eye protection when operating this equipment.

	WARNING: Electrical Hazard. 220 VAC running through the system.
	WARNING: Arc flash and shock hazard.

Table 1. Safety Label Images and Instructions

1.3 PPE Requirements

The use of Personal Protective Equipment (PPE) is mandatory when operating, setting up, or maintaining the machine. PPE ensures the operator can work safely in the presence of rotating tools, moving parts, sharp materials, and other workplace hazards.

The following PPE must be worn when working with the machine:

PPE	Description
Safety Glasses/Goggles	Protect eyes from flying chips, coolant spray, and other debris generated during machining.
Hearing Protection	Recommended protection against potential hearing damage caused by prolonged exposure to high noise levels.
Steel-Toed Safety Shoes/Boots	Required when handling raw materials, loading/unloading parts, or performing maintenance, to protect feet from falling objects or heavy components

Table 2. PPE Recommendations and Requirements

1.4 Emergency Procedure

In the event of an emergency, the operator must act quickly and follow the procedures below to ensure personal safety and minimize damage to the machine.

1. During common emergency situations such as workpiece/tool collision, coolant leak, or smoke, be sure to activate the E-Stop and avoid troubleshooting until the machine comes to a complete stop.
2. Move away from moving components and avoid contact with the machine until it has come to a complete stop.
3. Ensure all guards, interlocks, and safety devices are functioning before resuming operation.

1.4.1 Emergency Stop Button Locations

Pressing the Emergency Stop (E-Stop) Button will immediately cut power to the machine's motion and spindle. Operators must be trained on the location and proper use of the emergency stop button before operating the machine.

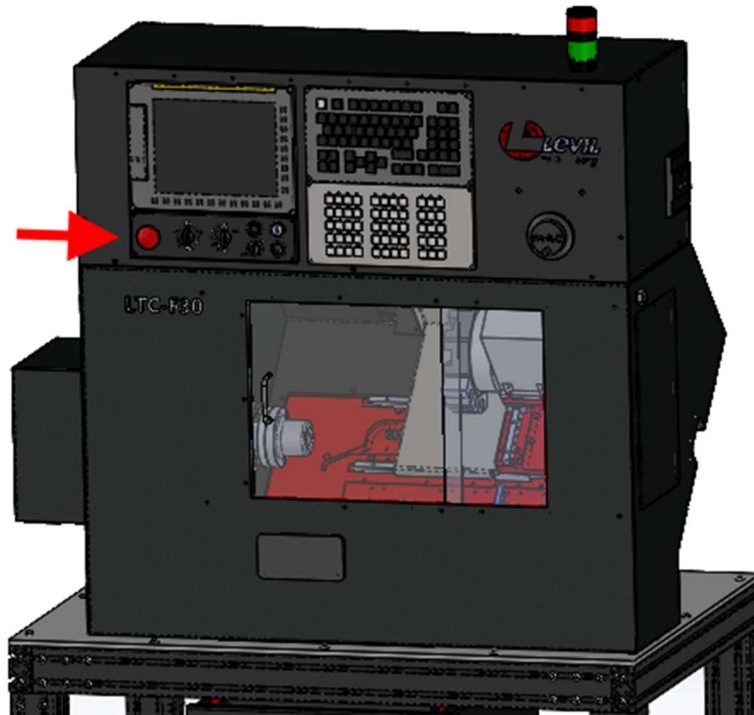


Figure 1. Emergency Stop Button Location on the LTC-30

2 Introduction

2.1 Introduction to the LTC-30

The LTC-30 is a compact, high-precision machining center designed for the manufacture of small-scale parts and for use in workforce development and technical training programs. Combining advanced multi-axis capability with an accessible design, this machine provides an ideal platform for both production applications and hands-on learning.

Equipped with full simultaneous 5-axis motion, the system allows users to produce complex geometries with superior accuracy and surface finish, reducing setup time and increasing manufacturing flexibility. Its small footprint and user-friendly control interface make it suitable for educational institutions, training centers, research labs, and small production environments.

In addition to supporting prototype development and precision component manufacturing, the machine serves as a valuable tool for training the next generation of CNC operators, machinists, and engineers, enabling them to gain practical experience in modern digital manufacturing and multi-axis machining techniques.

2.2 Machine Limitations

This CNC machine is designed for precision machining within defined operational boundaries. Using the machine outside of these limitations may cause equipment damage, reduce machining accuracy, or create safety hazards. Operators must always remain within the following general limitations.

Limitations	Description
Material Limitations	Intended for cutting standard machinable materials such as metals, plastics, and composites. Not suitable for extremely hard, brittle, or abrasive materials unless approved by the manufacturer. Never attempt to machine explosive, flammable, or toxic materials.
Workpiece Size and Weight	The machine should only be used with workpieces that can be properly clamped or fixtured within the available travel range. Do not exceed the load-bearing capacity of the worktable, spindle, or fixtures.
Cutting Tool Usage	Use only cutting tools designed for CNC machining and rated for the required spindle speed and material. Oversized or incompatible tools may compromise accuracy and create unsafe conditions.
Operating Conditions	Operate the machine within normal shop conditions (stable temperature, low humidity, clean and dry environment). Do not run the machine if electrical power, compressed air, or coolant systems fall outside recommended supply ranges.
Safety Restrictions	This machine is not intended for unattended operation unless proper monitoring systems are in place. Do not override or disable safety devices, guards, or emergency stop functions. <u>The machine must only be operated by trained personnel who understand its limitations and hazards.</u>

Table 4. Machine Limitations

CAUTION!

Failure to comply with these limitations may result in reduced performance, machine damage, loss of warranty coverage, or personal injury.

Define working characteristics such as type of machining, size of parts, mate

2.3 Operator Qualifications

This manual specifies the proper maintenance and operation of the CNC machine. It benefits both experienced and beginner CNC machine operators and should be read thoroughly by all users.

All guidelines included in this manual should be studied and understood to ensure the safety of the operator and to prevent any substantial damage to the machine.

3 Technical Specifications

3.1 Dimensional Drawings

The following drawing shows the overall dimensions of the system.

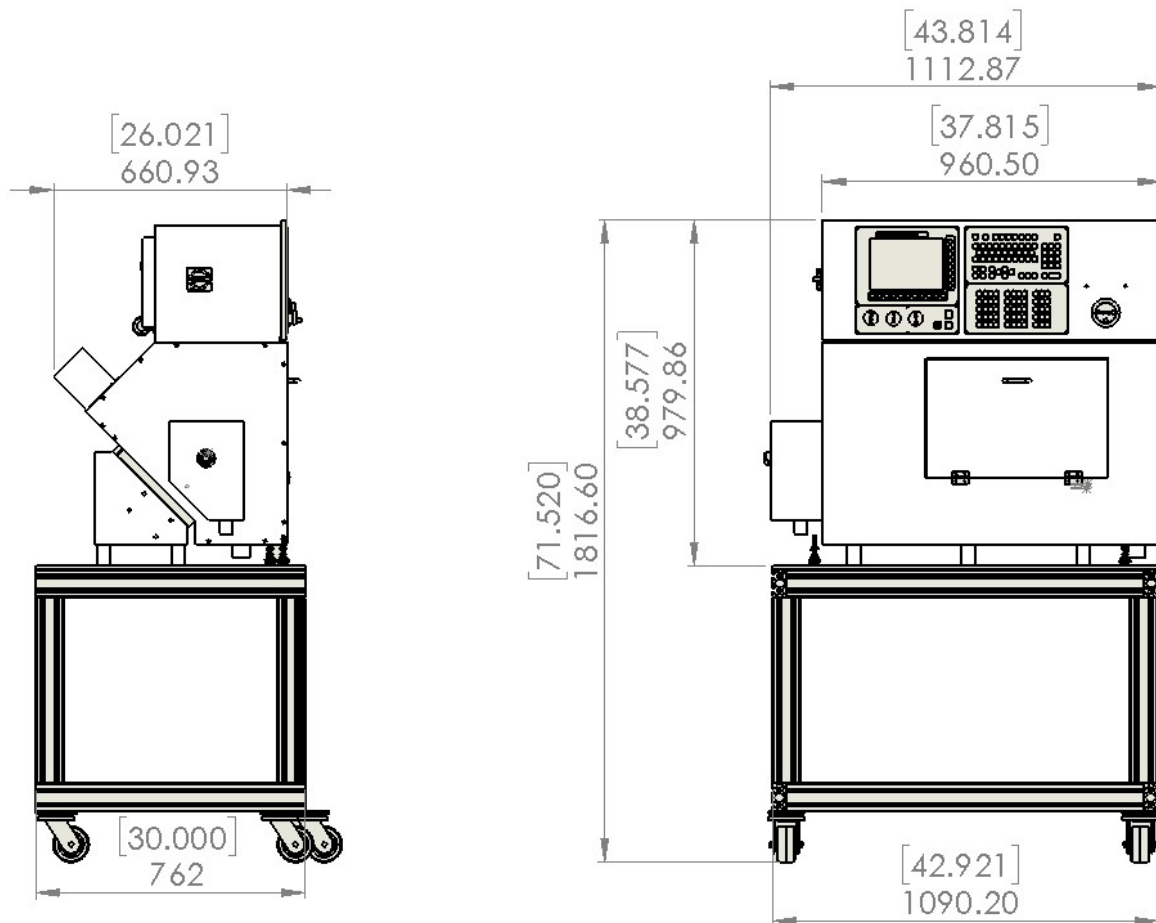


Figure 2. LTC-30 Dimensions Side and Front View, in mm

3.2 Utility Requirements

Below is a table describing the utilities power requirements to operate the machine to its full extent.

Utilities	
Air Consumption	87 L/min (3 cfm)
Power	208-240 VAC, 20A, 1ph

Table 5. Utilities

3.3 Power Specifications

The LMH-F300-5X must be connected to a stable and properly rated power supply to ensure safe and reliable operation. Incorrect electrical connections or unstable power can result in malfunction, damage to sensitive components, or serious safety hazards.

Item	Description
Voltages	1-phase, 220 VAC
Frequency	50/60 Hz $\pm$ 1 Hz
Voltage Tolerance	$\pm$ 10% or below
Power gross load capacity	4.4 kVA
Primary power cable	4 mm ² (12 AWG)
Grounding cable	4 mm ² (12 AWG)

Table 6. Power Specifications

3.4 System Specifications

Description	CNC Turning Certification Cart
Capacity	
Swing over bed	203 mm (8")
Max recommended cutting diameter	50.8 mm (2")
Max bar diameter	19 mm (3/4")
Travel	
X Axis	177 mm (6.97")
Z Axis	225 mm (8.85")
Resolution	0.001mm (0.00004")
Repeatability	0.005mm (0.0002")
Accuracy	0.01mm (0.0004")
Spindle (LS-32)	
Spindle Chuck	4" dia, self-centering 3 jaws
Spindle Speed	100 - 3,200 rpm
Drive Method	Direct Drive
Spindle Motor Power	1.5HP
Max Spindle Torque	8 Nm
Alternative Spindle Options	None
Feed	
Rapid Feed (X & Z)	15 m/min (590 ipm)
Cutting Feed (X & Z)	3 m/min (118 ipm)
BTP-50 Turret	
Number of Tools	8
Tool Change Method	Turret rotation
External Tool Shank	12.7 mm (1/2")
Internal Tool Shank diameter	19.01 mm (3/4")
Machine Weight	
Basic Setup	368.2 kg (810 lbs)
Utilities	
Air Consumption	87 L/min (3 cfm)
Power	220V, 20A

Table 7. System Specifications

3.5 Coolant

1. Use water-soluble coolant. If oil-based coolant is used, the coolant temperature will rise, causing thermal distortion of the machine. Oil-based coolants are also flammable, so more care must be taken to avoid fires.
2. Make sure that the coolant used has no adverse effects on the human body. Since water-based coolants often cause poisoning, pay sufficient attention to the hygiene of the operator.
3. Make sure that the coolant does not cause curing or expansion of rubber or plastic products, or chemical products.
4. Make sure to maintain the water-soluble coolant at the right concentration for best results, otherwise the solution can become stale and must be exchanged.
5. Always follow the user guidelines posted by the coolant manufacturer and do not alter or add substances that are not approved by the coolant manufacturer.

4 Machine Overview

4.1 Labeled Components

#	Component	#	Component cont.
1	Control Enclosure	12	X axis Servo Cover
2	OP-Panel	13	Coolant Power Connection
3	Manual Pulse Generator	14	Main Power Cable
4	Machine Enclosure	15	Granite Base
5	Door	16	Ethernet Port
6	Coolant Return Hose Connection	17	Compressed Air Connection
7	Machine Legs	18	ABS Battery Backup
8	Emergency Stop Panel	19	Z axis Servo
9	CNC Screen	20	X axis Servo
10	MDI Panel	21	Main Power Switch
11	Spindle Electronics Access Panel		

Table 8. Machine Components of LTC-30

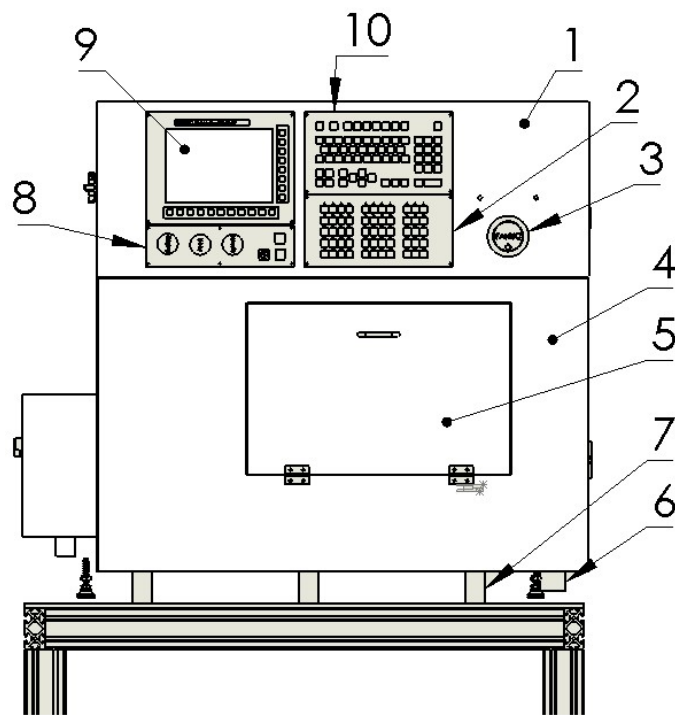


Figure 3. LTC-30 Numbered Components Front View

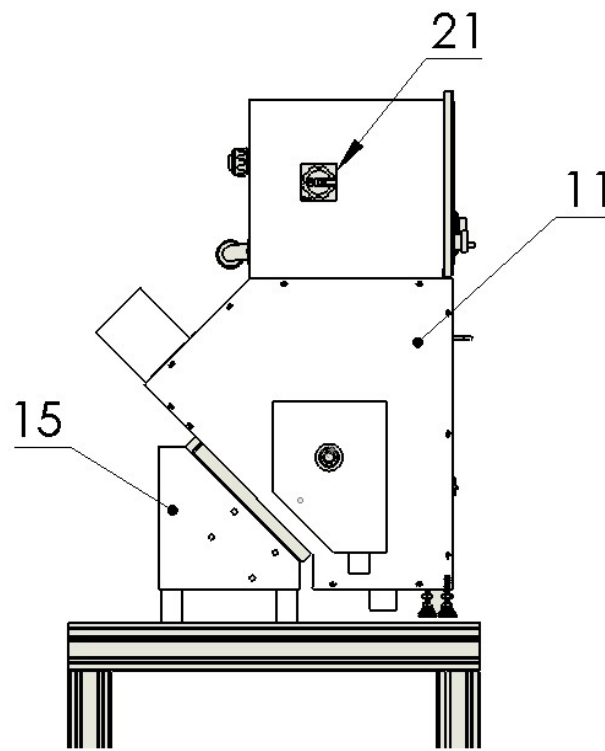


Figure 4. LTC-30 Numbered Components Left Side View

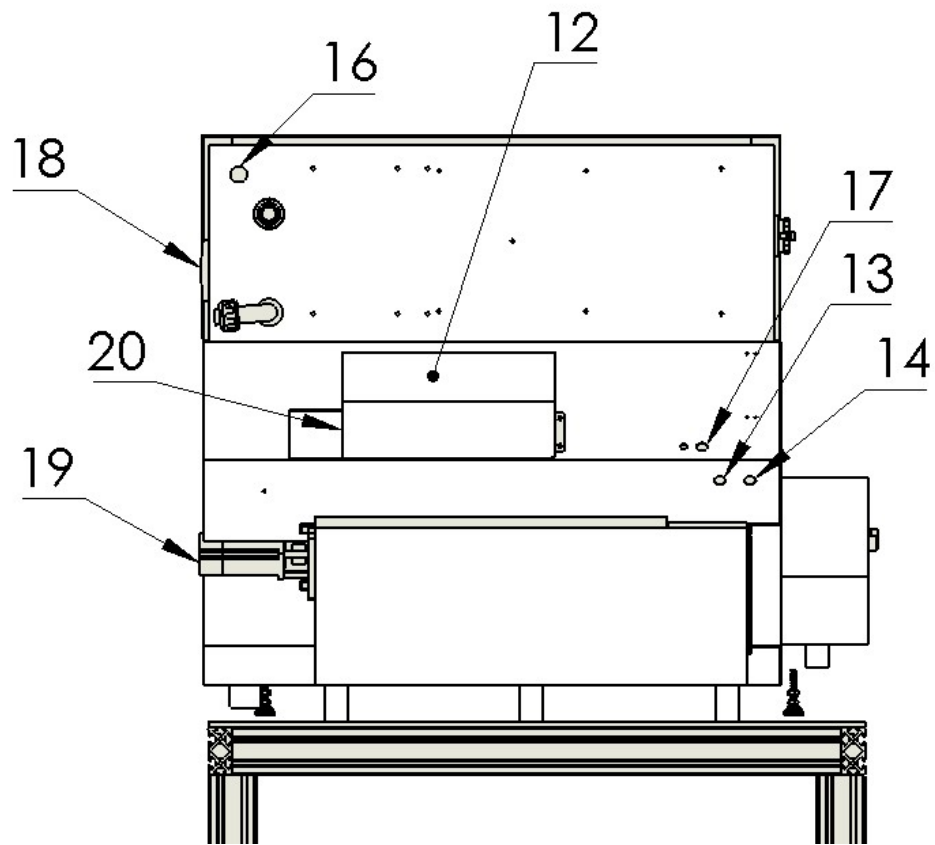


Figure 5. LTC-30 Numbered Components Back View

4.2 Key Components and Functions

The LTC-30 is composed of several main components that work together to perform precision machining. Understanding the role of each part helps ensure safe operation, proper maintenance, and efficient use.

Component	Function
Control Panel	The "brain" of the machine where operators input programs, adjust parameters, and monitor machining. Includes emergency stop, cycle start/stop, and manual control functions.
Manual Pulse Generator	Utilized for jogging in controlled increments along the axes by 0.001 mm, 0.01 mm, or 0.1 mm, depending on the setting.
Spindle	Rotates the cutting tool at variable speeds.
Axis Drive Systems	Motor-driven systems that move the tool or workpiece along programmed paths. Equipped with ball screws, linear guides, and feedback systems for accuracy.
Electrical Cabinet	Houses the power supply, drives, and electronic systems.

Table 9. Key Components and their Functions

4.3 Axis Movement

The machine operates using multiple linear and rotational axes that control the precise movement of the cutting tool and workpiece. Each axis is assigned to a specific direction of motion, typically defined as X and Z for linear movement.

Each axis is driven by a servo motor and monitored through an encoder feedback system, ensuring accurate positioning and repeatability. Axis limits, home positions, and travel ranges are defined within the machine parameters to prevent overtravel and collisions.

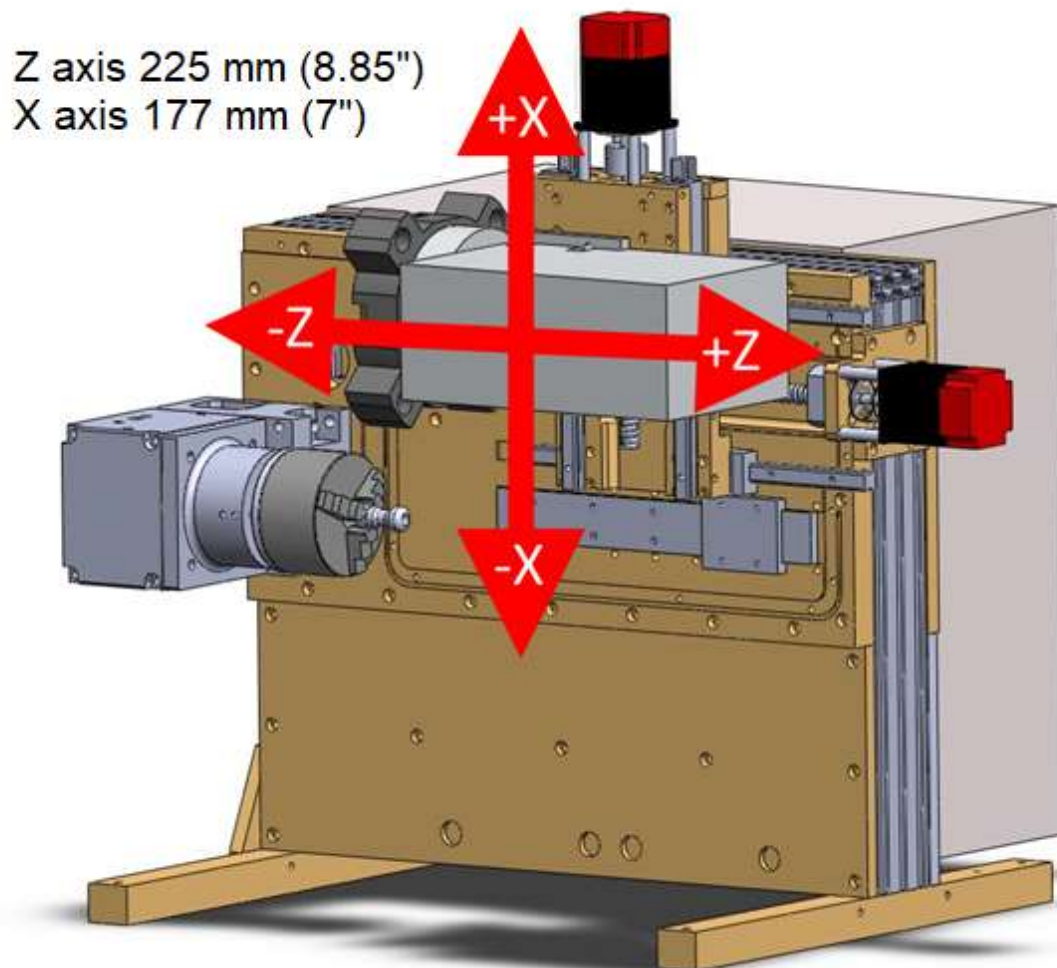


Figure 6. Positive and Negative Axis Movements for the Machine

5 System Installation and Setup

5.1 Operating Environment

5.1.1 General Preparation and Selecting Location

Do not power the machine until the installation preparations are completed. Never open the electronics bay cabinet door with the power on, high voltage will be present in the electronics bay and there will be a risk of shock or injury.

It is recommended to place the machine in an air-conditioned environment where the ambient temperature is kept between 0 to 45°C (32 to 113°F), and a relative humidity of 75% or below. The machine is not allowed to be exposed to sunlight or rain.

A clearance of at least 0.5 m between the cell and any surrounding machinery or walls is required to ensure easy access for maintenance or cleaning purposes. Installing the cell next to a planning, milling, or punching machine may result in poor performance due to vibrations from the ground.

5.1.2 Foundation and Layout

A good foundation is essential for a CNC machine because it ensures proper alignment and repeatable geometry by providing stiffness to the machine tool. A well-designed foundation helps maintain the accuracy and precision of the machine, leading to better performance and longer service life. Additionally, it can minimize vibrations and ensure stability during the machining process.

Make sure the foundation is leveled to avoid unnecessary stresses on the machine.

1. **Level surface:** Ensure that the surface on which the CNC machine will be placed is level and flat. This helps maintain the machine's accuracy and precision during operation.
2. **Vibration isolation:** It is crucial to minimize vibrations that can impact the machine's performance. Consider using vibration isolation pads or mounts under the machine to dampen any vibrations.

3. **Anchoring:** Anchoring support structure to the floor can increase the rigidity of the entire machine thus decreasing vibrations and increasing accuracy.
4. **Environmental factors:** Ensure that the foundation for the CNC machine is free from dust, moisture, and temperature fluctuations, as these factors can impact the machine's performance and longevity.
- 5.

5.1.3 Working Space Required

The following top view drawing of the machine depicts the necessary working space required for easy operation and maintenance of the machine.

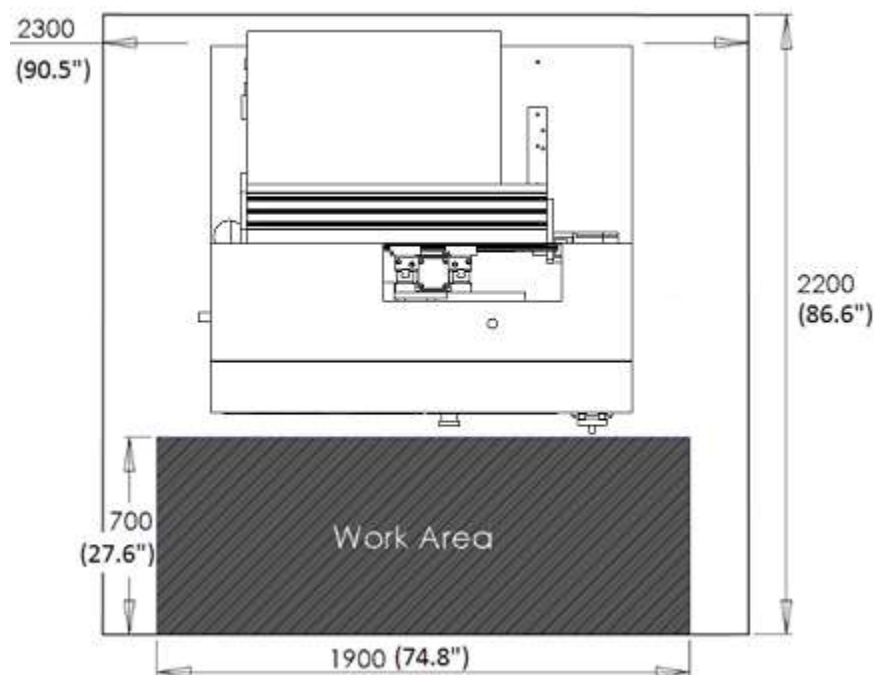


Figure 7. Working Space Required Top View, in mm

5.2 Installation procedure

1. Remove the top cover of the wooden case first and then the plates on the four sides.
2. Use a forklift as depicted in Figure 8 to lift the machine and place it on top of the Machine Stand.

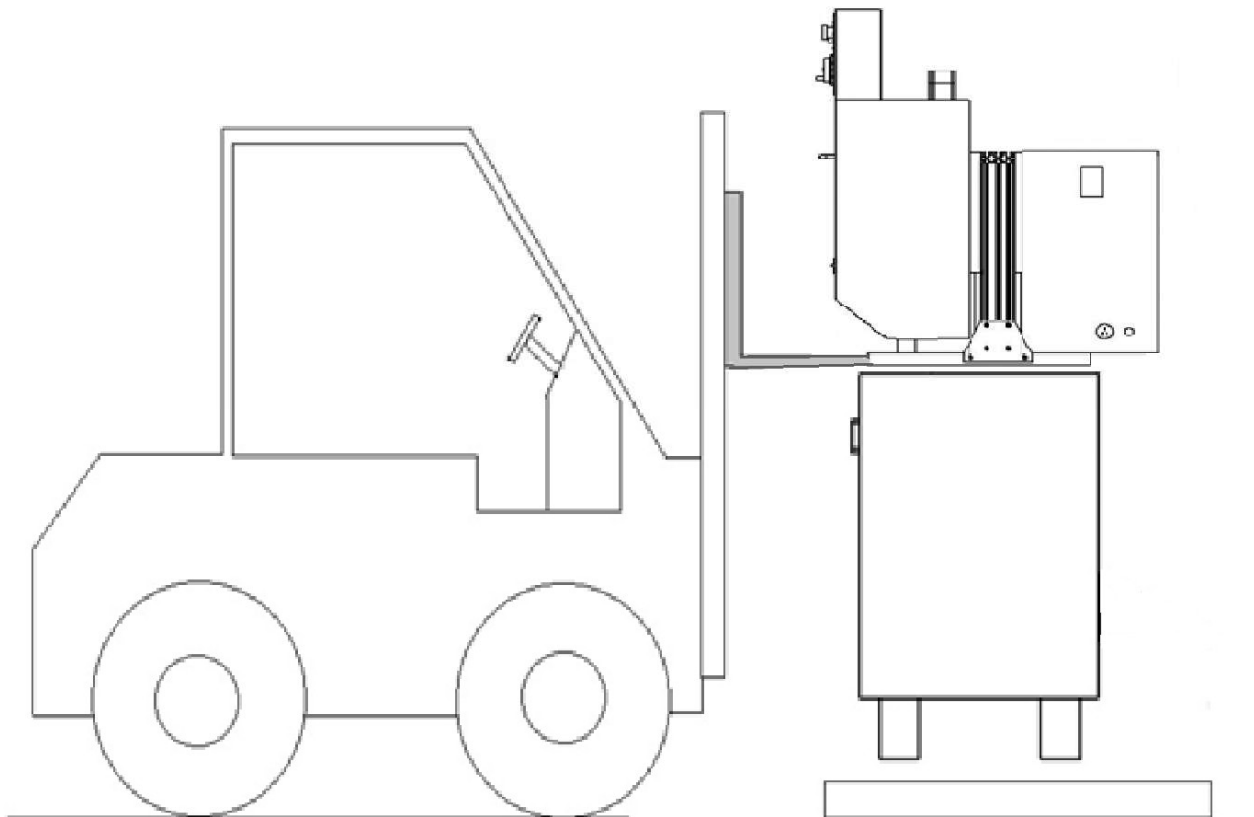


Figure 8. Proper way of lifting the machine

3. Secure machine to stand using screws provided on holes located on the legs of the machine.
4. Roll machine to desired location.
5. Lower levelers located on the casters of the machine stand to make machine more stable.
6. Connect the coolant and compressed air hoses. The machine should never be used without a connection to a compressed air source.

7. Connect the power cord to a 220 VAC source.

5.3 Checkups during the Test Run

Before starting the machine for a test run, check the following:

1. Check that there are no missing parts or accessories.
2. Make sure the linear guide way tracks are well lubricated.
3. All hoses should be firmly connected to their respective connections.
4. Check that the coolant tank installation on the cart is secure.

During the test run, turn the spindle at half of its maximum speed for about 20 minutes after the warmup procedure is completed. If there is any malfunction such as obvious abnormal noise coming from the spindle or an alarm message in the control screen, please contact the manufacturer for help.

5.4 Relocation of the Machine

This machine was designed to be modular for easy transportation by one individual without the need of a pallet jack or forklift if it is mounted on a machine stand with casters. If it is desired to relocate the machine to another room, the machine can be positioned such that it will fit through a door frame of at least 34" wide. The following procedure should be used for proper transportation of the machine from one room to the next.

5. If the machine is off, turn it on following the proper procedure.
6. Move the machine in the Z axis to the center of its travel.
7. Move the machine in the X axis down until the over-travel alarm is activated.
8. Press the E-stop button on the Operator's Panel.
9. Turn off the machine and disconnect the power cable.
10. Remove the compressed air hose connection and make sure there are no other cables/hoses attached to the machine.
11. Release the leveling pads or brakes on the caster wheels.
12. Grab the stand base by its side and pull the machine.
13. Align the machine with the door frame and carefully pull the machine through it making sure that the sides of the machine can go through without hitting the side of the door frame.
14. When the machine reaches its destination, apply the leveling pads or brakes on the caster wheels located under the stand.
15. Connect the compressed air hose to the side of the machine.
16. Connect the power cord to a 220 VAC source.
17. The machine is now ready to be powered on again.

6 System Controls & Interface

6.1 Overview of the Operator Interface

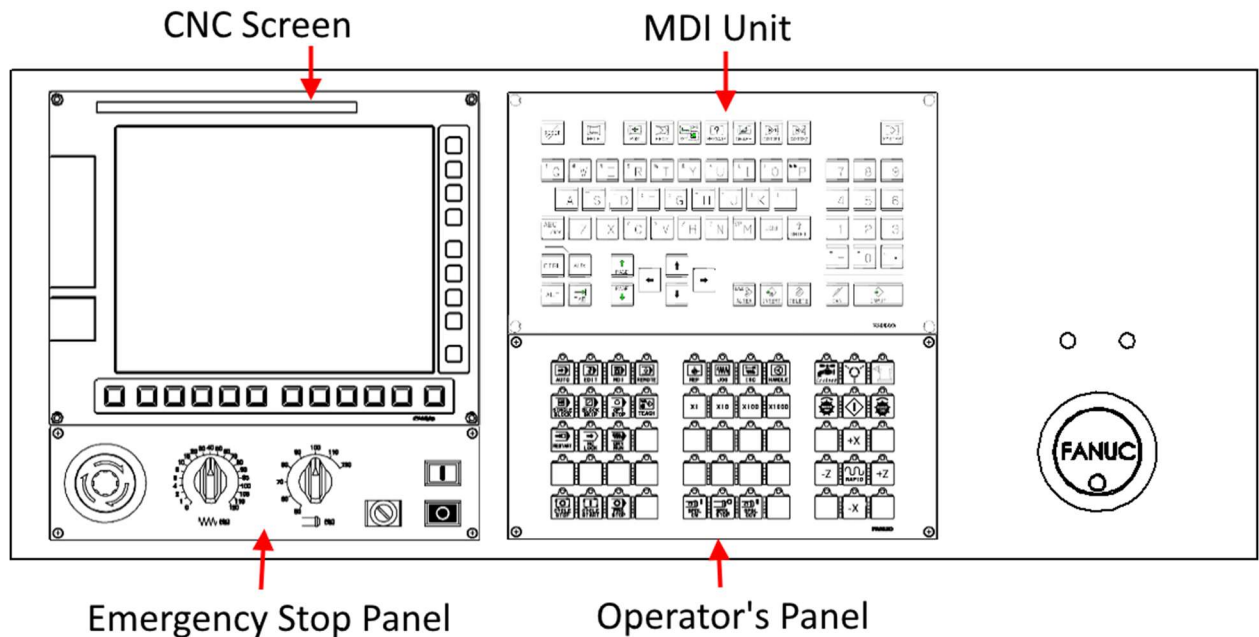


Figure 9. Operator Panel

The operator interface includes four main components:

1. CNC Screen
2. MDI Panel
3. Machine Operator Panel
4. Emergency Stop Panel

For information on the CNC screen and MDI panel, see the FANUC Series 31i-B5 OPERATOR'S MANUALS. For information on the functions of the Machine Operator Panel, see below.

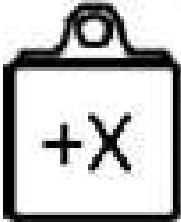
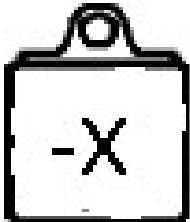
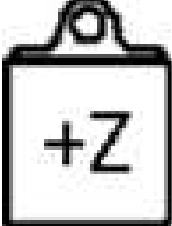
6.2 Overview of Machine Operator Panel Functions

Button	Function
	<u>Auto Mode Selection Signal</u> Sets automatic operation mode. Used when running codes automatically from the CNC memory.
	<u>Edit Mode Selection Signal</u> Sets program edit operation mode. Used to add/delete codes into the CNC memory. Also used to make changes manually to the code inside the CNC memory.
	<u>MDI Mode Selection</u> Sets the manual data input (MDI) mode. Used to manually input data into the CNC
	<u>DNC Operation Mode Selection</u> Sets DNC operation mode. Used to run codes from the Flash Memory port.
	<u>Reference Position Mode Selection</u> Sets reference position return mode. Used to move the machine towards its home position only.
	<u>Jog Feed Mode Selection</u> Sets jog feed mode. Used to jog the machine using the axis buttons located on the Operator's Panel.

	<u>Step Feed Mode Selection</u> Sets step feed mode. Used to move the machine in steps when pressing the axis buttons in the Operator's Panel
	<u>INC Amount Buttons</u> In Step Feed mode, choose between 0.1mm, 0.01mm, and 0.001mm intervals in the selected axis travel.
	<u>Manual Handle Feed Mode Selection</u> Sets manual handle feed mode. Used to move the machine using the MPG (manual pulse generator) located to the right side of the Operator's Panel
	<u>Single Block Button</u> Executes program line by line, stopping at every line. This key is used to check a program.
	<u>Block Skip Button</u> Pressing this button during automatic operation causes the block under execution to stop, skipping to the end of the block.
	<u>Optional Stop Button</u> Stops automatic operation after execution of the block of a program where M01 is specified in the program.
	<u>Teach Button</u> Manually create a program by teaching points to the machine. Must be in Handle Mode in order to use this function

	<u>Program Restart Button</u> A program may be restarted at a block by specifying the sequence number of the block.
	<u>Machine Lock Button</u> Locks the machine axis to have the CNC run through the program without actually moving the machine.
	<u>Dry Run Button</u> Sets the axis feed to the jog feed rate instead of a programmed feed rate when automatic operation is performed. This function is used to check the movement of the tool or speed up tool movement while there is no stock material.
	<u>Cycle Stop Button</u> Pauses automatic operation.
	<u>Cycle Start Button</u> Starts automatic operation.
	<u>Program Stop Button</u> Turns on the LED on the button when automatic operation is stopped by M00 specified in the program.
	<u>Spindle CW Button</u> In manual mode, press this button to turn on the spindle in a clockwise direction. Be sure to input an S value and an M3/M4 value, otherwise spindle will not rotate. Change to MDI to input or alter S value.

	<u>Spindle Stop Button</u> In manual mode, press this button to stop the spindle rotation.
	<u>Spindle CCW Button</u> In manual mode, press this button to stop the spindle rotation.
	<u>Coolant Toggle Button</u> Press this button to toggle the coolant ON and OFF
	<u>Chuck Toggle Button</u> (Option) Press this button to toggle the pneumatic chuck open or close Note: This may be optional on your machine
	<u>Tailstock Toggle Button</u> (Option) Press this button to toggle the tailstock to the forwards or backwards position Note: This may be optional on your machine
	<u>Turret Increase</u> Press the  button and this button simultaneously while in manual mode to change the tools in increasing number
	<u>Turret Tool Change Enable Button</u> Press this button to enable the turret increase or turret decrease buttons

	<u>Turret Decrease</u>  Press the button and this button simultaneously while in manual mode to change the tools in decreasing number
	<u>Automatic Door Operation</u> Press and hold this button for 2 consecutive seconds to actuate the door while the machine is in idle and/or the spindle is not running
	<u>Parts Catcher Operation</u> Press and hold this button for 2 consecutive seconds to actuate the parts catcher while the machine is in idle.
	<u>X-axis Positive Travel Button</u> In jog mode, press this button to move the spindle in the positive X direction. In handle mode, press this button to select X axis movement when using the MPG.
	<u>X-axis Negative Travel Button</u> In jog mode, press this button to move the spindle in the negative X direction. In handle mode, press this button to select X axis movement when using the MPG.
	<u>Z-axis Positive Travel Button</u> In jog mode, press this button to move the spindle in the positive Z direction. In handle mode, press this button to select Z axis movement when using the MPG.



Z-axis Negative Travel Button

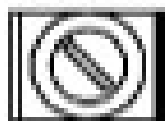
In jog mode, press this button to move the spindle in the negative Z direction.

In handle mode, press this button to select X axis movement when using the MPG.



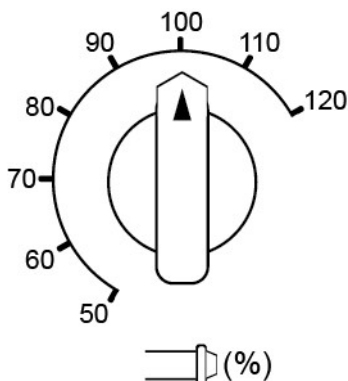
Rapid Button

Press an axis button and this button simultaneously while jog mode is activated to move faster in said direction.



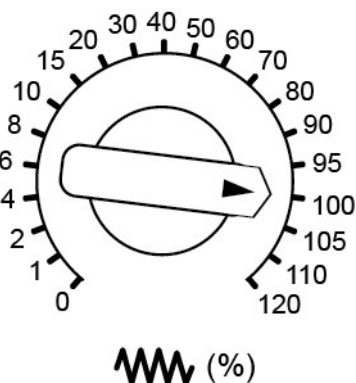
Edit Key Lock

Lock or unlock access to edit programs in the CNC.



Spindle Speed Override

Manually adjust the spindle speed when rotating. The changes are measured in the percentages of the initial speed setting.



Feed Rate Override

Manually adjust the feed rate of the machine when moving either manually or running a program. The changes are measured in the percentages of the initial speed setting.

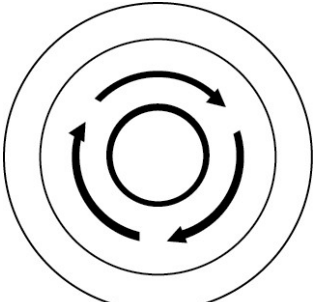
	<u>Emergency Stop Button</u> Cuts the power to the servo motors and spindle when activated. Press during an emergency or before powering off the machine.
	<u>Handle or Manual Pulse Generator (MPG)</u> Moves an axis in the Increment mode and Axis mode selected when in Handle Mode

Table 10. Operator Panel Module Buttons

6.3 G-Codes and M-codes

G codes			
G-code System			
A	B	C	
G00	G00	G00	Rapid positioning
G01	G01	G01	Linear interpolation
G02	G02	G02	Clockwise circular/helical interpolation
G03	G03	G03	Counterclockwise circular/helical interpolation
G04	G04	G04	Dwell
G09	G09	G09	Exact Stop
G10	G10	G10	Programmable data input
G11	G11	G11	Programmable data input cancel
G17	G17	G17	XY Plane select
G18	G18	G18	XZ Plane select
G19	G19	G19	YZ Plane select
G20	G20	G70	Inch units
G21	G21	G71	Millimeter units
G22	G22	G22	Stored Stroke Function On
G23	G23	G23	Stored Stroke Function Off
G27	G27	G27	Reference Position Return Check
G28	G28	G28	Return to reference position
G29	G29	G29	Movement from reference position
G30	G30	G30	2 nd , 3 rd , 4 th reference position return
G31	G31	G31	Skip Function
G32	G32	G32	Threading
G34	G34	G34	Variable Lead Threading

G35	G35	G35	Circular Threading CW
G36	G36	G36	Circular Threading CCW (When bit 3(G36) of parameter No. 3405 is set to 1)
G38	G38	G38	Tool radius/tool nose radius compensation: with vector held
G39	G39	G39	Tool radius/tool nose radius compensation: corner rounding interpolation
G40	G40	G40	Cancel cutter radius compensation
G41/G42	G41/G42	G41/G42	Start cutter radius compensation left/right
G49	G49	G49	Cancel tool length offset
G50	G92	G92	Coordinate system setting or max spindle speed clamp
G52	G52	G52	Local coordinate system setting
G53	G53	G53	Move in absolute machine coordinate system
G54	G54	G54	Use fixture offset 1
G55-59	G55-59	G55-59	Use fixture offset 2, 3, 4, 5, 6
G61	G61	G61	Exact stop mode
G62	G62	G62	Automatic corner override mode
G63	G63	G63	Tapping mode
G64	G64	G64	Cutting mode
G65	G65	G65	Macro call
G66	G66	G66	Macro modal call A
G67	G67	G67	Macro modal call A Cancel
G68	G68	G68	Mirror image on for balance cutting mode

G69	G69	G69	Coordinate system rotation off
G70	G70	G72	Finishing Cycle
G71	G71	G73	Stock removal in Turning
G72	G72	G74	Stock removal in Facing
G73	G73	G75	Pattern repeating Cycle
G74	G74	G76	End face peck drilling cycle
G75	G75	G77	Outer diameter/internal diameter drilling cycle
G76	G76	G78	Multiple thread cutting cycle
G80	G80	G80	Canned cycle cancel for drilling
G81	G81	G81	Canned cycle – spot drilling
G82	G82	G82	Canned cycle – counter boring
G83	G83	G83	Canned cycle – face drilling
G84	G84	G84	Canned cycle – face tapping
G85	G85	G85	Canned cycle – face boring
G87	G87	G87	Canned cycle – side drilling
G88	G88	G88	Canned cycle – side tapping
G89	G89	G89	Canned cycle – side boring
G90	G77	G20	Outer diameter/internal diameter cutting cycle
G92	G78	G21	Threading Cycle
G94	G79	G24	End face turning cycle
G96	G96	G96	Constant Surface Speed Control
G97	G97	G97	Constant surface speed control cancel
G98	G94	G94	Feed per minute

G99	G95	G95	Feed per revolution
	G90	G90	Absolute programming
	G91	G91	Incremental programming
	G98	G98	Canned cycle: return to initial level
	G99	G99	Canned cycle: return to R point level

Table 11. G-codes and functions

M Codes	
M00	Compulsory Stop
M01	Optional Stop
M02	End of program
M03	Spindle on (clockwise rotation)
M04	Spindle on (counter-clockwise rotation)
M05	Spindle off
M06	Automatic tool change
M08	Coolant on (flood)
M09	Coolant off
M10	Parts Catcher Advance (Optional)
M11	Parts Catcher Retract (Optional)
M29	Rigid tap mode On
M33	Touch Probe On (Optional)
M34	Touch Probe Off (optional)
M35	Drawbar release
M36	Drawbar engage
M41	Spindle Low Gear (Optional)
M42	Spindle High Gear (Optional)
M52	Automatic Door Open (Optional)
M53	Automatic Door Close (Optional)
M68	Automatic Chuck Clamp
M69	Automatic Chuck Unclamp
M78	Tailstock Advance
M79	Tailstock Retract
M100	Robot Load (Optional)
M101	Robot Reload (Optional)
M102	Robot Unload (Optional)
M103	Machine Clear of Robot On (Optional)
M104	Machine Clear of Robot Off (Optional)

Table 12. M-codes and functions

6.4 Keep Relays

The following table shows the keep relays used on the machine.

Keep Relay Address	Function
K0.1	Door sensor signal override
K0.2	Low air pressure signal override
K1.1	Use ROV 1%
K1.6	Tower light logic enable
K3.0	Auto Door Enable
K3.5	Air Blast Enable
K3.6	Touch Probe Enable
K4.0	Setup Enable
K6.5	FIN Undf MCode
K10.0	1Ax Ref +Direction
K10.1	2Ax Ref +Direction
K10.2	3Ax Ref +Direction
K10.3	4Ax Ref +Direction
K10.4	5Ax Ref +Direction
K10.5	6Ax Ref +Direction
K11.0	1Ax Ref -Direction
K11.2	2Ax Ref -Direction
K11.2	3Ax Ref -Direction
K11.3	4Ax Ref -Direction
K11.4	5Ax Ref -Direction
K11.5	6Ax Ref -Direction

Table 13. Keep Relays and Functions

7 Operation Instructions

7.1 Machine Start Up Procedure

To turn on the machine safely, the following instructions must be followed. You will run the risk of damaging the machine/internal components if this procedure is not followed.

1. Press the E-stop button. The E-stop button is the bright red button located on the Operators Panel.
2. Connect the power cable into a 208-240 3-phase VAC outlet.
3. Switch the Main Power switch to the ON position.
4. Wait for the CNC to boot up and then release the E-stop button when prompted with the EMERGENCY alarm.
5. The machine is now ready to be used. It is important to always perform a warmup of the machine before daily use.

7.2 Loading Files into the CNC using a USB Drive

6. Insert the USB drive containing the program to be loaded into the CNC's USB port located to the lower left side of the CNC screen.



7. Make sure the I/O channel is set to "17" by pressing the  key on the MDI panel followed by the **[SETTINGS]** soft key and checking that the I/O setting is 17.



8. Press the  button on the operator panel followed by the  button.



9. Press the **[FOLDER]** soft key followed by the **[OPRT]** soft key

10. Press **[DEVICE CHANGE]** followed by the **[CNC MEM]** soft key

11. If the foreground folder is **//CNC_MEM/USER/PATH1** as shown below in the red rectangle, skip steps 7-10



12. Using the arrow buttons and the input button on the MDI unit, navigate the folders (System > User > Path1) to enter the PATH1 folder

13. Press the **[>]** soft key until you see **[FORE CHANGE]** and press it

14. The foreground highlighted in the red rectangle above should say "PATH1"

15. Press the **[>]** soft key until you see the **[DEVICE CHANGE]** soft key

16. Press the **[USB MEM]** soft key.
17. Press the **[FILE INPUT]** soft key.
18. Search for the program to be loaded into the CNC and highlight it using the up and down arrow keys on the MDI panel.
19. Press the right arrow soft key to search for the **[F GET]** soft key and press it and notice that the name of the program is loaded into the buffer.
20. Press the right arrow soft key to search for the **[F SET]** soft key and press it.
21. Notice that the name is loaded into the "F =" buffer.
22. Write the program number to be assigned to the program and press the **[P SET]** soft key and notice the number is loaded into the "P =" buffer.
23. Press the **[EXEC]** soft key and notice the word "INPUT" appears on the lower right corner of the screen as the file is uploaded to the CNC.



24. Press the  button on the MDI panel to display the program and check that the correct program is loaded.

7.3 Outputting Programs from the CNC into the USB Drive

After a program has been edited on the CNC it can be exported into a USB drive. Please follow the directions below to export the program safely into the USB drive:

1. Insert a USB drive into the CNC's USB port located to the lower left side of the CNC screen

2. Make sure the I/O channel is set to "17" by pressing the  key on the MDI panel followed by the **[SETTINGS]** soft key and checking that the I/O setting is 17

3. Press the  button on the operator panel

4. Press the  function key on the MDI panel

5. Press the **[DIR]** soft key followed by the **[OPRT]** soft key.
6. Search for the **[F OUTPUT]** soft key using the right arrow soft key and press it
7. Type the program number to output and press the soft key **[O SET]** to specify an output file name
8. Type the output file name and press the soft key **[F-NAME]**
9. Press the **[EXEC]** soft key and notice the word "OUTPUT" flash on the lower right-hand side of the screen
10. Once the word "OUTPUT" stops flashing, the program has been saved into the USB drive

7.4 Deleting Programs from the CNC Memory

After a program has been used and is not needed any longer and there is a need to create space in the CNC memory, programs can be deleted.

Please follow the procedure below to delete programs from the CNC memory safely:

1. Press the  button on the operator panel
2. Press the  function key on the MDI panel
3. Write "Oxxx" where "O" is the letter O and "xxx" represents the program number to be deleted
4. Press the  function key on the MDI panel

7.5 Automatic Operation

This machine can run G-codes automatically if they have been pre-loaded into the CNC, if the codes are manually written into the CNC or if an external compact flash card containing the G-code is loaded into the CNC (DNC Operation).

Follow the procedures below to properly activate the machine for automatic operation.

For codes previously loaded into the CNC:



1. Press the  button on the operator panel.
2. Type "Oxxxx" where the "xxxx" represent the program number given to the codes when it was first loaded into the CNC.
3. Press the **[O SRH]** soft key.
4. Verify that the correct program is loaded on the "**Program (Check)**" window.
5. Check that all required tools are loaded in the machine with the correct tool positions and height offsets.
6. Set the reference zero position for the workpiece.



7. Press the  button on the operator panel to begin automatic operation.

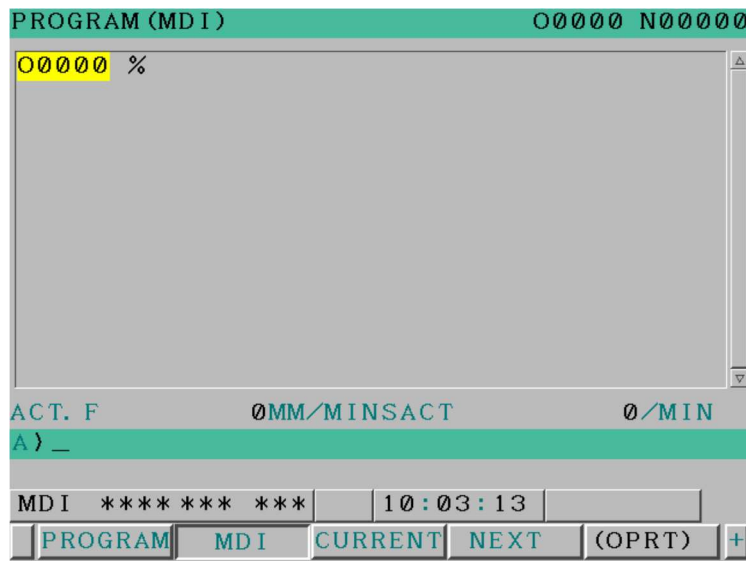
For codes to be written manually into the CNC:



1. Press the  button on the MDI panel



2. Press the  button on the operator panel
3. The following screen appears:



4. Manually input the commands using the MDI panel



5. When finished, press the  button on the operator panel to begin automatic operation

For codes to be run through the Compact Flash Card (DNC Operation):

1. Insert the Compact Flash card into the PCMCIA card reader slot located on the left side of the CNC's screen



2. Make sure the I/O channel is set to "4" by pressing the  key on the MDI panel followed by the **[SETTINGS]** soft key and checking that the I/O setting is 4



3. Press the  button on the operator panel



4. Press the  key on the MDI panel

5. Search for the **[DIR]** soft key using the left and right soft keys and press it

6. Press the **[OPRT]** soft key

7. Search for the **[DEVICE]** soft key using the right arrow soft key and press it

8. Press the **[M-CARD]** soft key

9. The following screen appears:

MEMORY CARD				N00000	
DNC FILE		O0123			
		REG NUM		60	
DEVICE : M_CARD					
NO.	FILE NAME	SIZE (KBYTE)	UPDATE		
D0017	O0123	1	2008/01/23		
0018	O0567	1	2008/02/06		
0019	O1000	1	2008/01/30		
0020	O1001	1	2008/01/31		
0021	O1002	1	2008/01/31		
0022	O1003	1	2008/01/31		
0023	O1234	1	2008/02/19		
0024	O2222	1	2008/01/28		
A) _					
RMT		**** *	***	10:07:34	
<	DEVICE	REFRESH	DNC SET	DNC CLR	+

10. Look through the files to find the program to be used and notice the file number to the left

11. Type the number using the MDI panel

12. Search for the **[DNC SET]** soft key using the right soft key and press it

13. You will notice that a "D" appears next to the file number

14. Press the  key on the MDI panel to display the program that is about to run

15. Press the  button on the operator panel to begin automatic operation

7.6 Spindle Operation

Spindle operation is simple on this machine. Simple commands must be loaded into the control to begin spindle operation.

CAUTION!

The spindle should always be warmed up before daily use or else you run the risk of lowering the spindle bearing's life. The process should begin by rotating the spindle at 1500 rpm for 10 minutes and then speeding up to 3,000 for another 5-10 minutes.

Please follow the procedure when attempting to operate the spindle manually.

1. Press the  button on the operator's panel.
2. Press the  key in the MDI panel to navigate to the manual data input page on the CNC.
3. Write the following "S1000 M3" using the MDI Panel.
4. Press the  key to finish the line command that you are about to load into the control. It should read "S1000 M3 ;"
5. Click the  key and notice the line command being loaded into the control.
6. Press the  button on the Operator's Panel and notice the spindle begins rotating at 1000 rpm. Make sure the door is closed so the safety sensor makes contact or else the machine will not run the command.

The letter "S" tells the control that you are about to give a "Spindle" command which is followed by a number (in our case we chose 1000) which denotes the desired spindle speed or rpm. The code "M3" tells the machine to turn on the spindle in a clockwise direction.

The spindle can be manually turned ON/OFF using the **[SPDL ON]** and **[SPDL STOP]** buttons on the Operator's Panel; however, an initial spindle speed and direction must be loaded into the control beforehand.

The spindle speed can be adjusted manually while the spindle is rotating by using the Spindle Override knob located on the Operator's Panel. The speed can be adjusted from 50% to 120 % of the loaded spindle speed in increments of 10%.

The spindle uses two methods for cooling which are pressurized air and liquid cooling.

The pressurized air enters through the right side of the spindle headstock and exits through small openings all around the bottom of the headstock. The pressurized air should be no less than 90 PSI and no more than 120 PSI. There is an adjustable flow valve that limits the amount of air flowing through the spindle. The valve is located next to the headstock on the right side. The compressed air can cool the spindle at speeds of 10,000 rpm or less. The flow of air will not be sufficient to cool the spindle at higher speeds. The valve should be $\frac{1}{4}$ of the way open when running the spindle at low speeds and completely open when running the spindle at speeds near 10,000 rpm when liquid cooling is not available.

The liquid cooling is done by using the machine's own coolant. The coolant is routed through the spindle headstock before exiting through the exit nozzle. It is recommended to use the coolant as a cooling method when running the spindle at speeds higher than 10,000 rpm. The compressed air valve should be open $\frac{1}{4}$ of the way if liquid cooling is available. Please read section 4.8 "Coolant System Operation" for a detailed description on the coolant system.

The following graph shows the torque vs speed curve for the spindle motor. The intermittent curve values last for only up to 2 full seconds.

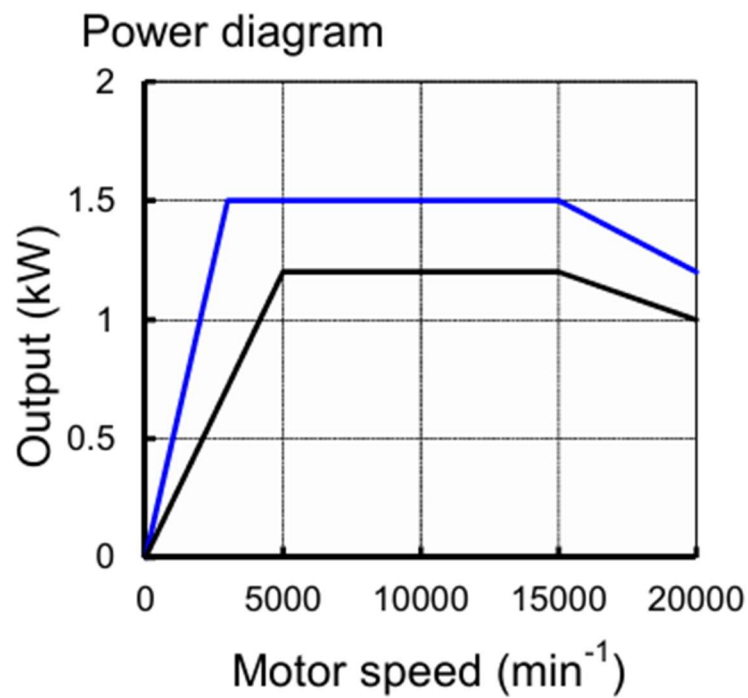


Figure 10. LS-F30 Power Curve

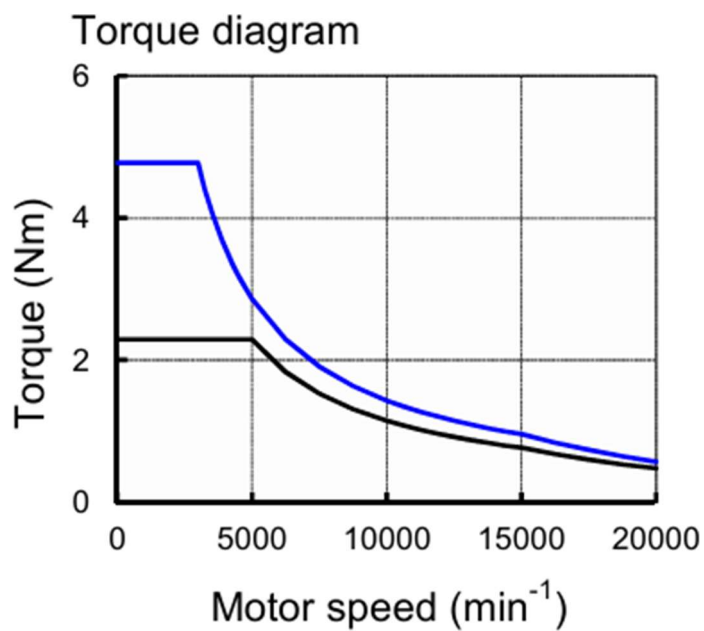


Figure 11. LS-F30 Torque Curve

7.7 Setting the Work-piece Coordinate System

Any time a new work-piece is placed in the machine, its coordinate system offset values (or the work-piece's "zero" position) must be measured so that the CNC can locate its exact position. The following procedure is a brief guide to ensure proper work piece set up when using an edge finder.

1. Secure work-piece in the work area to ensure it will not move during the measurement and machining process.
2. Change tools so that the reference tool (edge finder) is mounted in the spindle. Please review section [Tool Change Operations](#) for a more detailed description on how to do this.
3. Inspect the work-piece edges to make sure there are no burrs or other imperfections that may cause a false edge reading. If there are, use a file or manual deburring tool to smooth out the edges.
4. Start the spindle at 1000 rpm.
5. Move the machine so that the edge finder is about 25 mm (1") from the work-piece.
6. Choose an edge to measure (X or Y axis). Normally the left edge (X-axis) of the work piece is measured first.
7. Move the edge finder in the Z axis until the measurement end is just below the top surface of the work-piece.
8. In jog or handle mode, slowly move the edge finder closer to the chosen edge.
9. Keep moving the edge finder towards the edge until its upper and lower parts align and stabilize. The operator should look at the edge finder from a direction perpendicular to the edge being measured.
10. Move the tool one increment (0.1 mm or 0.01") at a time towards the work-piece until the edge finder's measurement end kicks, then retract the edge finder one increment before it kicked.



11. Press the  key and then the **[WORK]** soft key on the control panel to display the **Work Offsets** page. Navigate to the frame of reference used in the program for this work-piece. Frames of reference vary from **G54** to **G59**. For the purposes of this manual, do not use **G59** as a frame of reference for the work piece coordinate system.

12. Each axis has a numeric value, if doing the X axis first using the left edge, highlight the X axis and write "X-#" followed by the **[MEASURE]** soft key. The # represents the radius of the edge finder.
13. Move the edge finder away from the work-piece and position it along the next edge to be measured.
14. Repeat steps 7 through 11.
15. If doing the Y axis next, highlight the Y axis and write "Y#" followed by the **[MEASURE]** soft key. This will add the radius of the edge finder if measuring from the positive side of the work piece. If the measurement is to be done on the negative side, then a "Y- #" must be used.
16. Move the edge finder away from the work-piece and press the spindle stop button.
17. Position the edge finder right on top of the work-piece and lower it using the smallest Z axis interval possible.
18. Place a piece of paper in between the work-piece and the edge finder. While lowering the edge finder in small intervals, move the piece of paper until the tool clamps it down against the top surface of the work-piece.
19. In the Work Offset page, navigate to the reference frame being used and highlight the Z value. Write "Z#" and then the **[MEASURE]** soft key. The # represents the thickness of the piece of paper being used. On average, a piece of paper is roughly 0.1mm (0.004").
20. Return the spindle to its home position.
21. If multiple copies of the same work-piece are to be machined, mark the position of the measured work-piece so as to place the next part in the same position.

For more detailed information on measuring the work-piece coordinate system offset values, please review the **Easy CNC milling machine job setup** worksheet included with your device.

7.8 Tool Change Operations

The LTC-30 is equipped for **both manual** and **automatic tool changes**, allowing the operator to replace cutting tools as needed for different machining operations. This process must be performed carefully to ensure **operator safety, tool accuracy, and machine integrity**.

Always follow the procedures in this document when changing tools and verify that the spindle and work area are safe before resuming operation. The tool change system works by releasing the tool holder from the spindle and allowing gravity to pull the tool holder down into its pot in the tool rack.

It is particularly important to maintain the spindle taper and tool holder taper clean of any chips/dirt. They can get inside the tool change mechanism and cause the tool holder to get stuck and not release during a tool change operation. Chips and dirt can also cause the tool holder taper to not align itself with the spindle taper thus creating a run out error that will decrease the precision of the spindle. Since the tool rack sits in the work area and chips/dirt can fall on the tool holders while machining is in progress, it is recommended to leave the coolant on while performing a tool change.

CAUTION!

To perform a tool change, there must be a minimum of 90 PSI of compressed air attached to the machine. There is a quick disconnect male coupling in the back of the machine where an air hose can be attached using a quick disconnect female coupling.

7.8.1 Safety Precautions

Before performing any tool change:

1. Stop all machine motion and ensure the spindle has completely stopped rotating.
2. Press the Emergency Stop (E-Stop) or switch the machine to Manual/Idle mode.
3. Disconnect spindle power or ensure the control software has disabled the spindle output.
4. Wear safety glasses and remove loose clothing or jewelry.
5. Use proper wrenches and handle tools carefully to avoid injury or spindle damage

7.8.2 Required Tools

- ✓ 10mm open end wrench (for OD tools) or 3mm hex wrench (for ID tools)
- ✓ New cutting tool
- ✓ Clean cloth or compressed air (for cleaning tool holder/collet)

7.8.3 Tool Change Operations

The tool change system works by rotating the turret disk clockwise or counterclockwise. Before rotation of the tool turret disk is performed, the tool turret must be moved away from the spindle chuck to clear any tools that might hit the spindle chuck as they rotate.

In this machine you can change tools manually and automatically. The procedures below must be followed to properly perform a tool change without damaging any components of the machine.

CAUTION!

The inside cutting tools such as boring bars or drill bits will hit the spindle when the turret disk is rotated if they have not been moved clear of the spindle chuck. Move the machine towards its home position in both the X and Z axis before performing any tool changes.

- 1) Send the machine to its home position on the X and Z axis.



- 2) Select  mode, then on the program window, input "T####". The first two positions represent the tool number and the last two represent the tool number offset (i.e. T0202 selects tool number 2 and offset 2).

- 3) Once the line of command is ready, press the  key followed by  key. The line command should read "T101;" if choosing tool number 1 for the tool change.



- 4) To initiate the tool change, press the  button.

To change tools manually, set the machine to either handle or jog mode and do the following:

- 1) Send the machine to its home position on the X and Z axis.
- 2) Turn off the spindle if it is rotating.

- 3) Press and hold the  button or the and the  button simultaneously to activate the tool change mechanism in the clockwise direction (Increasing tool number)

- 4) Press and hold the  button and the  button simultaneously to activate the tool change mechanism in the counterclockwise direction (Decreasing tool number)

7.8.4 Final Checks

- ✓ Ensure the spindle and work area are free of tools and obstructions.
- ✓ Release the E-Stop and **reset the control system**.
- ✓ Perform a **test jog or dry run** to confirm tool clearance before restarting the machining program.

7.9 Setting Tool Length Offsets

Before a new tool can be used, its tool length offset must be measured so the machine knows how long the tool is. Please follow this procedure when attempting to measure tool length offset:

- 1) Mount the work piece in the chuck
- 2) Active coordinate system (G54-G59) used to set the position of the work-piece
- 3) Place the desired tool in the turret
- 4) Rotate the turret to have the desired tool in the active tool slot
- 5) Using the handle or jog mode, move the tool towards the outer edge of the work piece until it touches the work piece



- 6) Press the  key followed by the **[OFFSET]** soft key to display the tool offsets page and press the **[GEOM]** soft key
- 7) Using the arrow buttons on the control panel, navigate through the screen and highlight the Z position for the corresponding tool number
- 8) Write "Z0" and press the **[MEASURE]** soft key to store the difference in length between the reference point and the tool being measured.
- 9) Position the tool turret so the tool can barely cut the work piece in the X axis.
- 10) Start the spindle at 1,000 rpm.
- 11) Move in the Z axis and cut the work piece deep enough so the new diameter can be measured with a caliper or micrometer.
- 12) Move in the positive Z axis to move away from the work piece. **DO NOT** move in the X axis.
- 13) Turn off the spindle.
- 14) Measure the diameter of the work piece.



- 15) Press the  key and then the **[OFFSET]** soft key on the control panel to display the **Work Offsets** page and press the **[GEOM]** soft key
- 16) Using the arrow buttons on the control panel, navigate through the screen and highlight the X position for the corresponding tool number
- 17) Write "X#" where the # represents the diameter measured from the work piece and press the **[MEASURE]** soft key to store offset in the X axis.
- 18) Return the tool turret to its home position.
- 19) Repeat steps 3 through 17 for any additional tools.

7.10 Coolant System Operation

The machine is equipped with a coolant system which consists of the following components:

1. 10 gallon coolant reservoir.
2. 220 V @ 60 Hz, 1/4 hp pump.
3. Chip Collector.
4. Adjustable flow valve.
5. Hoses to and from the machine.
6. Any-which-way coolant hose with one round and one flat nozzle mounted on the spindle.

All the internal components will be fitted by the manufacturer. The external components such as hoses and hose clamps must be attached by the user. Once the hoses have been attached, they do not need to be removed unless they need to be exchanged.

It is recommended that the coolant of choice be semi-synthetic and designed to work best for the material to be cut by the machine. There are some fully synthetic coolants that can be corrosive towards plastic parts such as O-rings located on many components of the machine which is why the use of synthetic coolants is not recommended.

The coolant system is turned on and off directly from the operator's panel, or via the commands M08 and M09 through the machine control's MDI.

Please follow the procedure below to operate the coolant system.

1. Select a manual mode in the operator's panel (Jog, Handle, Ref).

2. Press the  button in the operator's panel to activate the coolant (LED should turn on).

3. Press the  button again in the operator's panel to deactivate the coolant (LED should turn off)

7.11 Automatic Door Operation

Machines outfitted with an automatic door system will consist of the following components:

- 1) Main door with sliding blocks
- 2) Back door
- 3) Slides
- 4) 12" stroke air piston
- 5) Air directional valve
- 6) Air flow control fittings
- 7) Air hoses
- 8) Air pressure control valve

CAUTION!

Always keep any part of the body, articles of clothing and other people clear of the door during automatic CNC operations and when manually actuating the door. Bodily injury can happen due to pinching points or crushing points when actuating the door.

Please follow the procedure below to properly actuate the automatic door.

For manual operation:

- 1) Make sure there are no obstructions in the way of the door path such as tools, body parts, clothes, etc.
- 2) Stop the machine if it is running in automatic mode
- 3) Stop the spindle if it is on



- 4) Press and hold the button for two consecutive seconds to toggle the door open or close

For automatic operation:

- 1) Make sure there are no obstructions in the way of the door path such as tools, body parts, clothes, etc.
- 2) Within the G-code program or MDI mode, use M code M52 to open the door or M53 to close it

NOTE: When opening and closing the door automatically within the G-code program, all axis will interlock while the door is open, and the program will not

proceed if there is a movement programmed. The G-code must be written so that while the door remains open, no movement commands are given.

7.12 Tailstock Operation

Machines outfitted with a tailstock system will consist of the following components:

- 1) Live center with Morse 2 taper
- 2) Tailstock base
- 3) Linear guideway
- 4) 1.5" stroke air piston
- 5) Air directional valve
- 6) Air flow control fittings
- 7) Air hoses
- 8) Air pressure control valve

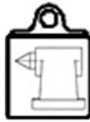
CAUTION!

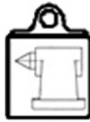
Always keep any part of the body, articles of clothing and other people clear of the tailstock during automatic CNC operations and when manually actuating the tailstock. Bodily injury can happen due to pinching points or crushing points when advancing or retracting the tailstock.

Please follow the procedure below to properly actuate the tailstock.

For manual operation:

- 1) Make sure there are no obstructions in the way of the tailstock path such as tools, body parts, clothes, etc.
- 2) Stop the machine if it is running in automatic mode
- 3) Stop the spindle if it is on



- 4) Press and hold the  button for two consecutive seconds to toggle the tailstock advance or retract

For automatic operation:

- 1) Make sure there are no obstructions in the way of the door path such as tools, body parts, clothes, etc.
- 2) Within the G-code program or MDI mode, use M code M78 to advance the door or M79 to retract it

NOTE: When actuating the tailstock automatically within the G-code program, the spindle should be off, else the machine will give an alarm.

7.13 Automatic Chuck Operation

Machines outfitted with an automatic chuck system will consist of the following components:

- 1) 5C collet chuck
- 2) Draw bar
- 3) Belleville disk springs
- 4) 3/4" stroke air piston
- 5) Air directional valve
- 6) Air hoses

CAUTION!

Always keep any part of the body, articles of clothing and other people clear of the chuck during automatic CNC operations and when manually actuating the door. Bodily injury can happen due to pinching points or crushing points when actuating the chuck.

Please follow the procedure below to properly actuate the automatic door.

For manual operation:

- 1) Stop the machine if it is running in automatic mode
- 2) Stop the spindle if it is on
- 3) Make sure there are no shavings around the collet



- 4) Press and hold the button for two consecutive seconds to toggle the collet open or closed

For automatic operation:

- 1) Within the G-code program or MDI mode, use M code M68 to open the chuck or M69 to close it

7.14 Parts Catcher Operation

Machines outfitted with a parts catcher system will consist of the following components:

- 1) Part catcher assembly
- 2) 3" stroke air piston
- 3) Air directional valve
- 4) Air flow control fittings
- 5) Air hoses
- 6) Air pressure control valve

CAUTION!

Always keep any part of the body, articles of clothing and other people clear of the part catcher during automatic CNC operations and when manually actuating the system. Bodily injury can happen due to pinching points when actuating the parts catcher

Please follow the procedure below to properly actuate the parts catcher.

For manual operation:

- 5) Make sure there are no obstructions in the way of the door path such as tools, body parts, clothes, etc.
- 6) Stop the machine if it is running in automatic mode



- 7) Press and hold the button for two consecutive seconds to toggle the parts catcher open or closed

For automatic operation:

- 3) Make sure there are no obstructions in the way of the parts catcher such as tools, body parts, tailstock, etc.
- 4) Within the G-code program or MDI mode, use M code M10 to extend the Parts catcher or M11 to retract it

7.15 Machine Shut Down Procedure

When the machine is ready to be turned off, please follow the following procedure.

1. Send the machine to its home position on the Z axis by selecting the REF button on the Operator's Panel and pressing the +Z button until the machine reaches its home position and repeat for another axis.
2. Press the E-stop button to activate it.
3. Switch the Main Power switch to the OFF position.

7.16 Emergency Stop & Reset Procedure

The CNC machine is equipped with an Emergency Stop (E-Stop) button that immediately cut power to all machine motion and spindle activity.

7.16.1 E-Stop Activation

To activate the E-stop, press the red Emergency Stop button firmly.

Examples of when to utilize the E-Stop Button

1. If a collision between tool, workpiece, or fixture is imminent.
2. If abnormal noises, vibrations, or smoke are detected.
3. If coolant, oil, or other fluids create a safety hazard.
4. If an operator or bystander is at risk of injury.

IMPORTANT!

Do not attempt to restart the machine until the cause of the emergency has been identified and corrected.

7.16.2 E-Stop Reset

Once the emergency has been resolved, the machine may be reset and prepared for operation. To reset the machine after an E-Stop.

1. Ensure safety by confirming that the hazard has been fully addressed.
2. Release the E-Stop by turning and pulling the Emergency Stop button to its released position
3. Turn on main power if the main disconnect was used
4. Power up the CNC control, clear alarms, and reset the machine home position as required.
5. Perform system checks to verify coolant, lubrication, tool changers, and work holding devices are functioning correctly.
6. Restart operation carefully by running the machine in jog/manual mode first to confirm safe operation before resuming automatic cycles.

IMPORTANT!

Always document the incident in accordance with company safety procedures. If the machine does not restart normally, contact maintenance or technical support.

8 **Maintenance**

Never perform any maintenance work on the machine while it is powered on unless it is required. If power is required, press the emergency button and tag out the machine before performing any maintenance or inspection work on the machine.

8.1 **Maintenance Schedule**

Daily

- ✓ Machine Warm-up
 - Every day before use, warm up the machine by turning on the spindle for 10 to 20 minutes at about 1500-3000 rpm. Failure to do so may result in a shorter lifespan of the spindle bearings.
 - The mill warmup program is included with every machine to run the spindle and servos to the specified amounts.
 - If the machine is used right after being started, following a long idle period, sliding parts may wear down due to lack of even lubrication. Furthermore, thermal expansion of the machine components may jeopardize machining accuracy. To prevent these outcomes, always warm up the machine before daily operation by moving each axis through their entire travel at 50% of the machine's rapid speed for 10 minutes.
- ✓ Clean chips
 - Every workday after machine use, safely dispose of any debris that was created during the production day to maintain a clean and secure workspace.

Weekly

- ✓ Lubrication
 - Refer to section [Lubrication Guide](#) on how to properly maintain the guideways.

Bi-Annually

- ✓ Coolant Refill
 - Refer to section [Part Replacement Schedule](#) on proper coolant maintenance.

8.2 Cleaning Instructions

Do not use gasoline or any other flammable solutions to clean the outside of the machine. Utilizing the machine's own coolant for cleaning the work area is recommended.

CAUTION!

If the coolant is aimed directly in between the plastic cover and the stainless-steel tub, the coolant can overflow from under the plastic cover. The same applies to the rolling curtains and the stainless-steel tub.

Keep the tools and spindle taper clean, failure to do so may result in a misaligned tool or the spindle not being able to pick up the tool.

The rolling curtains should be cleaned of debris weekly to ensure a long working life. To clean the curtains, move the machine to its X-axis travel limits (both positive and negative) and remove the chips/debris that have accumulated in the front and back sides.

The chips that accumulate in the stainless-steel tub can be removed in two ways. Using a wet/dry vacuum with a small nozzle to remove most of the chips that have accumulated under the worktable is the easiest and cleanest way. You can also remove the mesh material located on the right side of the stainless-steel tub and allow the coolant to run and slowly remove all the chips under the worktable.

CAUTION!

The exit nozzle has a small opening and can become clogged if too much material or big pieces are allowed to flow through the nozzle. The chips will be collected by the strainer located on the coolant reservoir.

CAUTION!

The strainer has a small area to collect the chips and can overflow quickly, unless cleaned periodically.

8.2.1 Treatment of Waste

Deposit chips and left-over work-piece material in a bucket and responsibly waste it.

8.3 Lubrication Guide

Two primary lubricants are both grease and oil used for motion systems.

8.3.1 Ball Screw Lubrication Procedure

The ball screw nut requires lubrication to maintain proper friction between the bearings and the ball screw. The ball screw nut is surrounded by a liquid absorbent material on both openings of the ball screw nut base which is soaked in oil during the machine assembly process and will maintain the ball screws lubricated for a while before they require lubrication again.

Re-lubrication of the oil absorbent material should be done every 1 to 2 weeks when the machine is in use daily. If the machine will sit idle for long periods of time, a coating of oil should be applied every time the ball screw feels dry.

To re-lubricate, add a coat of oil (lithium based, 30-140 cst, ISO 32-100) all over the ball screw and slowly move the axis back and forth throughout its entire travel length so the oil absorbent material can soak in the oil. Fast movement will cause the oil to fly all over. After the process is done, clean up the excess oil.

8.3.2 Linear Guide Way Lubrication Procedure

Linear guide way lubrication is important for maintaining the function of linear guide ways. If the lubrication is not sufficient, the frictional resistance at rolling area will increase and the service life will be shortened because of wear of rolling parts.

There are four linear blocks per axis on the X, Y, and Z axis. Each linear block has a fitting located on one of its sides. Access to the fittings requires little or no removal of machine parts. They are all visible without the removal of any components.

Two primary lubricants are both grease and oil used for motion systems. Grease lubrication should be done with a lithium-based grease No. 2 and should be applied every 100 Km of travel. Moving each axis for 150 mm back and forth after the grease has been applied to all four linear blocks will ensure proper distribution of the grease.

Oil lubrication should be done with an oil of viscosity 30-150 cst in intervals of 1 to 2 weeks when the machine is used daily

8.4 Part Replacement Schedule

Component	Inspection Frequency	Replacement Interval	Maintenance Tips
Spindle Bearings <i>[If applicable]</i>	Every 3 months	Every 2–3 years (or 6,000–8,000 spindle hours)	Check for noise, vibration, and runout. Replace sooner if cutting heavy materials or high RPM use.
Drive Belts <i>[If applicable]</i>	Every 6 months	Every 1–2 years	Inspect for fraying, cracks, or slack. Keep properly tensioned.
Ball screws <i>[If applicable]</i>	Every 6 months	Every 3–5 years	Clean and lubricate regularly. Replace if backlash exceeds tolerance or movement feels rough.
Linear Guide Rails / Bearings <i>[If applicable]</i>	Every 3 months	Every 3–4 years	Wipe rails and apply light oil. Replace if uneven motion or scoring appears.
Lubrication System (Pump, Lines, Fittings) <i>[If applicable]</i>	Every 6 months	Replace lines every 2 years; pump every 4–5 years	Ensure oil flows to all axes. Replace filters and check for leaks.
Coolant Pump <i>[If applicable]</i>	Every 6 months	Every 3 years	Flush coolant tank regularly. Replace if noisy or losing pressure.
Coolant / Cutting Fluid <i>[If applicable]</i>	Monthly check	Replace every 3–6 months	Monitor concentration and pH. Clean tank and remove tramp oil.
Way Covers / Bellows <i>[If applicable]</i>	Every 6 months	Every 3–5 years	Keep clean and free of chips. Replace if torn or stiff.
Spindle Drive Belt <i>[If applicable]</i>	Every 6 months	Every 2 years	Look for glazing or cracking. Retention as needed.
Electrical Fans / Filters <i>[If applicable]</i>	Every 3 months	Filters yearly; fans every 2–3 years	Keep control cabinet dust-free to prevent overheating.
Tool Changer Components <i>[If applicable]</i>	Every 6 months	Every 3–4 years	Check pneumatic actuators, grippers, and sensors. Replace worn O-rings and seals.
Hydraulic / Pneumatic Lines <i>[If applicable]</i>	Every 6 months	Every 2–3 years	Inspect for leaks and brittleness. Replace damaged hoses.
Encoder / Limit Switches <i>[If applicable]</i>	Annually	Replace as needed	Check for consistent readings and clean connections.
Control Batteries (CNC control, servo drives) <i>[If applicable]</i>	Annually	Every 1–2 years	Replace lithium or coin-cell backup batteries per manufacturer's guidance.

Power Supply Fans <i>[If applicable]</i>	Annually	Every 3–5 years	Clean vents; replace fans that slow or stop.
Touch Probe / Tool Setter <i>[If applicable]</i>	Every 3 months	Replace as needed	Calibrate regularly; replace if repeatability drifts.

Table 14. Part Replacement Schedule

8.5 Calibration Procedures

8.5.1 Servo Adjustment

The servo motors for the X and Z axes are positioned in a direct drive configuration attached to the ball screws by a shaft coupling. If the machine is commanded to move but it is noticed that the actual distance moved is less, or the home position of the machine seems to be changing, it could mean that the servo or ball screw is slipping inside the coupling. Check to make sure that the shaft coupling is tightened on both sides (servo and ball screw) to make sure that neither shaft keeps slipping.

The home position will need to be reset for the axis in question. Please follow the APC warning and "DS0300 APC alarm: Need Ref Return" section to safely set up the home position.

8.5.2 Aligning the spindle head and the tool turret

If the tool turret or spindle head is moved either for maintenance reasons or due to a crash, the alignment of either will need to be re-set. The alignment position is measured from the center of the spindle to the center of the external tool holder mounted on the tool turret. Please follow the procedure below to ensure proper alignment of both systems.

For the alignment of the tool turret, please use the following procedure:

- 1) Mount a dial indicator with a magnetic base on the Z-axis guide ways.
- 2) Measure the 3 o'clock face of the tool turret disk where an external tool sits by moving in the Z axis. If there is an error higher than 0.01 mm (0.0004"), adjust its position using shimmies (at the top 2 or bottom 2 screws that hold the tool turret) until there is less than 0.01 mm (0.0004") of error between the left and the right side of the tool turret disk.
- 3) Tighten the screws of the tool rack and re-measure.
- 4) Loosen 3 screws and leave the 4th screw semi-tight.
- 5) Repeat steps 2 and 3 measuring the 6 o'clock face of the tool turret disk along the Z axis. Do not use shimmies, only rotate the tool turret.
- 6) Follow the APC warning and "DS0300 APC alarm: Need Ref Return" procedure to set the X axis home position.

For the alignment of the spindle, please use the following procedure:

- 1) Place a dial indicator on the tool turret and a straight cylinder on the spindle chuck.
- 2) Measure the top side of the cylinder by moving back and forth on the Z axis.
- 3) Remove the cover on the left side of the machine to gain access to the spindle. The spindle base uses 4 set screws that are used for alignment and four screws used to keep the base in place.
- 4) Loosen the 4 holding screws and use the 4 set screws to rotate the spindle head base to decrease the error until there is less than 0.01 mm (0.0004")
- 5) Tighten the holding screws and measure the cylinder to check the alignment.
- 6) Follow the APC warning and "DS0300 APC alarm: Need Ref Return" procedure in Section 5.1 to set the X axis home position.

The tool turret and spindle are ready to be used again.

9 Troubleshooting

9.1 Basic Errors

Issue	Possible Cause	Recommended Solution
Machine not powering on	Main power supply disconnected, blown fuse, or tripped breaker	Check main power connection, reset breaker, and replace any blown fuses. Verify emergency stop is released.
Axis not moving / servo alarm	Servo drive fault, overtravel limit reached, or improper homing	Clear any alarms, reset overtravel by manually backing off the axis, and perform a proper homing sequence. Check servo enable signals.
Unexpected toolpath or movement	Incorrect work offset, tool offset, or G-code error	Verify and correct work and tool offsets. Simulate or dry-run the program before cutting.
Poor surface finish	Dull tool, incorrect spindle speed/feed, or vibration	Replace or sharpen tool. Adjust cutting parameters. Check machine stability and workpiece clamping.
Excessive tool wear or breakage	Incorrect cutting parameters, material hardness, or poor coolant flow	Review recommended speed and feed rates. Inspect coolant delivery and verify proper tool selection.
Spindle not starting	Spindle enable signal missing or drive fault	Check spindle enable circuit, reset spindle drive, and confirm M-code activation (e.g., M03/M04).

Workpiece dimensions out of tolerance	Thermal drift, tool wear, or improper calibration	Allow machine to warm up, compensate for tool wear, and recalibrate axis if necessary.
Alarm on power-up	Parameter corruption or axis position loss	Perform machine reference (home) cycle. If alarm persists, check parameters or reload backup configuration.
Excessive noise or vibration	Loose components, worn bearings, or imbalance	Inspect spindle, fixtures, and tool holders for looseness or damage. Rebalance tools if necessary.
Coolant not flowing <i>[If applicable]</i>	Low coolant level, clogged line, or pump failure	Refill coolant tank, clean filter and lines, and verify pump operation.
Program not starting	Door interlock active, M-code missing, or program hold engaged	Close and lock safety doors, check for program hold, and ensure correct program structure (start and end codes).
Axis drift or inaccuracy	Encoder feedback issue or mechanical backlash	Inspect and clean encoder connections. Check axis ball screws and compensate backlash if adjustable.

Table 15. Basic Errors

9.2 Mechanical Issues

Over time, normal wear, improper operation, or maintenance lapses can lead to mechanical or motion-related issues such as **axis backlash**, **sticking motion**, or a **non-operational spindle motor**.

This section outlines the steps to **inspect, diagnose, and verify** these conditions safely.

If any issue persists after performing these checks, contact your instructor, supervisor, or authorized service technician before continuing operation.

9.2.1 Safety Precautions

Before performing any troubleshooting or inspection:

1. Power down the machine and wait for all motion to stop.
2. Engage the Emergency Stop (E-STOP).
3. Disconnect power at the main disconnect if hands-on mechanical inspection is required.
4. Wear safety glasses and avoid touching sharp cutting tools or rotating components.
5. Never attempt to service electrical components unless qualified to do so.

9.2.2 Checking for Backlash

Backlash is the slight delay or play between axis direction changes, caused by wear in lead screws, ball nuts, or coupling joints. Excessive backlash can result in dimensional inaccuracy or poor surface finish.

Preparation

1. Turn on the control and home all axes.
2. Switch the MODE SELECT knob to HANDLE (JOG) mode.
3. Select a low feed increment (e.g., 0.01 mm or 0.001in).

Test for Play

1. Place a dial indicator against a fixed point on the axis to be tested (e.g., the table or spindle head).
2. Jog the axis slowly in the positive direction until the indicator needle moves.
3. Zero the dial indicator.
4. Reverse the direction and jog slowly until the axis begins to move again.
5. Record the indicator movement before motion begins — this is the backlash amount.

Evaluate

- Normal backlash is typically less than 0.02 mm (0.0008 in) for educational machines.
- If backlash exceeds this limit, check for loose couplings, worn ball nuts, or misalignment.
- If mechanical parts are tight and backlash remains, contact service personnel for compensation adjustments in the control parameters.

9.2.3 Checking for a Stuck or Binding Axis

A stuck axis or jerky motion may result from contamination, improper lubrication, or mechanical obstruction.

Visual Inspection

1. Power down the machine and open the covers.
2. Inspect the ball screws, linear guides, and way covers for chips, debris, or signs of damage.
3. Clean with lint-free cloth and appropriate solvent if necessary.

Manual Movement [Power OFF]

1. With the machine powered down and servo motors disengaged, gently attempt to move the axis by hand (if possible).
2. The motion should be smooth and consistent — any binding, grinding, or sticking may indicate contamination or misalignment.

Jog Test [Power ON]

1. Restore power and return the control to HANDLE (JOG) mode.
2. Jog each axis slowly across its full travel range.
3. Listen for abnormal noises or sudden stops.
4. If the axis halts unexpectedly or lags behind command motion, stop immediately and inspect for obstructions.

Check Lubrication

- Verify that the automatic lubrication system is functioning.
- Check reservoir level and look for oil distribution along guideways.
- If lubrication is absent, replenish with the recommended way oil before continuing.

9.2.4 Spindle Motor Not Operating

If the spindle fails to start or rotate when commanded, the problem may be electrical, mechanical, or software related.

1. Confirm Software and Mode

- ✓ Verify that the control is in MEM (AUTO), MDI, or HANDLE mode — the spindle cannot start in EDIT mode.
- ✓ Ensure that all alarms are cleared and the E-STOP is released.
- ✓ Check the spindle speed command (S-code) in the active program or MDI input. Example: S1000 M03 for 1000 RPM clockwise rotation.

2. Check for Interlocks

- ✓ Verify that door interlocks are closed (if equipped).
- ✓ Ensure coolant cover sensors or spindle safety switches are not triggered.
- ✓ Check that spindle override is not set to 0%.

3. Observe Control Indicators

- ✓ When pressing CYCLE START, confirm that the spindle running indicator light on the control panel activates.
- ✓ If the spindle does not turn and no alarms appear, the spindle inverter or drive may have tripped.
- ✓ Check for alarm messages on the screen or the drive unit LEDs inside the cabinet (if accessible by qualified personnel).

WARNING!

Only qualified personnel should perform this next step.

4. Verify Power and Connections

- ✓ Ensure that spindle motor power cables and drive connectors are secure.
- ✓ Check for any tripped circuit breakers or blown fuses in the electrical cabinet.

9.2.5 Summary Table

Symptom	Possible Cause	Corrective Action
Excessive backlash	Worn ball screw, loose couplings	Inspect and tighten components, compensate via control
Axis sticks or binds	Debris, dry guides, misalignment	Clean, lubricate, inspect linear guides
Spindle not rotating	Mode error, interlock, drive fault	Verify mode, reset alarms, check drive and power

Table 16. Mechanical Issues, probable cause and corrective actions.

9.3 APC warning and “DS0300 APC alarm: Need Ref Return”

This machine is equipped with absolute encoders which means that they will remember their position even if the machine's power is turned off. This is accomplished by a battery pack (located in the electronic bay of the machine) which is connected to one of the servo drives located inside the machine's main electrical bay area.

If the battery is running low on power, the CNC screen will flash an “APC” message with yellow background. At this point, the power on the machine should stay on until the batteries have been replaced.

Should the battery die before it is replaced, the position of each servo will be lost and the alarms “DS0300 APC alarm: Need Ref Return” and “DS0306 APC Alarm: Battery Voltage 0” will be shown on the CNC screen for each axis.

This battery pack, dependent on the generation of the model, contains one of three options:

1. FANUC Yellow Battery (P/N A98L-0031-0025)
2. D Cell Battery
3. AA Batteries

A FANUC replacement battery pack can be obtained through FANUC America's Parts Department (1-888-FANUC US (select-2→1→1)) using the part number A98L-0031-0025.

A 'D Cell' or 'AA' replacement battery pack can be obtained through any local retailer.

CAUTION!

The following procedure must be used to correctly set each servo's Home Position.

If the batteries are being replaced due to the flashing APC warning denoted by the letters APC with a yellow background on the CNC screen, and no alarms (DS0300 or DS0306) have been issued by the CNC control, only follow steps 2-5 without turning off the power to the machine.

If the alarms DS0300 and DS0306 have been issued by the CNC control, follow the entire procedure.

The following procedure should be done by a qualified technician.

- 1) Follow the Shut Off procedure, disconnect the power cord and tag it out.
- 2) Open the battery access panel located on the back side of the control panel
- 3) Replace the four AA cell type batteries with new ones.
- 4) Place the battery access panel back into place
- 5) Plug the power cord into 220 VAC and turn on the machine.
- 6) Once booted up, release the E-stop button.
- 7) Place a dial indicator in the spindle chuck
- 8) Perform a tool change so an empty boring bar tool holder is in the active tool cutting slot.
- 9) Move the machine on the negative X-axis and eye ball centering the boring bar tool holder with the spindle.
- 10) Use a dial indicator to measure the inside of the boring bar tool holder and adjust the error between both centers.
- 11) From the center of the boring bar holder, move the X axis up 160 mm (6.2992")



- 12) Select  mode.



- 13) Press the  function key on the MDI panel.

- 14) Press the **[SETTINGS]** soft key.

- 15) Input a 1 on the **Parameter Write** option.



- 16) Press the  key on the MDI panel.

- 17) Using the right arrow soft key, search for the **[PARAM]** soft key.

- 18) Write **1815** using the number keys.

- 19) Press the **[SEARCH]** soft key.

- 20) Using the arrow keys, highlight bit #4 (**APZ**) in the X axis.

- 21) Input a number 1.



- 22) Press the  key.

- 23) Activate the E-stop button.

- 24) Reboot the machine.

- 25) Move the Z axis slowly in the positive direction until the machine reaches the physical end of travel.

- 26) Move in the -Z direction for 10mm.

- 27) Repeat steps 16-21 for the Z axis.

- 28) Cycle power.

- 29) The axis reference position alarm should no longer appear.

9.4 MTB Alarms and Messages

The following table lists all the MTB alarms and how to rectify them.

Alarm #	Cause	Remedy
EX1000	Emergency Stop is pressed	Release emergency stop button
EX1001	PMC Alarm	The PMC is in an alarm state, contact MTB
EX1010	Low air pressure	Keep air pressure above minimum required
EX1020	Door opened during Auto/Spindle Operation	Keep door closed during Auto/Spindle operation
EX1021	Door2 opened during Auto/Spindle operation	Keep door2 closed during Auto/Spindle operation

Table 17. MTB Alarms

The following table lists all the MTB messages.

Message #	Description
EX2050	Hold button for 1 second to activate spindle
EX2051	Spindle is ON
EX2052	Spindle ON prohibited with drawbar unclamped
EX2060	Main door is open (Close door for Auto/Spindle Operation)
EX2062	Hold button for 2 seconds to actuate main door
EX2063	Door 2 is open (Close door for Auto/Spindle operation)
EX2064	Main door is open
EX2065	Side door is open
EX2080	Drawbar is unclamped (Clamp drawbar for spindle operation)
EX2081	Drawbar actuation prohibited during Auto/Spindle operation
EX2082	Y-Axis not in position for drawbar actuation
EX2083	Hold button for 2 seconds to actuate drawbar
EX2090	Change to a manual mode for operation (Jog, Inc or Handle)
EX2091	Change to Jog mode for operation
EX2092	Change to Handle mode for operation
EX2093	Change to Auto mode for operation
EX2100	-X Direction interlocked due to imminent crash
EX2151	Absolute Encoder battery low, do not turn off machine
EX2151	Absolute encoder battery low. Do not turn off machine until battery is replaced

Table 18. MTB Messages

10 Spare Parts & Accessories

10.1 Spare Parts

10.1.1 Overview

To ensure continuous operation and minimize downtime, it is recommended to maintain an inventory of commonly used spare parts and consumables. The following list identifies typical spare components for a CNC milling machine. Actual part numbers and specifications may vary depending on the model, spindle type, and control system configuration.

Always refer to the machine's parts catalog or contact the authorized service provider for model-specific replacements.

10.1.2 Mechanical Components

Component	Description / Function	Recommended Quantity
Ball Screw Coupling	Connects servo motor to ball screw	1 per axis
Servo Timing Belt	Connects servo motor timing pulley to balls crew timing pulley	1 per axis
Servo Timing Pulley	Connects servo motor to timing belt	1 per axis
Linear Guideway Bearing Block	Provides smooth axis motion	1-2 per axis
Ball Nut Assembly	Ensures backlash-free linear motion	1 per axis
Way Covers / Bellows	Protect guideways/ball screws from chips	1 set
Drawbar or Collet Nut	Holds cutting tools in the spindle	1 spare
Tool Holder / Collet Set (ER Type)	Holds various cutting tools	Assorted sizes
Spindle Belt <i>[If applicable]</i>	Transfers motion from motor to spindle	1-2
Handwheel Encoder (Manual Pulse Generator)	For manual jogging operation	1
Worktable T-Slot Bolts & Clamps	For securing workpieces	1 set

Table 19. Mechanical Components Spare Parts

10.1.3 Lubrication and Fluid System

Component	Description / Function	Recommended Quantity
Automatic Lubrication Pump Filter <i>[If applicable]</i>	Filters way oil in lube system	1
Oil Tubing / Fittings <i>[If applicable]</i>	Deliver lubricant to guideways	1 set
Coolant Pump <i>[If applicable]</i>	Circulates coolant to cutting area	1
Coolant Hose / Nozzle <i>[If applicable]</i>	Directs coolant to tool	1–2
Way Oil (ISO 68)	For guideway lubrication	1–2 L
Spindle Oil or Grease <i>[If applicable]</i>	For spindle bearing lubrication	As specified
Coolant Additive / Concentrate <i>[If applicable]</i>	Water-soluble coolant mixture	1 container

Table 20. Lubrication and Fluid System Spare Parts

10.1.4 Tooling and Consumables

Component	Description / Function	Recommended Quantity
End Mills / Cutters	Cutting tools for general machining	Assorted types/sizes
Drill Bits	Hole-making operations	Assorted sizes
Tool Probes / Touch Sensors <i>[If applicable]</i>	Tool height measurement	1
Workpiece Probe	For part alignment and measurement	1
Tool Holders / Collets	Secure tools in spindle	1 set
Spindle Taper Cleaner <i>[If applicable]</i>	Cleans tool interface	1
Machine Cleaning Brushes / Rags	Daily maintenance	Several

Table 21. Tooling and Consumables Spare Parts

10.1.5 Control System Components

Component	Description / Function	Recommended Quantity
Operator Panel Keys / Keypad Membrane	Common replacement for worn panels	1 set
Backup Battery (for CNC and Servo Drives)	Maintains memory and parameters	1 set (replace annually)
CF Card / USB Backup Drive	For saving parameters and part programs	1
Emergency Reset Relay	Control circuit safety relay	1
Servo Motor Encoder Cable	Feedback cable for X, Y, Z axes	1 per axis

Table 22. FANUC control Spare Parts

10.2 Accessories

The following are lists of the standard and optional accessories with the LTC-30.

10.2.1 Standard Accessories

1. Through turret coolant
2. Splash guard
3. Status Tower Light
4. 8 Position tool turret with 4 ID tool holders for $\frac{3}{4}$ " shank dia.
5. Machine Operating manual
6. FANUC Oi-F Operating Manuals
7. Steel Machine Stand with leveling casters
8. Metal chip filter

10.2.2 Optional Accessories

1. Tail Stock
2. Pneumatic 5C collet chuck
3. Pneumatic power chuck 3 Jaw
4. Coolant system
5. Auto Door
6. Parts Catcher