



# OPERATOR'S MANUAL



TP4704

## **VMC SERIES II VERTICAL MACHINING CENTERS**

**Equipped with the  
Siemens 810D Control**

**- NOTICE -**

**Damage resulting from misuse, negligence, or accident is not covered by the Hardinge Machine Warranty.**

Information in this manual is subject to change without notice.

This manual covers information and procedures specific to Hardinge VMC Series II Vertical Machining Centers equipped with the Siemens 810D Control.

Refer to the Siemens control information supplied with the machining center for information regarding the operation of the Siemens 810D control.

In no event will Hardinge Inc. be responsible for indirect or consequential damage resulting from the use or application of the information in this manual.

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**CONVENTIONS USED IN THIS MANUAL**

**- WARNINGS -**

**Warnings must be followed carefully to avoid the possibility of personal injury or damage to the machine, tooling, or workpiece.**

**- CAUTIONS -**

**Cautions must be followed carefully to avoid the possibility of damage to the machine, tooling, or workpiece.**

**- NOTES -**

Notes contain supplemental information.

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**READ COMPLETE INSTRUCTIONS CAREFULLY BEFORE OPERATING OR PROGRAMMING HARDINGE VMC SERIES II VERTICAL MACHINING CENTERS.**

**- WARNING -**

**Occupational Safety and Health Administration (OSHA) Hazard Communication Standard 1910.1200, effective September 23, 1987, and various state “employee right-to-know laws” require that information regarding chemicals used with this machine be supplied to you. The list of chemicals appears in manual SP-134, the Material Safety Data Sheets (MSDS). Refer to the applicable section of the MSDS supplied with your machine when handling, storing, or disposing of chemicals. Store MSDS of other chemicals used with this machine in the same packet with manual SP-134.**

**HARDINGE SAFETY RECOMMENDATIONS**

Your Hardinge machine is designed and built for maximum ease and safety of operation. Since some previously accepted shop practices may not reflect current safety regulations and procedures, they should be re-examined to insure compliance with the current safety and health standards.

Hardinge Inc. recommends that all shop supervisors, maintenance personnel, and machine tool operators be advised of the importance of safe maintenance, setup, and operation of all equipment. Our recommendations are described below. **READ THESE SAFETY RECOMMENDATIONS BEFORE PROCEEDING ANY FURTHER.**

**READ THE APPROPRIATE MANUAL OR INSTRUCTIONS** before attempting operation, programming, or maintenance of the machine. Make certain that you understand all instructions.

**DON'T ALLOW** the operation or repair of equipment by untrained personnel.

**CONSULT YOUR SUPERVISOR** when in doubt as to the correct way to do a job.

**WEAR SAFETY GLASSES AND PROPER FOOT PROTECTION** at all times. Wear a respirator, helmet, gloves, and ear muffs or plugs when necessary.

**DON'T OPERATE EQUIPMENT** unless proper maintenance has been regularly performed and the equipment is known to be in good working order.

**WARNING and INSTRUCTION TAGS** are mounted on the machine for your safety and information. Do not remove them.

**DON'T ALTER THE MACHINE** to bypass any interlock, overload, disconnect switch, or other safety devices.

**DON'T OPERATE ANY MACHINE** while wearing rings, watches, jewelry, loose clothing, or neckties. Long hair must be contained by a net or shop cap for safety.

**MAKE CERTAIN** that the equipment is properly grounded. Consult and comply with the National Electric Code and all local codes.

DISCONNECT MAIN ELECTRICAL POWER before attempting repair or maintenance.

DON'T OPERATE EQUIPMENT if unusual or excessive heat, noise, smoke, or vibration occurs. Report any excessive or unusual conditions as well as any damaged parts to your supervisor.

ALLOW ONLY AUTHORIZED PERSONNEL to have access to enclosures containing electrical equipment.

DON'T REACH into any control or power case area unless electrical power is OFF.

DON'T TOUCH ELECTRICAL EQUIPMENT when hands are wet or when standing on a wet surface.

REPLACE BLOWN FUSES with fuses of the same size and type as originally furnished.

ASCERTAIN AND CORRECT the cause of any shutdown before restarting the machine.

KEEP THE AREA AROUND THE MACHINE well lighted and dry.

KEEP CHEMICALS AND FLAMMABLE MATERIAL away from operating equipment.

HAVE THE CORRECT TYPE OF FIRE EXTINGUISHER handy when machining combustible material and keep the chips clear of the work area.

DON'T USE a toxic or flammable substance as a solvent cleaner or coolant.

INSPECT ALL SAFETY DEVICES AND GUARDS to make certain that they are in good condition and are functioning properly.

MAKE CERTAIN THAT PROPER GUARDS are in place and that all doors and covers are in place and secured before starting a machining cycle.

DON'T OPEN GUARDS while any machine component is in motion. Make certain that all people in the area are clear of the machine when opening the guard door.

MAKE SURE that all spindle tools and any tool-holding devices are properly mounted.

MAKE SURE that fixture plates and all other table-mounted work-holding devices are properly mounted.

MAKE CERTAIN that all tooling is secured either in the tool magazine or spindle before starting the machine.

DON'T USE worn or defective hand tools. Use the proper size and type tool for the job being performed.

USE CAUTION around exposed mechanisms and tooling especially when setting up. Be careful of sharp edges on tools.

USE ONLY a soft-faced hammer on table work-holding devices and fixtures.

MAKE CERTAIN that all tool mounting surfaces are clean before mounting tools.

DON'T USE worn or broken tooling on the machine.

INSPECT ALL WORK-HOLDING DEVICES daily to make certain that they are in good operating condition. Replace any defective devices before operating the machine.

ANY ATTACHMENT, TOOL, OR MACHINE MODIFICATION obtained from any source other than Hardinge Inc., must be reviewed by a qualified safety engineer before installation.

USE MAXIMUM ALLOWABLE gripping pressure on work-holding devices. Consider the weight, shape, and balance of the tooling.

DON'T EXCEED the rated capacity of the machine.

DON'T LEAVE tools, workpieces, or other loose items where they can come in contact with a moving component of the machine.

REMOVE ANY LOOSE PARTS OR TOOLS from the work area before operating the machine. Always clear the machine and work area of tools and parts, especially after work has been completed by maintenance personnel.

REMOVE SPINDLE WRENCHES before starting the machine.

CHECK THE SETUP, TOOLING, AND SECURE THE WORKPIECE if the machine has been turned OFF for any length of time.

CHECK THE LUBRICATION AND COOLANT LEVELS and the status of control indicator lights before operating the machine.

KNOW where all **EMERGENCY STOP** push buttons are located.

MAKE CERTAIN THAT PROPER FUNCTIONS are programmed and that all controls are set in the desired modes before pressing the Cycle Start push button.

DRY CYCLE a new setup to check for programming errors.

DON'T ADJUST tooling, workpiece, or coolant hoses while the machine is running.

KEEP CLEAR of any "pinch point" and any potentially hazardous situation.

DON'T LEAVE the machine unattended while it is operating.

DON'T REMOVE OR LOAD workpieces while any part of the machine is in motion.

BE CAREFUL of sharp edges when handling newly machined workpieces.

DON'T CHECK the finish or dimension of a workpiece near a running spindle or moving slide.

DON'T ATTEMPT to brake or slow the machine with hands or any makeshift device.

DON'T REMOVE CHIPS with hands. Make certain that all machine movement has stopped and then use a hook or similar device to remove chips and shavings.

DON'T CLEAN the machine with an air hose.

KEEP TOTE PANS a safe distance from machine. Don't overfill the tote pans.

Unless otherwise noted, all operating and maintenance procedures are to be performed by one person. To avoid injury to yourself and others, be sure that all personnel are clear of the machine when opening or closing the coolant guard door and any access covers.

**FOR YOUR PROTECTION - WORK SAFELY**

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- NOTES -

- NOTES -

# CHAPTER 1 - OPERATION

## INTRODUCTION

This manual covers information and procedures specific to Hardinge VMC Series II Vertical Machining Centers equipped with the Siemens 810D Control.

Refer to the Siemens control information supplied with the machining center for information regarding the operation of the Siemens 810D control.

## MACHINE CONTROL FEATURES

### EMERGENCY STOP PANEL

#### Power ON Indicator Light

Indicator light “A”, Figure 1.1, is ON when the machining center is turned ON.

#### Fault Indicator Light

Indicator light “B” turns ON when a fault condition occurs.

#### Tool Clamped Indicator Light

Indicator light “C” is ON when “Spindle Tool Clamp” is active.

#### Emergency Stop Push Button

When Emergency Stop push button “D” is pressed, all machine and chip conveyor motion is stopped. Pull the Emergency Stop push button UP to release. The operator control panel is also equipped with an Emergency Stop push button.

Refer also to “Tool Magazine Push Buttons”, on the next page.

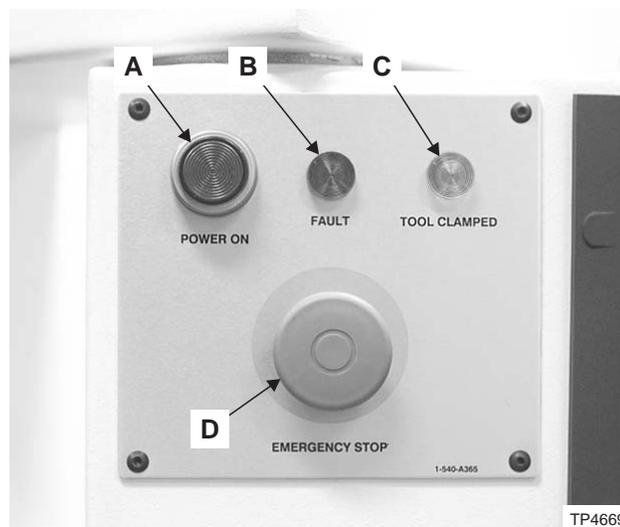


Figure 1.1 - Emergency Stop Panel

## TOOL MAGAZINE PUSH BUTTONS

### - NOTE -

The manual index push buttons for the standard tool magazine and an Emergency Stop push button are located on the left side of the machine.

The manual index push buttons for the optional tool magazine and an Emergency Stop push button are located on the right side of the machine.

### Tool Magazine Manual Index Push Buttons

Push buttons “E” and “F”, Figure 1.2, allow the machine operator to manually cycle the tool magazine when Jog mode is active.

### Emergency Stop Push Button

When Emergency Stop push button “G” is pressed, all machine and chip conveyor motion is stopped. Pull the Emergency Stop push button UP to release. The operator control panel is also equipped with an Emergency Stop push button.

Refer also to “Emergency Stop Panel”, on the previous page.

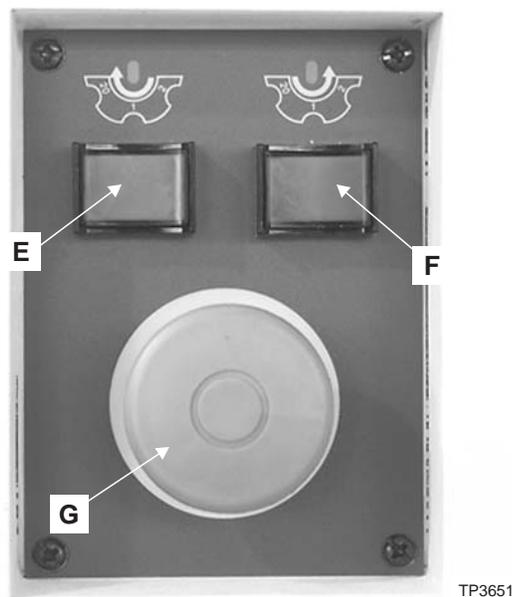


Figure 1.2 - Tool Magazine Push Buttons

## TOOL RELEASE PUSH BUTTON

### - WARNING -

**Be sure the spindle is stationary before attempting to remove or install a tool in the spindle.**

**Exercise caution when releasing a tool holder held in the machine spindle. DO NOT attempt to grip the cutting tool, personal injury may result.**

**Be prepared to accept the weight of the tool and tool holder. Do not drop the tool and tool holder. Personal injury or damage to the tool, tool holder, or workpiece may result.**

Push button "H", Figure 1.3 , activates Tool Release, which will remain active as long as this push button is held IN. The spindle clamps the tool when this push button is released.

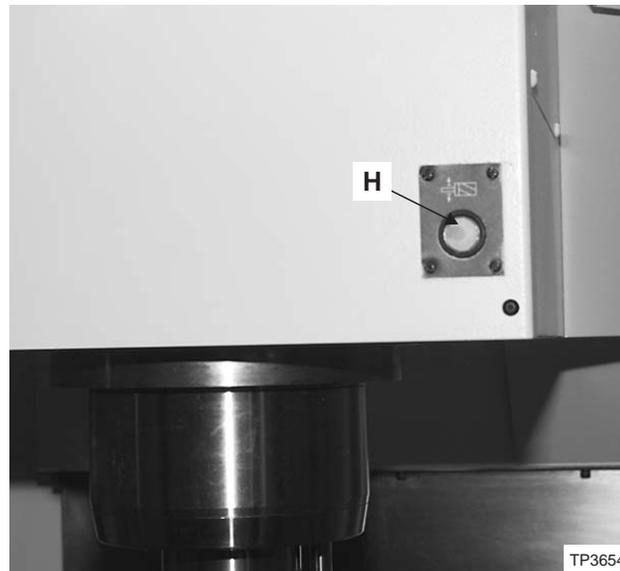


Figure 1.3 - Tool Release Push Button

## MACHINE POWER UP AND ZERO RETURN (REFERENCE HOME)

### - NOTE -

The guard door must be closed when jogging an axis or homing the machine axes.

1. Close the main guard door.
2. Turn main disconnect switch "I", Figure 1.4, ON.
3. At the back of machine, slide valve "J", Figure 1.5, upward to turn the machine air ON.

### - NOTE -

The machine will power up in the ShopMill mode.

**WAIT** until the following alarm message is displayed before proceeding to step 4:

"3000↓ EMERGENCY STOP"

4. Pull Emergency Stop push button "D", Figure 1.1, out and release to allow the machine to power up.
5. Press the Reset push button to clear the Emergency Stop.

### - NOTE -

The Feed Hold indicator light will be ON when Feed Hold is active.

6. Press the Feed Hold push button to deactivate Feed Hold.
7. Press the Axis Home push button. The Axis Home indicator light will start flashing and the X, Y, and Z axes will automatically home.
8. Press the Manual push button to put the machine in the ShopMill manual mode.

## MACHINE POWER DOWN

1. Press an Emergency Stop push button.
2. Turn main disconnect switch "I", Figure 1.4, OFF.
3. Pull main air valve "J", Figure 1.5, downward to turn the machine air supply OFF.



Figure 1.4 - Main Disconnect Switch

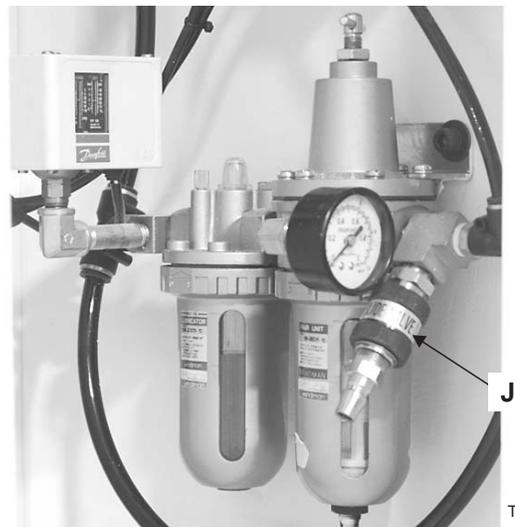


Figure 1.5 - Main Air Valve

## MOUNT A WORK-HOLDING DEVICE ON THE TABLE

### - NOTE -

It is good shop practice to apply a thin coat of light oil to the machine table before mounting the work-holding device to prevent rust and corrosion.

1. Clean the table and work-holding device of all chips and burrs.
2. Determine where on the machine table the work-holding device will be installed.
3. Align the locating keys on the work-holding device with the locating key slots on the machine table and place the work-holding device on the table.
4. Apply the appropriate strapping, such as T-bolts, nuts, and clamps.

Refer to Figures 1.6 and 1.7 .

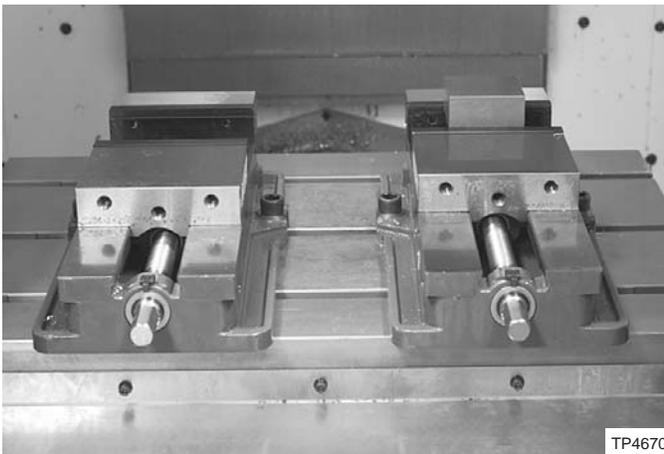


Figure 1.6 - Two Vises Mounted on the Machine Table



Figure 1.7 - Rotary Table Mounted on the Machine Table

# TOOLING

## TOOL HOLDERS

### - WARNING -

Be sure to use the correct type of tool holder, based on the configuration of the machine.

### -CAUTION -

All tool holders must conform to the appropriate specification, based on the spindle configuration of the machine tool. Consult a Hardinge Applications Engineer concerning ALL special tooling applications that require deviation from the specification.

Apply Loctite® 242 threadlocker to the threads on each retention knob before installing on the tool holder body.

### - NOTE -

A spindle configuration tag is located on the tool magazine, as shown in Figure 1.9 .

The machine spindle is configured to use 40 taper V-Flange tool holders that conform to one of the following specifications:

V40CT [Standard]

BT-40 JIS [Optional]

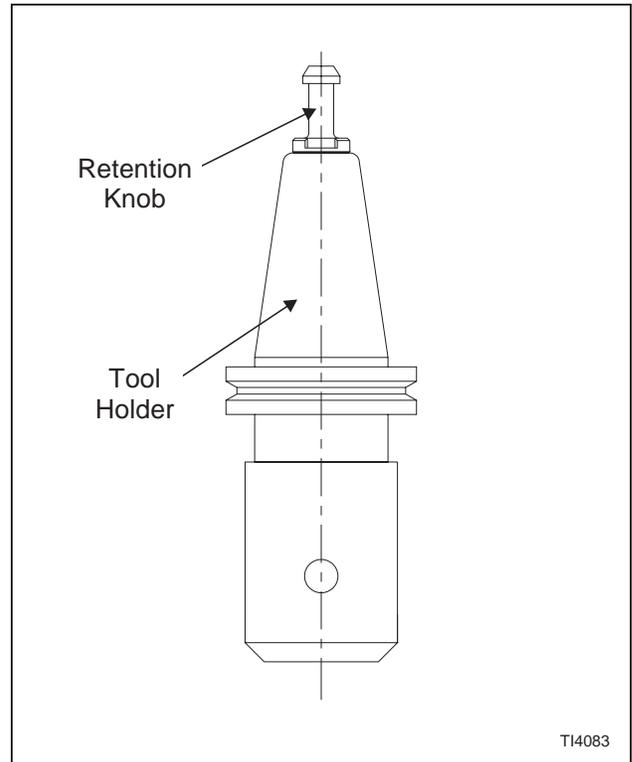


Figure 1.8 - Tool Holder Retention Knob



Figure 1.9 - Spindle Configuration Tag

## TOOL GEOMETRY

The tool magazine is designed to handle tooling that does not exceed the specifications shown in the table below. Refer to Figure 1.10 .

### - NOTE -

The maximum diameter is measured in relation to the centerline of the tool holder.

Tool Specification	Maximum Value	
	English	Metric
Length	9.84 in.	250 mm
Diameter	3.5 in.	88.9 mm
Weight	13.2 lb	6.0 Kg

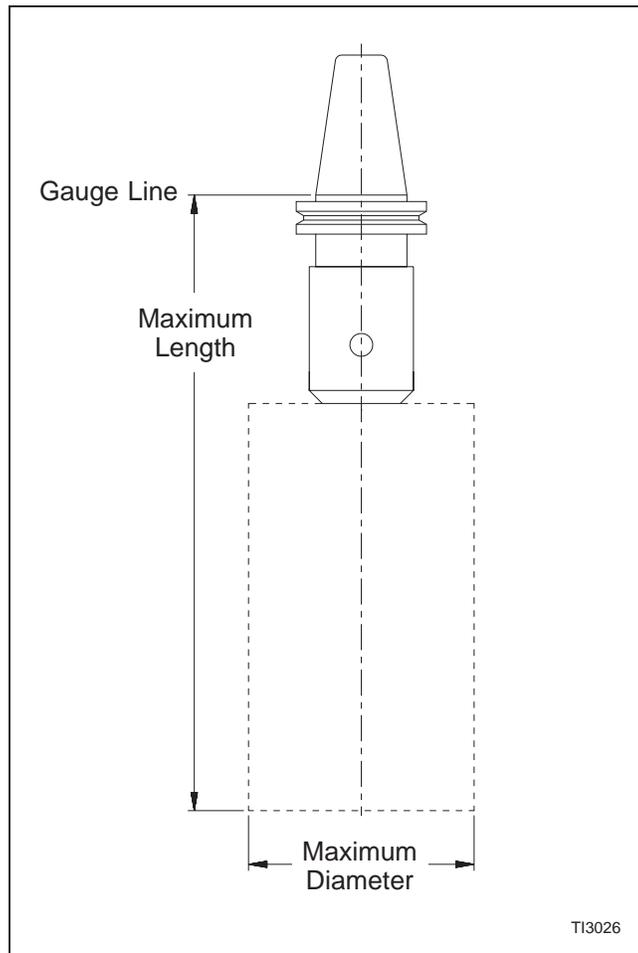


Figure 1.10 - Tool Geometry

## **ASSEMBLE TOOLS**

1. Determine what tools and holders will be needed for the operation and lay them out.
2. Install the correct retention knobs in the tool holders.
3. Install each tool in the proper tool holder and tighten.

### **- NOTE -**

Be sure each tool is the appropriate length for the application before securing in the tool holder.

Never tighten or loosen tools in the spindle.

Tool holders should not be left in the spindle overnight.

## **BUILD A TOOL FILE**

1. Select Manual mode.
2. Press the T,S,M soft key. (Horizontal soft key menu)
3. Press the Tools soft key. (Vertical soft key menu)
4. Cursor up or down to the desired tool number.
5. Press the New Tool soft key. (Vertical soft key menu)
6. Select the tool type from vertical soft keys.
7. Press the Input key.

### **- NOTE -**

Tool names can be up to 15 characters in length.

8. Key in the tool name and press the Input key.
9. Press the Input key.
10. Key in the tool diameter and press the Input key.
11. Key in the number of inserts and press the Input key.
12. Press the Alternate soft key to select spindle direction and press the Input key.
13. Press the Alternate soft key to select Coolant ON/OFF and press the Input key.
14. Repeat steps 4 thru 13 for additional tools.

## **LOAD TOOLS INTO THE TOOL MAGAZINE**

### **- NOTE -**

A tool must first be defined in the tool file before an automatic tool change can be executed. Refer to "Build a Tool File", page 1-8.

1. Close the main guard doors.
2. Select Manual mode.
3. Press the T,S,M soft key. (Horizontal soft key menu)
4. Move the cursor up or down to "T".
5. Key in "0" (zero) and press the Input key.
6. Press the Cycle Start push button. This will unload the spindle.
7. Open the tool magazine door on the side of the machine.
8. Use push button "E" or "F", Figure 1.2, to index the tool magazine to the desired tool pocket.

### **- NOTE -**

When loading a tool into the tool magazine, be sure the tool identification marker faces the operator.

9. Manually load the tool into the magazine.
10. Repeat steps 8 and 9, as needed.
11. Close the tool magazine door

## **LOAD TOOL INTO THE SPINDLE**

12. Press the T,S,M soft key. (Horizontal soft key menu)
13. Press the Tools soft key. (Vertical soft key menu)
14. Move the cursor up or down to the desired tool.
15. Press the In Manual soft key.
16. Press the Cycle Start push button. This will load the tool into the spindle.

## **MANUALLY INDEXING A TOOL MAGAZINE**

1. Select Manual mode.
2. Press the appropriate push button ("E" or "F", Figure 1.2) to rotate the tool magazine in the desired direction.
3. Release the push button when the required tool pocket is positioned at the desired position.

## SETTING THE WORK COORDINATES

### SET THE Z WORK COORDINATE TO ZERO

#### - NOTE -

The top of the workpiece is set to Z zero for ease of programming.

This procedure makes use of a 2 inch gauge block.

1. Select Manual mode.
2. If a tool is in the machine spindle:

#### - WARNING -

**DO NOT attempt to hold the tool and tool holder by gripping the cutting tool. Personal injury could result. Be sure to have a firm grip on the tool holder body.**

**When removing tooling from the machine spindle, be prepared to accept the weight of the tool and tool holder.**

- a) Open the main guard door.
  - b) Obtain a firm grip on the tool holder body.
  - c) Press and hold Tool Release push button "H", Figure 1.3, to release the tool in the spindle.
  - d) Release the Tool Release push button.
3. Close the main guard door.
  4. Use X and/or Y axis direction keys to jog the table to position the workpiece under the spindle.
  5. Press the -Z axis direction key to jog the spindle face to a position approximately three inches above the workpiece.
  6. Press the MPG Enable push button.
  7. Turn the handwheel axis select switch to the Z Axis and increment select switch to X10. This setting will allow the operator to move the axes .001 inch for every line on the dial.

The Increment Select switch settings are as follows:

Switch Setting	Movement Increment	
	English (In.)	Metric (mm)
X100	.010	.1
X10	.001	.01
X1	.0001	.001

**- CAUTION -**

**Use caution when touching off spindle face to the gauge block. Be sure the spindle keys do not interfere with the block.**

8. Turn the handwheel in the correct direction to move the spindle face down until the 2.0" side of the gauge block slides between the spindle face and workpiece.

9. Press the Work Measure soft key. (Horizontal soft key menu)

10. Set the Z axis work coordinate:

a) Press the Edge> soft key. (Vertical soft key menu)

b) Press the Z soft key. (Vertical soft key menu)

c) Press the Cursor up or down to Z OFFS.

d) Press the Alternate soft key to select the desired work coordinate system on the vertical soft key menu:

1 = G54	9 = G509	17 = G517	25 = G525	33 = G533	41 = G541
2 = G55	10 = G510	18 = G518	26 = G526	34 = G534	42 = G542
3 = G56	11 = G511	19 = G519	27 = G527	35 = G535	43 = G543
4 = G57	12 = G512	20 = G520	28 = G528	36 = G536	44 = G544
5 = G505	13 = G513	21 = G521	29 = G529	37 = G537	45 = G545
6 = G506	14 = G514	22 = G522	30 = G530	38 = G538	46 = G546
7 = G507	15 = G515	23 = G523	31 = G531	39 = G539	47 = G547
8 = G508	16 = G516	24 = G524	32 = G532	40 = G540	48 = G548

e) Press the cursor down key to Z0.

f) Key in the dimension of the gauge block: 2.0

g) Press the Input key.

h) Press the Work Measure key (Vertical soft key menu). This will set the Z axis work coordinate.

11. Press the Work Offset key (Vertical soft key menu) to verify the selected work coordinate.

12. Press the In Manual soft key (Vertical Soft key menu) to return to the Set Work Offset page.

13. Press the Abort soft key (Vertical soft key menu) to return to the basic menu.

## SET THE X WORK COORDINATE TO ZERO

### - NOTE -

The operator or setup person should know where the X zero of the workpiece is programmed. This information may be obtained from the programmer or setup sheet.

1. Select Manual mode.
2. Open the main guard door.
3. Press and hold Tool Release push button "H", Figure 1.3 .
4. Install the Edge Finder in the spindle. The tool ID marker must point to the right.
5. Release the Tool Release push button.
6. Close the main guard door.
7. Press the X and/or Y axis direction keys to jog the table to the X0 (zero) side of the workpiece.
8. Press the -Z axis direction key to jog the edge finder down to a position approximately one inch above the workpiece.
9. Press the MPG Enable push button.
10. Turn the handwheel axis select switch to Z axis and set the increment select switch to X10. This setting will allow the operator to move the axes .001 inch for every line on the dial

The Increment Select switch settings are as follows:

Switch Setting	Movement Increment	
	English (In.)	Metric (mm)
X100	.010	.1
X10	.001	.01
X1	.0001	.001

11. Turn the handwheel in the correct direction so the edge finder moves down below the top of the work surface.
12. Start spindle motion:
  - a) Press the T,S,M soft key. (Horizontal soft key menu)
  - b) Move the cursor down to S.
  - c) Key in 1000 (for spindle speed).
  - d) Press the Input key. The cursor will move down to Spindle.
  - e) Press Alternate soft key to select spindle direction.
  - f) Press the Input key.
  - g) Press the Cycle Start push button. The spindle will start.
  - h) Press the Back soft key to return to basic menu.

13. Turn the handwheel axis select switch to the X position and the increment select switch to X10.
14. Turn the handwheel in the correct direction until the edge finder makes contact with the side of the workpiece.
15. Press the Spindle Stop push button.
16. Turn the handwheel axis select switch to the Z position.
17. Turn the handwheel in +Z (positive) direction to move the edge finder away from the workpiece.
18. Turn the handwheel axis select switch to the X position.
19. Turn the handwheel in the X direction until  $\frac{1}{2}$  of the edge finder is over the workpiece.  
(Example : .200 dia. edge finder, move  $X\pm.100$ ).
20. Press the Work Measure soft key. (Horizontal soft key menu)
21. Set the X axis work coordinate:
  - a) Press the Edge> soft key. (Vertical soft key menu)
  - b) Press the X soft key. (Vertical soft key menu)
  - c) Move the cursor up or down to Zero Offset.
  - d) Press the Alternate soft key to select the work coordinate system.
  - e) Press the Input key. The cursor will move down to direction X.
  - f) Press the Alternate soft key to select the +X or -X side of the workpiece.
  - g) Press the Input key. The cursor will move down to X0.
  - h) Key in 0 and press the Input key.
  - i) Press the Work Measure soft key. (Vertical soft key menu) This will set the X axis work coordinate.
22. Press the Work Offset soft key to verify the work coordinate.
23. Press the In Manual soft key (Vertical Soft key menu) to return to the Set Work Offset page.
24. Press the Abort soft key. (Vertical soft key menu)
25. Press the Back soft key to return to the basic menu

## SET THE Y WORK COORDINATE TO ZERO

### - NOTE -

The Edge Finder should be in spindle.

The operator or setup person should know where the Y zero of the workpiece is programmed. This information can be obtained from the programmer or setup sheet.

1. Select Manual Mode.
2. Close the main guard door.
3. Press the X and/or Y axis direction keys to jog the table to the Y0 (zero) side of the workpiece guard door must be closed.
4. Press the Z Axis direction key to jog the edge finder down to a position approximately one inch above the workpiece.
5. Press the MPG Enable push button
6. Turn the handwheel axis select switch to Z axis and set the increment select switch to X10. This setting will allow the operator to move the axes .001 for each line on the dial.

The Increment Select switch settings are as follows:

Switch Setting	Movement Increment	
	English (In.)	Metric (mm)
X100	.010	.1
X10	.001	.01
X1	.0001	.001

7. Turn the handwheel in the correct direction so the edge finder moves down below the top of the work surface.
8. Start spindle motion:
  - a) Press the T,S,M soft key. (Horizontal soft key menu)
  - b) Move the cursor down to S.
  - c) Key in 1000 (for spindle speed).
  - d) Press the Input key. The cursor will move down to Spindle.
  - e) Press Alternate soft key to select spindle direction.
  - f) Press the Input key.
  - g) Press the Cycle Start push button. The spindle will start.
  - h) Press the Back soft key to return to basic menu.

9. Turn the handwheel axis select switch to the Y position and the increment select switch to X10.
10. Turn the handwheel in the correct direction until the edge finder makes contact with the side of the workpiece.
11. Press the Spindle Stop push button.
12. Turn the handwheel axis select switch to the Z position.
13. Turn the handwheel in the +Z (positive) direction to move the edge finder away from the workpiece.
14. Turn the handwheel axis select switch to the Y position.
15. Turn the handwheel in the Y direction until  $\frac{1}{2}$  of the edge finder is over the workpiece.  
(Example : .200 dia. edge finder, move  $X\pm.100$ ).
16. Press the Work Measure soft key. (Horizontal soft key menu)
17. Set the Y axis work coordinate:
  - a) Press the Edge> soft key. (Vertical soft key menu)
  - b) Press the Y soft key. (Vertical soft key menu)
  - c) Move the cursor up or down to Zero Offset.
  - d) Press the Alternate soft key to select the work coordinate system.
  - e) Press the Input key. The cursor will move down to direction Y.
  - f) Press the Alternate soft key to select the +Y or -Y side of the workpiece.
  - g) Press the Input key. The cursor will move down to Y0.
  - h) Key in 0 and press the Input key.
  - i) Press the Work Measure soft key. (Vertical soft key menu) This will set the Y axis work coordinate.
18. Press the Work Offset soft key to verify the work coordinate.
19. Press the In Manual soft key (Vertical Soft key menu) to return to the Set Work Offset page.
20. Press the Abort soft key. (Vertical soft key menu)
21. Press the Back soft key to return to the basic menu
22. Press the +Z axis direction key to move the Edge Finder up a safe distance away from the workpiece.

## SET TOOL LENGTH OFFSETS

### - NOTE -

All tool length offsets must be touched off from the G54 (01) work coordinate position. G54 is the machine default.

This procedure makes use of a 2 inch gauge block.

1. Select Manual mode.
2. Close the main guard door.
3. Load a tool from the tool magazine into the spindle:
  - a) Press the T,S,M soft key. (Horizontal soft key menu)
  - b) Press the Tools soft key. (Vertical soft key menu)
  - c) Move the cursor up or down to the desired tool.
  - d) Press the In Manual soft key.
  - e) Press the Cycle Start push button. The selected tool will be loaded into the spindle.
4. Press the X, Y, and Z axis direction keys to jog the tool to a position approximately 3 inches above workpiece.
5. Press the MPG Enable push button
6. Turn the handwheel axis select switch to the Z position and increment select switch to X10. This setting will allow the operator to move the axes .001 for each line on the dial.

The Increment Select switch settings are as follows:

Switch Setting	Movement Increment	
	English (In.)	Metric (mm)
X100	.010	.1
X10	.001	.01
X1	.0001	.001

7. Turn the handwheel in the correct direction to move the tool close to the 2.0" side of the gauge block until the gauge block slides between bottom of the tool and workpiece.

8. Set the tool length offset:
  - a) Press the Measure Tool soft key. (Horizontal soft key menu)
  - b) Press the Length Manual> soft key. (Vertical soft key menu)
  - c) Move the cursor down to Z0.
  - d) Key in 2.0 and press the Input key.
  - e) Press the Set Length soft key. (Vertical soft key menu) This will set the tool length offset.
9. Press the Tools soft key. (Vertical soft key menu) The tool in the spindle will be at the top of the tool list.

**- NOTE -**

The tool length that is in the tool file can be checked by measuring from the spindle face to the tip of the tool.

All tool lengths will be a positive value.

## PROGRAM CONTROL

### ACTIVATE A STORED PROGRAM

1. Press the Basic menu key.
2. Press the Program Manager soft key.
3. Move the cursor to the desired file directory and press the Input key.
4. Move the cursor to the desired program file and press the Input key. The selected program file will be activated.

### MAKE THE FIRST PART

1. Activate a stored program
2. Press the Machine From Here soft key.
3. Press the ROV Rapid Traverse push button.
4. Turn the Rapid/Feedrate Override switch to 10%.
5. Press the Cycle Start push button.

#### - NOTE -

Turning the Rapid/Feed Override switch to zero percent when a rapid command is active will stop axis motion. Axis motion will continue when the Rapid/Feed Override switch is set to any non-zero value.

The Program Check page will show the Absolute Position and Distance To Go to complete the move.

Single Block mode is used for first part set-up for block by block execution.

## REPEAT A TOOL OPERATION

### - CAUTION -

**Use extreme caution when repeating a tool operation, especially after an edit has been made.**

1. Press the Block Search soft key.
2. Move the cursor to the desired tool operation.
3. Press the Start Search soft key.

### - NOTE -

Once the control finds the selected operation, it will then prompt the operator to initiate NC start (Cycle Start).

4. Set the Feed/Rapid Override switch to desired percent.
5. Press the Cycle Start push button.

## DISPLAY THE PROGRAM DIRECTORY

1. Press the Basic Menu key.
2. Press the Program Manager soft key.

## DELETE A PROGRAM FROM MEMORY

1. Press the Basic Menu key.
2. Press the Program Manager soft key.
3. Move the cursor to the desired folder and press the Input key.
4. Move the cursor to the desired program file.
5. Press the Cut soft key. The program will be deleted.

- NOTES -

# CHAPTER 2 - OPERATOR MAINTENANCE

## INTRODUCTION

Operator maintenance is normally confined to cleaning the machine, maintaining the lubrication oil and coolant levels, and chip removal. It is a good practice to check all fluid levels at the beginning of each shift. The operator should also check the cooling fans periodically to see that they are free of obstructions and functioning properly.

For more extensive maintenance procedures, refer to the maintenance manual (M-379).

## MACHINE AIR SYSTEM

The machine is equipped with a heavy duty air filter/regulator and air/oil lubricator assembly, shown in Figures 2.1 and 2.2 .

### AIR LINE FILTER/REGULATOR

#### - NOTE -

Main air valve “D”, Figure 2.1, should be turned OFF when the machine is not in use.

### Adjusting the Machine Air Pressure

The recommended range for machine air pressure is 58 psig [4.0 bars] to 87 psig [6.0 bars]. The machine is equipped with an air pressure sensor that will force the machine into Emergency Stop if the air pressure is outside of this range. Machine air pressure is displayed on gauge “C”, Figure 2.1 .

If necessary, adjust the air filter/regulator to set the machine air pressure to within the recommended range.

1. Push main air valve “D”, Figure 2.1, upward to turn the machine air ON.
2. Loosen lock nut “B”.
3. Turn handle “A” clockwise or counterclockwise to increase or decrease machine air pressure.
4. Tighten lock nut “B”.

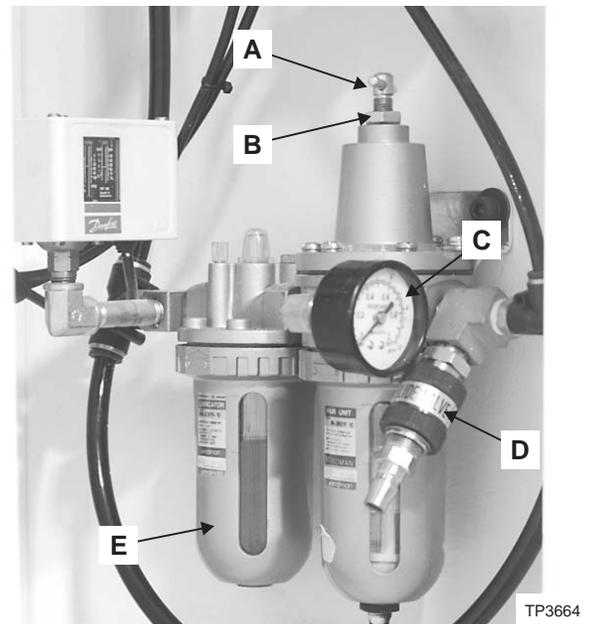


Figure 2.1 - Air Control System

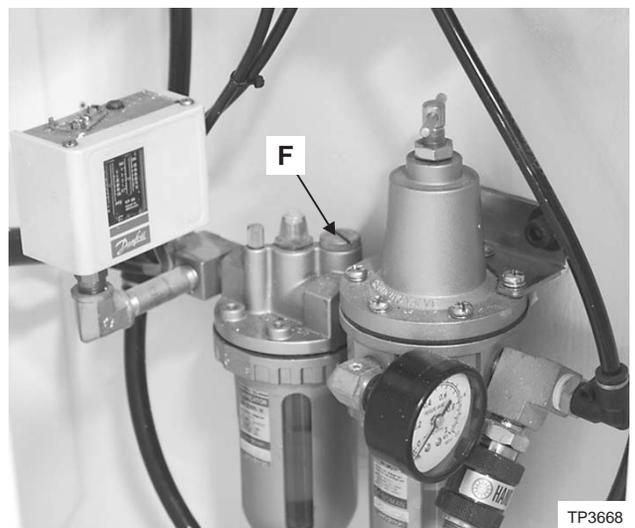


Figure 2.2 - Air/Oil Lubricator Filler Cap

## AIR/OIL LUBRICATOR

### - NOTE -

The air/oil lubricator DOES NOT mix oil with the air supplied to the operator air nozzle located at the front of the machine.

Air/oil lubricator “E”, Figure 2.1, mixes oil with the air supplied to the machine.

### FILLING THE AIR/OIL LUBRICATOR

### - WARNING -

**Failure to properly relieve the machine air pressure can result in personal injury.**

### - NOTE -

Refer to the tag mounted near the air/oil lubricator to identify the lubrication oil to be used.

1. Pull main air valve “D”, Figure 2.1, downward to turn the machine air OFF.
2. Relieve the air system pressure:
  - a) Disconnect the air line from the main air valve.
  - b) Push the main air valve upward to open the valve and relieve the air pressure.
  - c) Pull the main air valve downward to close the main air valve when system pressure is relieved.
3. Unthread filler cap “F”, Figure 2.2 .
4. Fill the lubricator bowl to the top of the sight window with the specified oil.
5. Replace filler cap “F”.
6. Connect the air line to the main air valve.
7. Push the main air valve upward to turn the machine air ON.
8. Press the Reset push button.

## COOLANT SYSTEM

Hardinge machine tools are designed using the latest technology and highest quality materials available. However, due to the ever-increasing number of coolant selections available, it is impossible to test material compatibility with each and every coolant. For additional information regarding the coolant facilities on this machine, refer to the maintenance manual (M-379).

### - CAUTION -

**Whenever water-soluble coolants are used it is important to use the manufacturer's recommended mix ratio (concentration). It is also important to maintain the coolant by keeping the proper concentration level when coolant solution is added to compensate for evaporation. Another important factor is coolant pH (acidity). Typically, the coolant pH should be in the range of 8.5 to 9. Below 8.5 the rust inhibitors in the coolant start depleting, which can result in corrosion of machine components. In addition, the quality of the water should be tested by the coolant manufacturer so that the proper coolant additives can be administered. Failure to follow these recommendations could result in damage to the machine, seals, and paint.**

**If the coolant you have selected starts to react (cause material to rust, pit, swell, soften, crack, blister etc.) with any portion of the machine tool, Hardinge suggests that you discontinue use and contact your coolant representative for alternative coolants.**

**It should also be noted that certain chemicals react with different metals. Hardinge recommends that you consult with your coolant representative to assure that the material you are cutting does not react with the coolant you have selected.**

The coolant level should not be allowed to fall below sight gauge "I", Figure 2.4 . To fill the coolant tank, open the front coolant guard doors and pour the required amount of coolant directly into the chip pan. Fill the coolant tank to the "FULL" line on the sight gauge tag. Either water-based or oil-based coolant can be used.

The coolant tank should be drained and cleaned at least every six months or whenever the type or brand of coolant is changed. More frequent cleaning may be required if the material being machined contaminates the coolant. Refer to the maintenance manual (M-379) for instructions on draining and cleaning the coolant system.

### COOLANT TANK CAPACITY

Approximate coolant tank capacities are shown in the following chart:

Machine Models	Coolant Tank Capacity
VMC600II, 800II, and 1000II Machines	40 gallons [150 liters]
VMC1250II and 1500II Machines	80 gallons [300 liters]

## CHIP REMOVAL (Machines Without an Optional Chip Conveyor)

The machine is equipped with two chip pans. The chip pans are accessed from each side of the machine. The chip pans are indicated by "G", Figure 2.3, and "H", Figure 2.4 .

1. Power down the machine as outlined on page 1-4.
2. Wait a few minutes to allow the coolant to drain into the coolant tank.
3. Position the chip receptacle near the chip pan to be emptied.
4. Remove the chip pan from the machine.

**- WARNING -**

**DO NOT remove chips with your hands.**

5. Pour, rake, or shovel the chips into the chip receptacle.
6. Replace the chip pan.
7. Repeat steps 4 through 6 for the other chip pan.



Figure 2.3 - Left Side Chip Pan

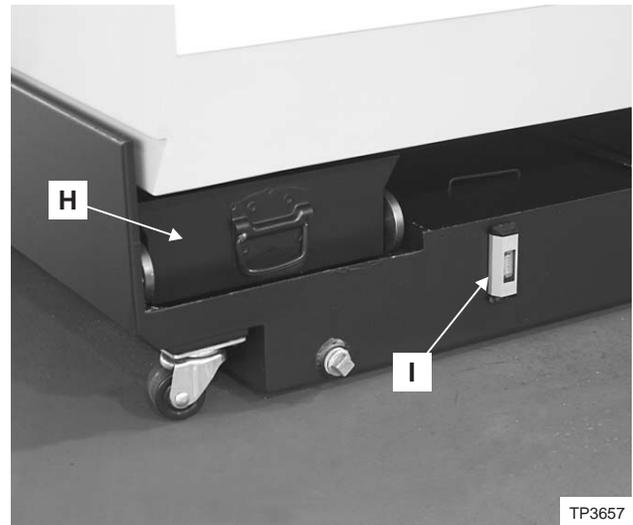


Figure 2.4 - Right Side Chip Pan

- NOTES -

- NOTES -

# CHAPTER 3 - TOOL CHANGE RECOVERY

## INTRODUCTION

The tool change is designed with an automatic recovery feature that should allow recovery under all interrupt conditions, including an operator Reset, Emergency Stop and power OFF.

Under normal conditions the ATC Cycle key on the control panel can be used to re-start the tool change sequence after the interruption. The message "510309 Tool Change Cycle Interrupted" will also be displayed once any Emergency Stop message is cleared to indicate an interruption to the tool change sequence. A status pointer in the NC tracks the tool change step-by-step and allows the cycle to be restarted at the point the interrupt occurred.

When the tool change sequence is interrupted by a power OFF, the Z axis will be referenced by the cycle at the appropriate point to allow for safe completion of the cycle. Referencing the Z axis either manually or with the auto reference is not allowed by the interlocks. Cycle start is also inhibited until the tool change cycle is completed.

Under circumstances where the standard recovery feature does not work it is possible to cancel the tool change interrupt and recover the system manually.

## RECOVERY PROCEDURE

### - NOTE -

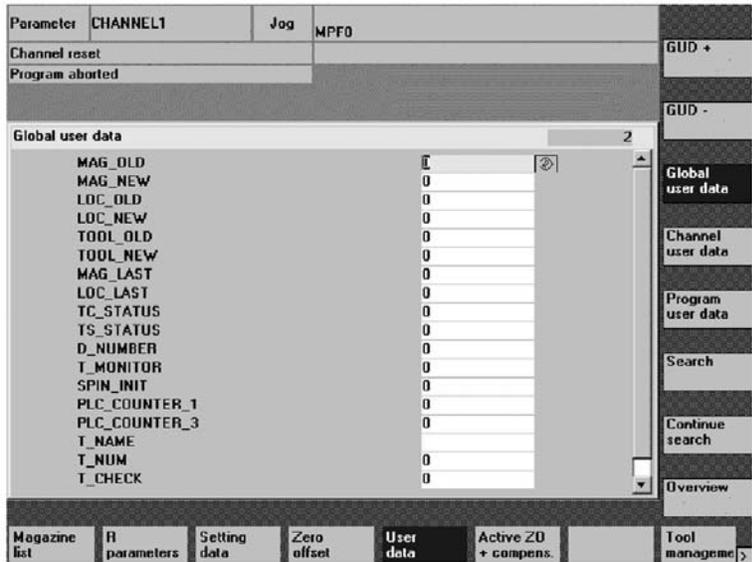
The recovery can be done either from the CNC ISO or ShopMill interface.

1. Release the Emergency Stop must be released and clear alarm "3000 Emergency Stop".
2. Use the Menu Select key to change to {Offset} in ShopMill or {Parameter} area in ISO.
3. ISO mode: Press the horizontal User Data soft key.  
ShopMill mode: Use the > key; then, press the horizontal User Data soft key.
4. Press the vertical Global User Data soft key and use the vertical GUD + and GUD - soft keys to locate GUD area #2. This is shown in Figure 3.1 for ISO & Figure 3.2 for ShopMill.
5. Move the cursor to the data entry field for the variable "TC\_Status". "TC\_Status" tracks the tool change status.
6. Enter the value "99" and press the Input key to accept the data.
7. Press the ATC Cycle key and the tool change message will be canceled, the cycle will complete, and "TC\_Status" will return to its "tool change complete" status of "0".

The alarm "700018 System Tool Data May Not Match Machine After Interrupt!" will be displayed to warn that the tool magazine may not match the current NCK tool management data.

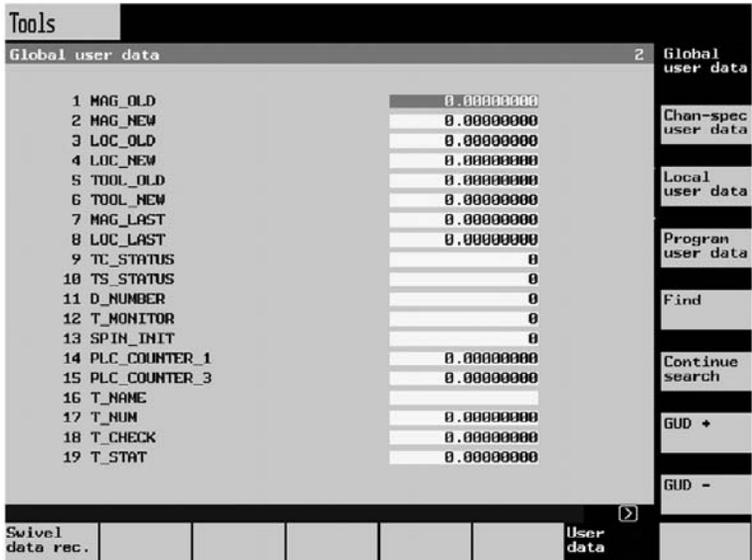
At this point the PLC interrupt is cleared, which will allow operation of the normal machine functions with the standard interlocks in place.

Magazine advance/retract & tool clamp/unclamp can be controlled by M Codes as required. The Z axis can be jogged without referencing, but care must be taken as no soft limit is active! If the axis is referenced a 2nd soft limit will prevent jogging lower than the tool change position.



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Figure 3.1 - CNC ISO Global User Data Area #2



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Figure 3.2 - ShopMill Global User Data Area #2

**- NOTE -**

It is now critical to make sure that the actual tool magazine matches the NCK tool management data. The tool change is acknowledged to the NCK at the start of the cycle so until the tool is physically changed the hardware & software do not match.

The current active tool can be seen on the CNC ISO interface at the lower right area of the screen at the field labeled "Tool" & on the ShopMill interface at the upper right area of the screen in the box "T,F,S" in the field labeled "T". If no active tool is displayed then there should be no tool in the spindle.

8. Make sure that the current active tool is physically in the spindle. If it is not, it needs to be placed there manually. Remove it from the magazine and use the manual unclamp push button to place it in the spindle. If the old tool has not yet been placed back in the magazine, it also needs to be done manually.

The current software status of the NCK tool management is clearly shown in the ShopMill tool table as shown in Figure 3.3. Tools are listed with the spindle listed first against the spindle icon and other tools listed in order of the magazine locations.

The tool change system is now reset.

The tool setup operation has the same type of interrupt setup as the tool change cycle. There are two key tool setup sequences, tool-to-tool & tool-to-magazine.

The message "510315 Tool Setup Cycle Interrupted" will be displayed for a setup interruption. One key difference between the setup & change cycles is when the NCK active tool is updated, the change cycle updates the NCK at the start as it has defined what is the next tool, the setup cycle updates the NCK at the end as it waits to see which tool has been loaded to the spindle.

**- NOTE -**

The method of canceling the tool setup cycle is the same as for the tool change.

The pointer for tracking the to setup cycle is "TS\_Status", so enter "TS\_Status" as "99" and press the Tool to Tool or the Tool to Mag key depending on which routine is interrupted.

The definitions for the TC\_STATUS & TS\_STATUS codes are shown on the following pages.

Loc	Typ	Tool name	DP 1st cutting edge		Angle	H	Spindle	
			Length	ϕ			1	2
1	[Spindle Icon]	1	102.000	1.0000		4	[X]	[ ]
2	[Tool Icon]	2	1.0000	1.0000		2	[X]	[ ]
3	[Tool Icon]	3	0.0000	0.0000		0	[X]	[ ]
4	[Tool Icon]	4	0.0000	0.0000	0.0	0	[X]	[ ]
5	[Tool Icon]	5	0.0000	0.0000		0	[X]	[ ]
6	[Tool Icon]	6	0.0000	0.0000		0	[X]	[ ]
7	[Tool Icon]	7	0.0000	0.0000		0	[X]	[ ]
8	[Tool Icon]	8	0.0000	0.0000		0	[X]	[ ]
9	[Tool Icon]	9	0.0000	0.0000		0	[X]	[ ]
10	[Tool Icon]	10	0.0000	0.0000		0	[X]	[ ]
11	[Tool Icon]	11	0.0000	0.0000		0	[X]	[ ]
12	[Tool Icon]	12	0.0000	0.0000		0	[X]	[ ]
13	[Tool Icon]	13	0.0000	0.0000		0	[X]	[ ]

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Figure 3.3 - ShopMill Tool List

## TC\_STATUS CODE DEFINITIONS

### Machine Not Equipped with Swing-Arm Tool Changer

TC_Status Code	Completed	In Progress
0	Normal state when tool change has successfully completed.	Acknowledge tool change to NCK.
1	Tool change acknowledged to NC.	Interrogation of tool change routine as Tool-to-Tool, New Tool Only or T0.
2	Interrogation of tool change routine.	Tool-to-Tool: Z to tool change position, spindle orientation & magazine rotation to old tool location.
11	Z axis at tool change position, spindle oriented & magazine rotated to old tool location.	Magazine advance.
12	Magazine advanced.	Old tool unclamp from spindle, Z axis up to clear tool taper & magazine rotate to new tool location.
13	Old tool unclamped from spindle, Z axis clear of tool taper & magazine rotated to new tool location.	Z axis down to change position.
14	Z axis at tool change position.	New tool clamp in spindle, magazine retract & spindle orientation cancel.
15	New tool clamped in spindle, magazine retracted & spindle orient canceled.	New Tool Only: Z to tool change position, spindle orientation & magazine rotation to new tool location.
21	Z axis at tool change position, spindle oriented & magazine rotated to new tool location.	Magazine advance & spindle unclamp.
22	Magazine advanced & spindle unclamped.	Z axis down to change position.
23	Z axis at tool change position.	New tool clamp in spindle, magazine retract & spindle orientation cancel.
24	New tool clamped in spindle, magazine retracted & spindle orient canceled.	T0: Z to tool change position, spindle orientation & magazine rotation to old tool location.
31	Z axis at tool change position, spindle oriented & magazine rotated to old tool location.	Magazine advance.
32	Magazine advanced.	Old tool unclamp from spindle & Z axis up to clear tool taper.
33	Old tool unclamped from spindle & Z axis clear of tool taper.	Spindle clamp (empty), magazine retract & spindle orientation cancel.
34	Spindle clamped (empty), magazine retracted & spindle orient canceled.	Not applicable.

## Machine Equipped with Swing-Arm Tool Changer

TC_Status Code	Completed	In Progress
0	Normal state when tool change has successfully completed.	Acknowledge tool change to NCK.
1	Tool change acknowledged to NC.	Z axis to change position, spindle orientation & magazine rotation to change position.
2	Z axis at change position, spindle oriented & magazine rotated to change position.	Tool pot swing to spindle, tool exchange & tool pot swing to magazine.
3	Tool pot swung to spindle, tools exchanged & tool pot swung to magazine.	Not applicable.

## TS\_STATUS CODE DEFINITIONS

### Machine Not Equipped with Swing-Arm Tool Changer

TS_Status Code	Completed	In Progress
0	Normal state when tool setup has successfully completed.	Check condition of next tool for tool setup.
1	Tool setup condition checked.	Interrogation of tool setup routine as Tool-to-Tool, First Tool or Last Tool to Magazine.
2	Interrogation of tool setup routine.	Tool-to-Tool: Z to tool change position & spindle orientation.
11	Z axis at tool change position & spindle oriented.	Magazine advance.
12	Magazine advanced.	Old tool unclamp from spindle, Z axis up to clear tool taper & magazine rotate to next valid tool location.
13	Old tool unclamped from spindle, Z axis clear of tool taper & magazine rotated to next valid tool location.	Z axis down to change position.
14	Z axis at tool change position.	Next valid tool clamp in spindle, magazine retract, spindle orientation cancel & acknowledge tool change to NCK.
15	Next valid tool clamped in spindle, magazine retracted, spindle orient canceled & tool change acknowledged to NCK.	First Tool: Z to tool change position & spindle orientation.
21	Z axis at tool change position & spindle oriented.	Magazine advance & spindle unclamp.
22	Magazine advanced & spindle unclamped.	Z axis down to change position.
23	Z axis at tool change position.	Next valid tool clamp in spindle, magazine retract, spindle orientation cancel & acknowledge tool change to NCK.
24	Next valid tool clamped in spindle, magazine retracted, spindle orient canceled & tool change acknowledged to NCK.	Last Tool to Magazine: Z to tool change position & spindle orientation.
31	Z axis at tool change position & spindle oriented.	Magazine advance.
32	Magazine advanced.	Last tool unclamp from spindle & Z axis up to clear tool taper.
33	Last tool unclamped from spindle & Z axis clear of tool taper.	Spindle clamp (empty), magazine retract, spindle orientation cancel & acknowledge tool change to NCK.
34	Spindle clamped (empty), magazine retracted, spindle orient canceled & tool change acknowledged to NCK.	Not applicable.

## Machine Equipped with Swing-Arm Tool Changer

TS_Status Code	Completed	In Progress
0	Normal state when tool setup has successfully completed.	Check condition of next tool for tool setup.
1	Tool setup condition checked.	Interrogation of tool setup routine as Tool-to-Tool, First Tool or Last Tool to Magazine.
2	Interrogation of tool setup routine.	Tool-to-Tool: Z to tool change position, spindle orientation & magazine rotation to next valid location.
11	Z at tool change position, spindle oriented & magazine rotated to next valid location.	Tool pot swing to spindle, tool exchange & tool pot swing to magazine.
12	Tool pot swung to spindle, tools exchanged & tool pot swung to magazine.	Acknowledge tool change to NCK.
13	Tool change acknowledged to NCK.	First Tool: Z to tool change position & spindle orientation.
21	Z axis at tool change position & spindle oriented.	Tool pot swing to spindle, tool exchange & tool pot swing to magazine.
22	Tool pot swung to spindle, tools exchanged & tool pot swung to magazine.	Acknowledge tool change to NCK.
23	Tool change acknowledged to NCK.	Last Tool to Magazine: Z to tool change position & spindle orientation.
31	Z axis at tool change position & spindle oriented.	Tool pot swing to spindle, tool exchange & tool pot swing to magazine.
32	Tool pot swung to spindle, tools exchanged & tool pot swung to magazine.	Acknowledge tool change to NCK.
33	Tool change acknowledged to NCK.	Not applicable.

## SWING ARM SPECIAL FEATURES

### - NOTE -

All of the preceding information in this chapter is also valid for the swing-arm type tool changer.

There are also some extended setup/recovery features available for the swing-arm type tool changer, as follows.

Option MD14512[12] Bit 1 can be used to activate the swing-arm tool change service mode function. Alternately from the PLC STATUS function page change DB20.DBX12.1 from “0” to “1” to temporarily enable the service mode. Message “700049 Warning - Swing Arm ATC Service Mode!” will appear when the service mode is active.

With the service mode active the MCP axis jog & rapid keys can be used to move the swing arm through its 3 step engage, exchange & disengage sequence.

- +X Moves the swing arm through its first sequence step, “engage”, from “disengage” position to the “engage” position.
- X Moves the swing arm reverse through its first sequence step from the “engage” position back to the “disengage” position.
- +Y Moves the swing arm through its second sequence step, “exchange”, from the “engage” position to the “exchange” position.
- Y Moves the swing arm reverse through its second sequence step from the “exchange” position to the “engage” position.
- +Z Moves the swing arm through its third sequence step, “disengage”, from the “exchange” position to the “disengage” position.
- Z No function.
- Rapid Moves the swing arm through its entire “engage”, “exchange” & “disengage” sequence continuously as long as the key is pressed.

### - NOTE -

The axis jog keys do not control axis motion while the swing-arm service mode is active.

Although the swing arm sequence involves 3 distinct steps the single M Code M86 controls each step. The PLC decodes the current swing arm position from limit switches integrated on the swing arm mechanism to determine the next step when an M86 is programmed. If the swing arm overtravels its position on any sequence step M86 cannot respond as the current position will be effectively invalid. Overtraveling of the swing arm must be corrected with mechanical adjustments.

## PLC COUNTER RESET

The tool magazine counters are PLC based counters and must be reset after any Series Startup file is read-in.

### - NOTE -

The reset procedures are also valid for any other loss of position.

### RESET WITH AN MDA PROGRAM

1. Rotate the left side standard single magazine or swing arm magazine so that position #1 is at the change position.
2. If the right side magazine is fitted rotate it so that position #21 is at the change position.
3. Enter the following program in MDA mode (refer to Figure 3.4):

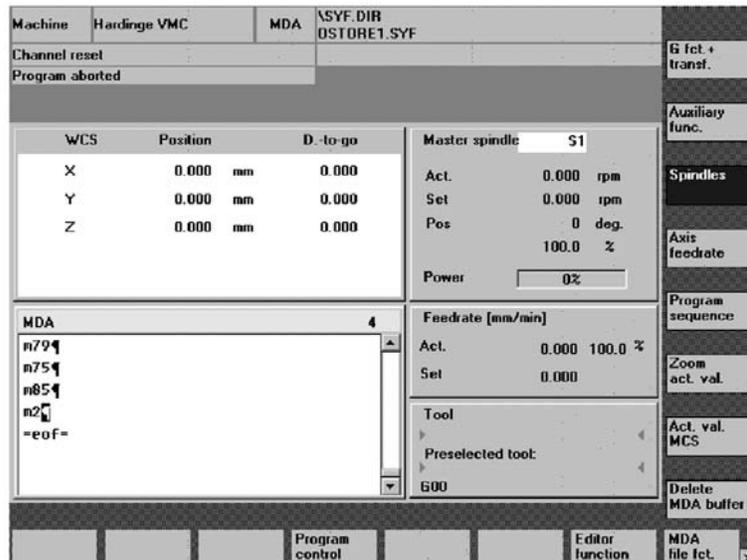
M79

M75

M85

M2

4. Press the Cycle Start key.
5. The counters for the magazine are now reset.



TP5655

Figure 3.4 - MDA Program Screen

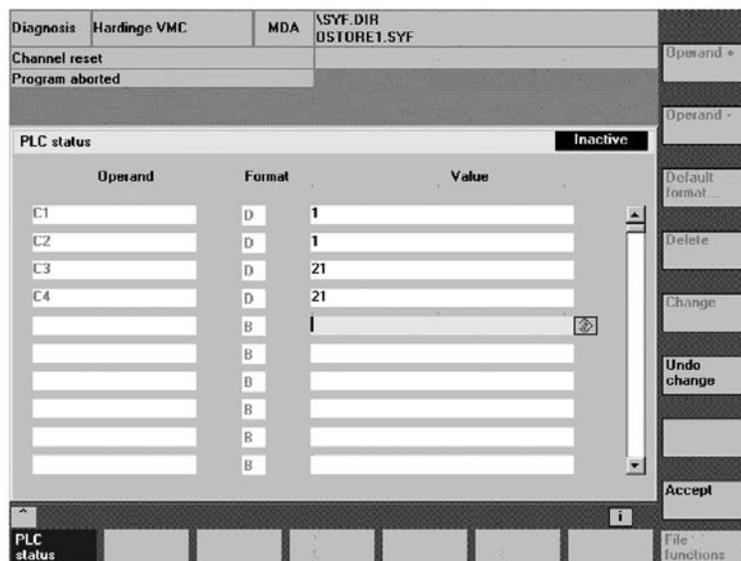
## RESET BY FORCING PLC COUNTER VALUES

1. Rotate the left side standard single magazine or swing arm magazine so that position #1 is at the change position.
2. If the right side magazine is fitted rotate it so that position #21 is at the change position.
3. Press the Menu Select key and horizontal Diagnosis soft key to change to the Diagnosis area.
4. Press the horizontal PLC Status soft key to display the PLC Status screen (refer to Figure 3.5).
5. Press the vertical Delete & OK soft keys to clear the current entries.
6. Type the entries C1 & C2 for the left side single or swing arm magazines. Additionally type in C3 & C4 when the right side magazine is fitted.
7. Change the "Format" to "D" for decimal by moving the cursor to the "Type" column and toggling with the Select key.
8. Press the vertical Change soft key to change the values.
9. Enter 1 for C1 & C2 and 21 for C3 & C4 if necessary and press the vertical Accept soft key to force the change into the counters.

### - NOTE -

An alarm or alarms will appear when the values are accepted. These are only transitional alarms as the values are changed.

10. Press Reset to clear the alarm(s).
11. The counters for the magazine are now reset.



TP5656

Figure 3.5 - PLC Status Screen

- NOTES -

- NOTES -

# APPENDIX

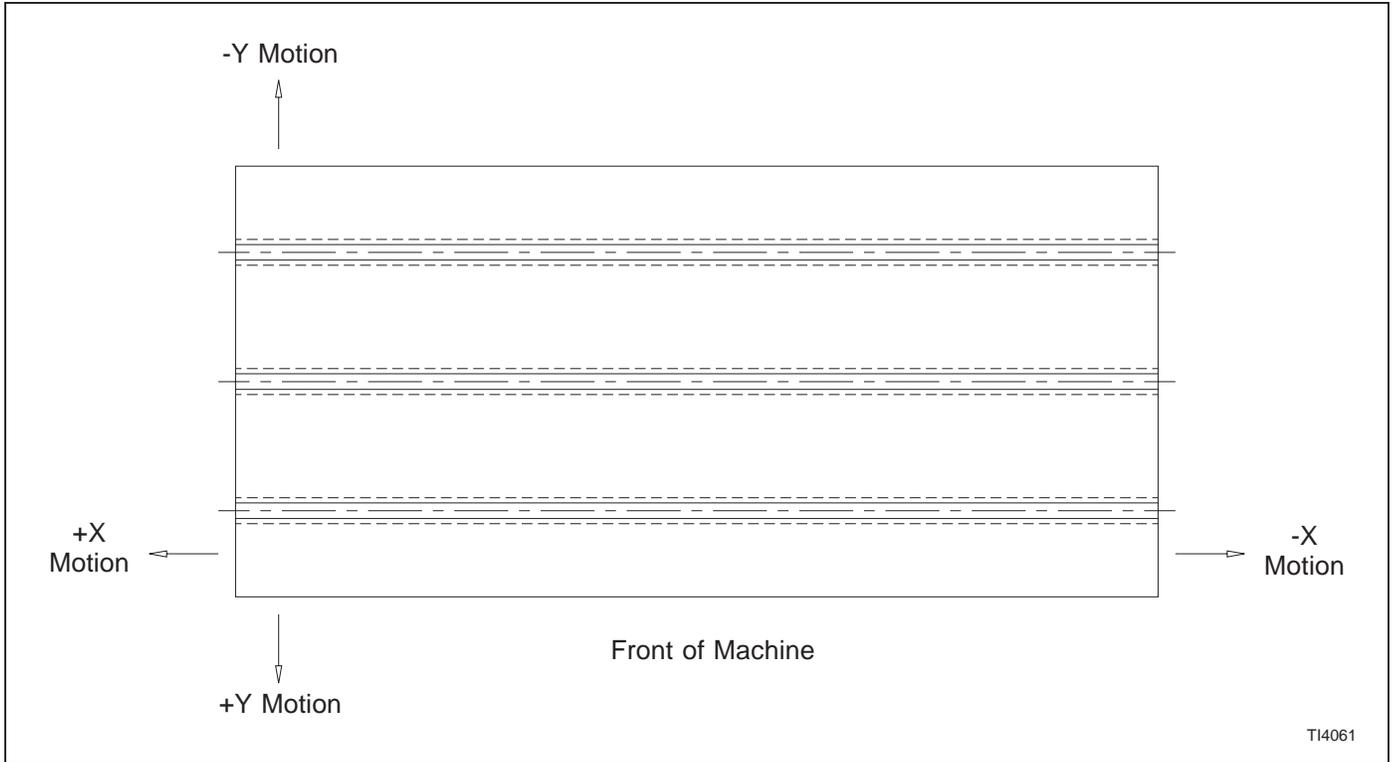


Figure A.1 - X and Y Axis Definition

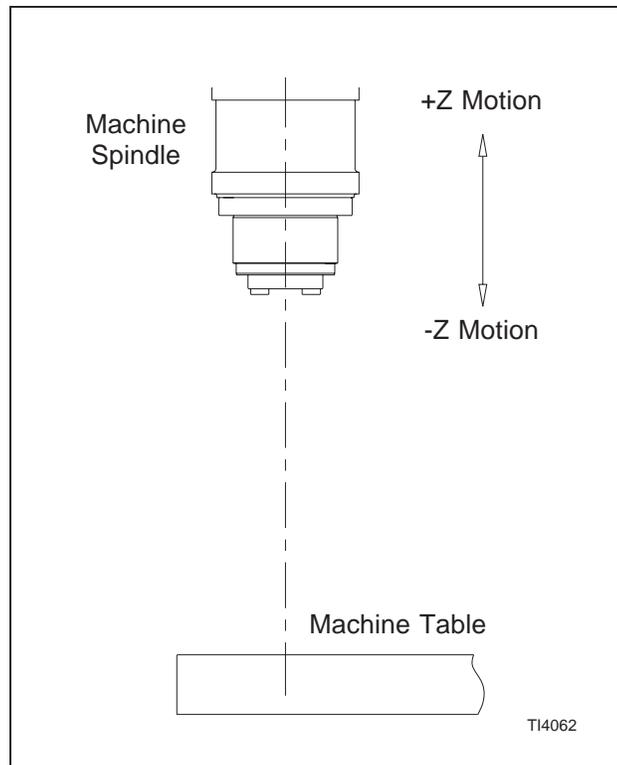


Figure A.2 - Z Axis Definition

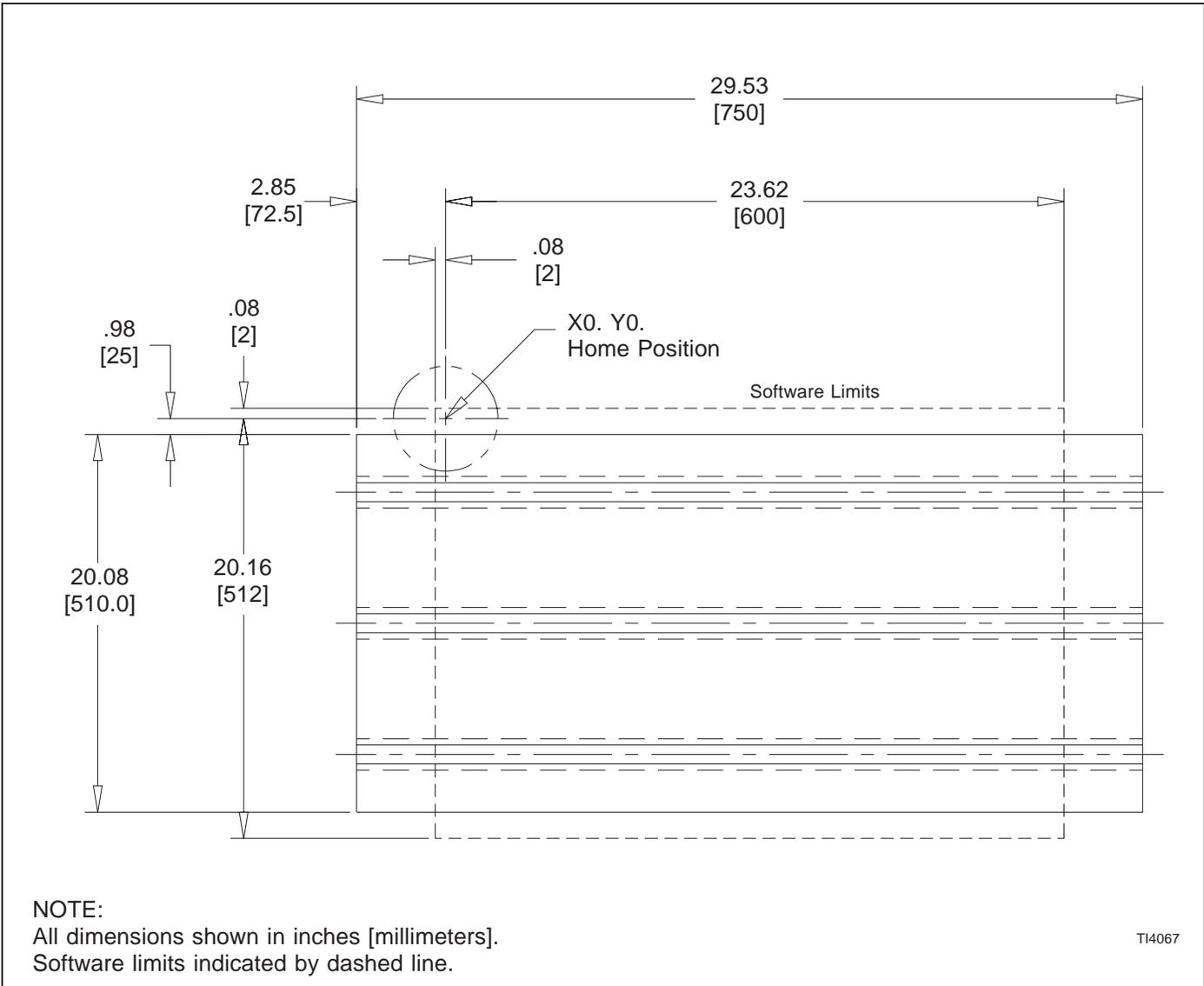


Figure A.3 - X and Y Axis Travel Specifications with Work Envelope (VMC600II Machining Center)

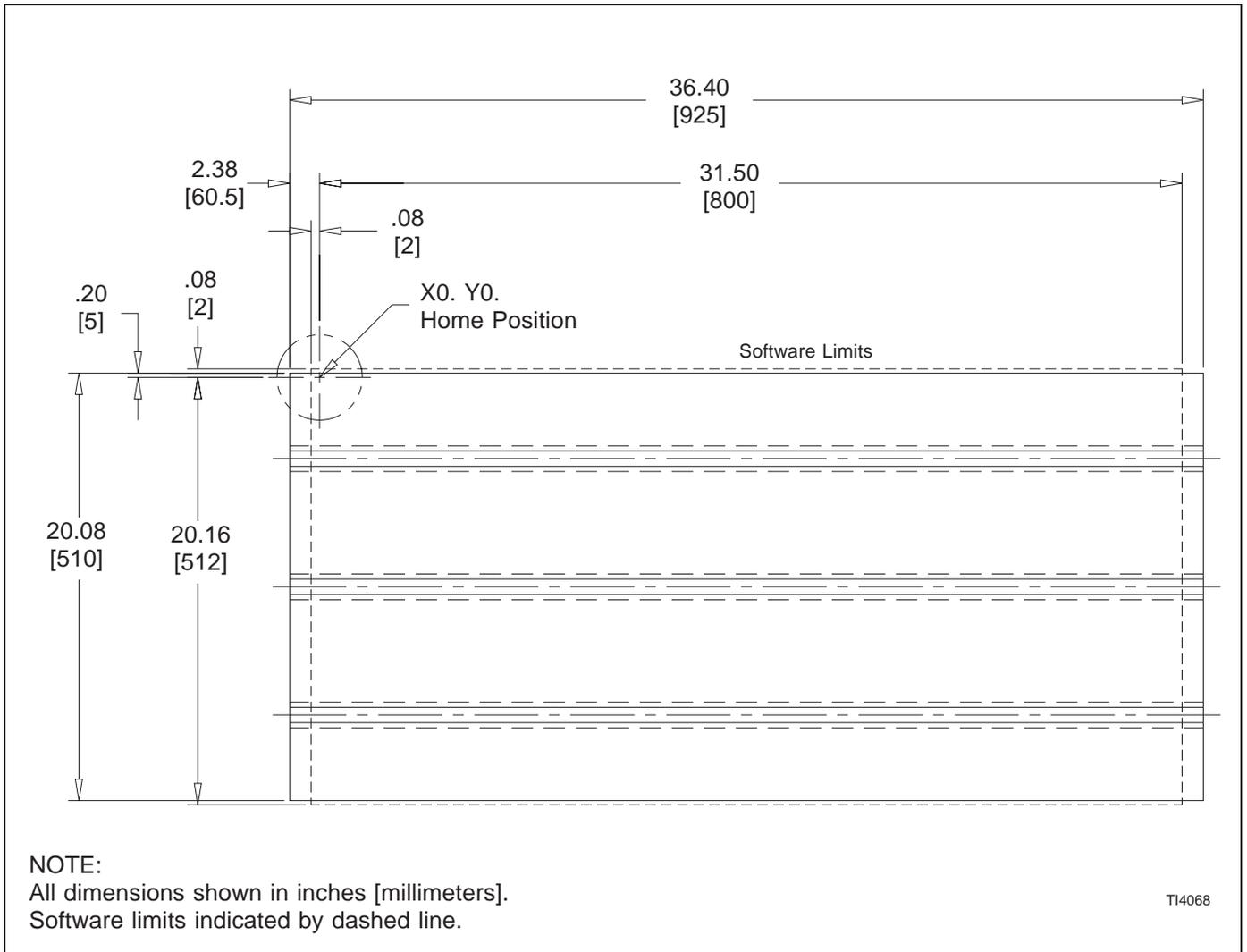


Figure A.4 - X and Y Axis Travel Specifications with Work Envelope (VMC800II Machining Center)



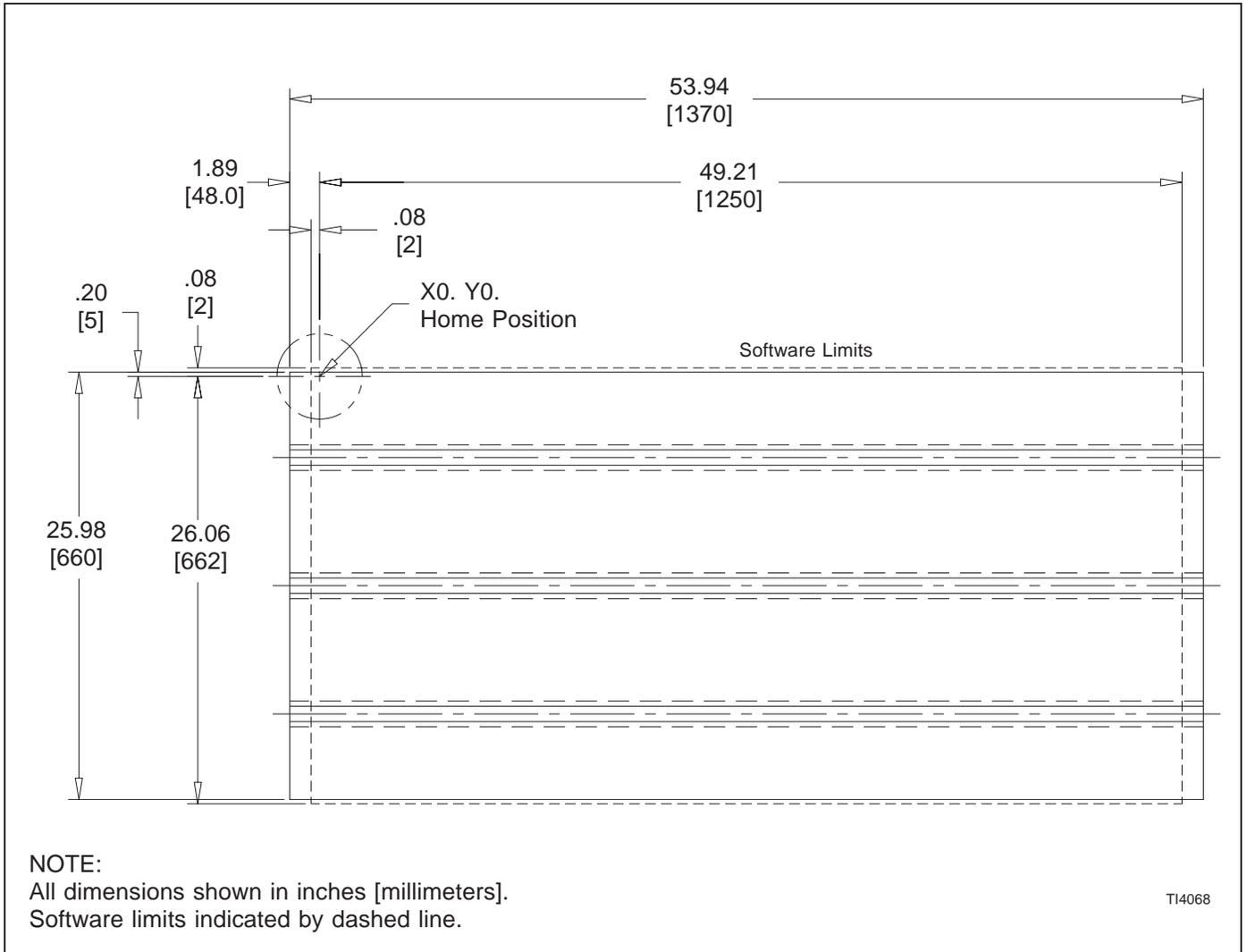


Figure A.6 - X and Y Axis Travel Specifications with Work Envelope (VMC1250II Machining Center)

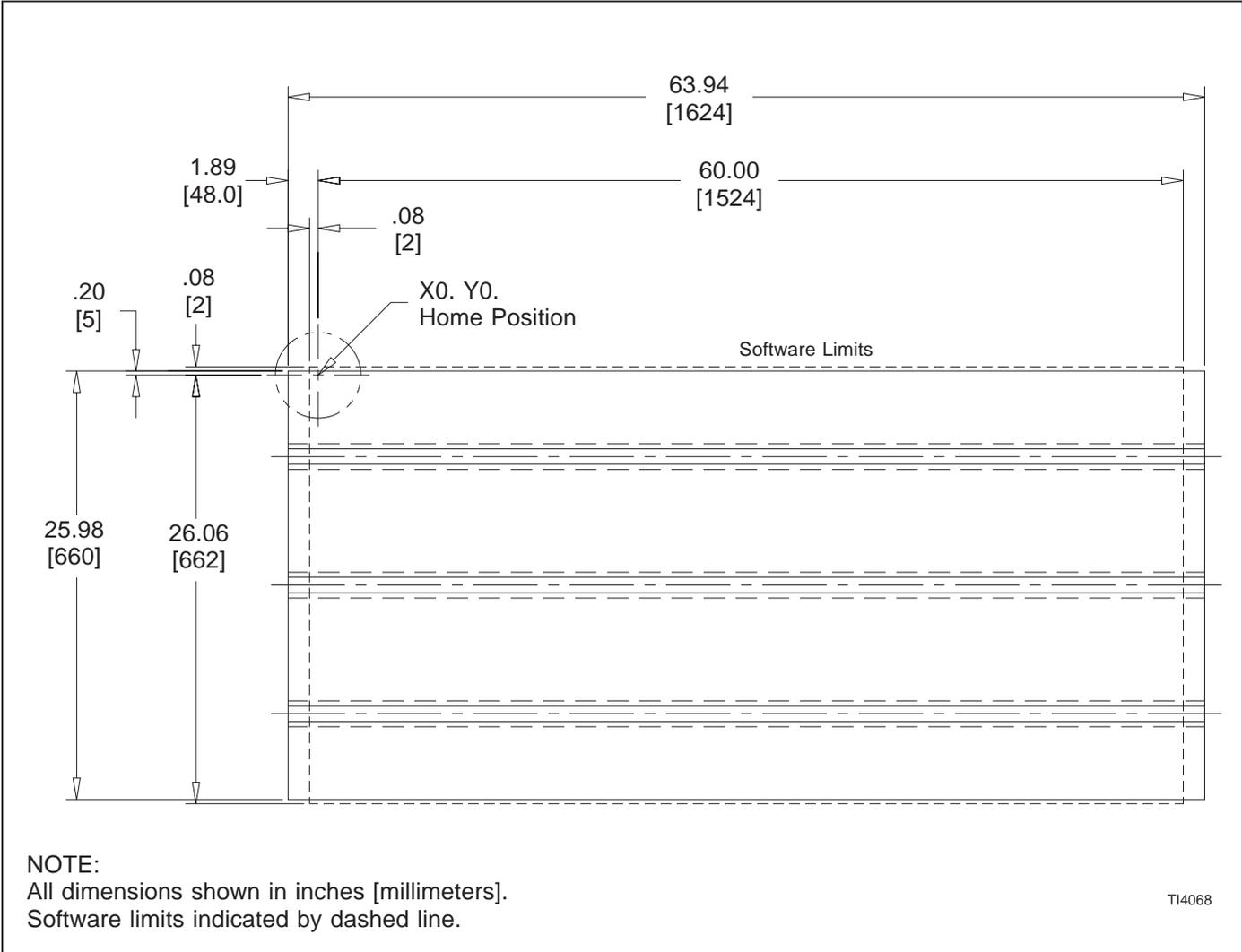
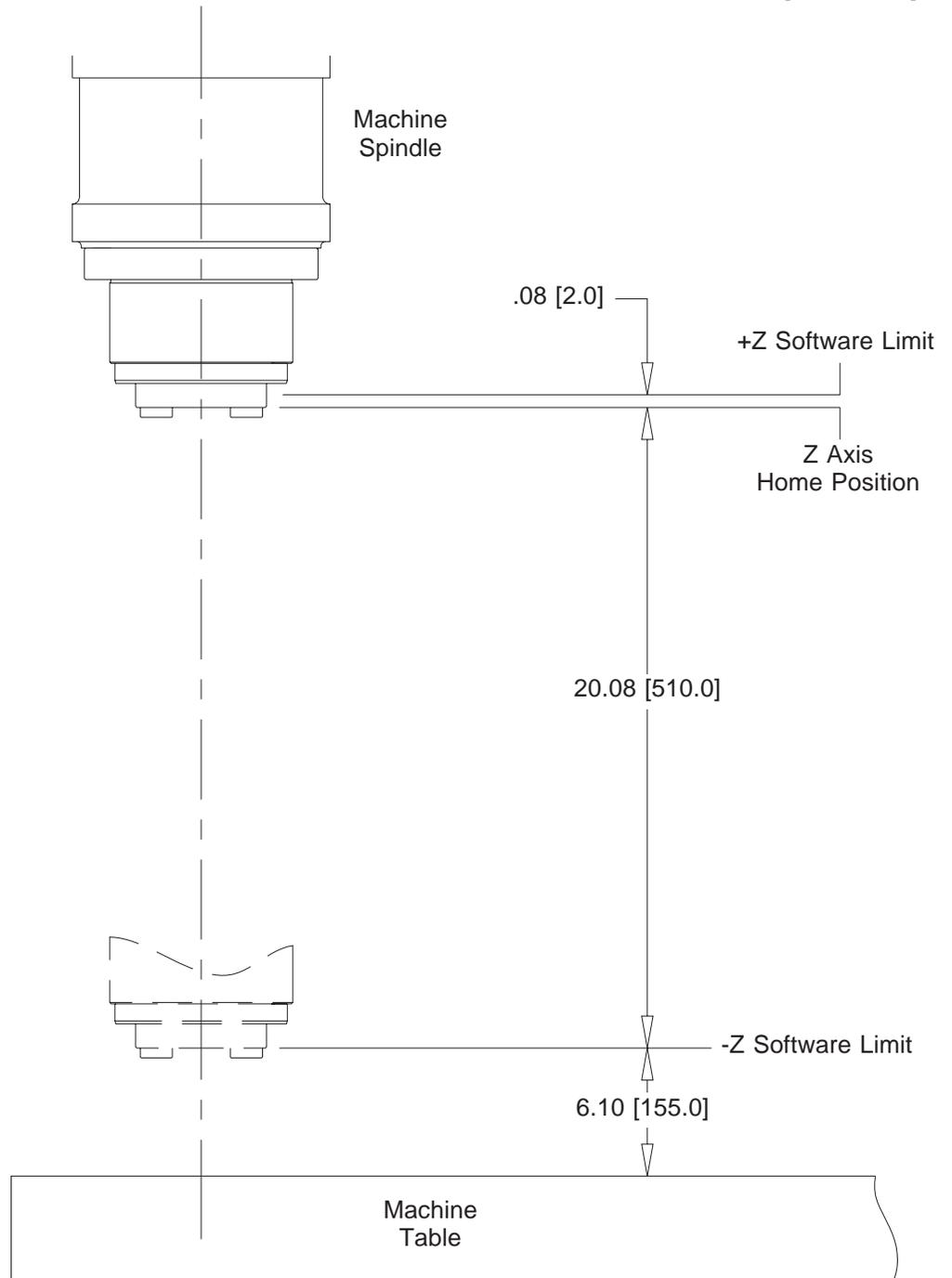


Figure A.7 - X and Y Axis Travel Specifications with Work Envelope (VMC1500II Machining Center)

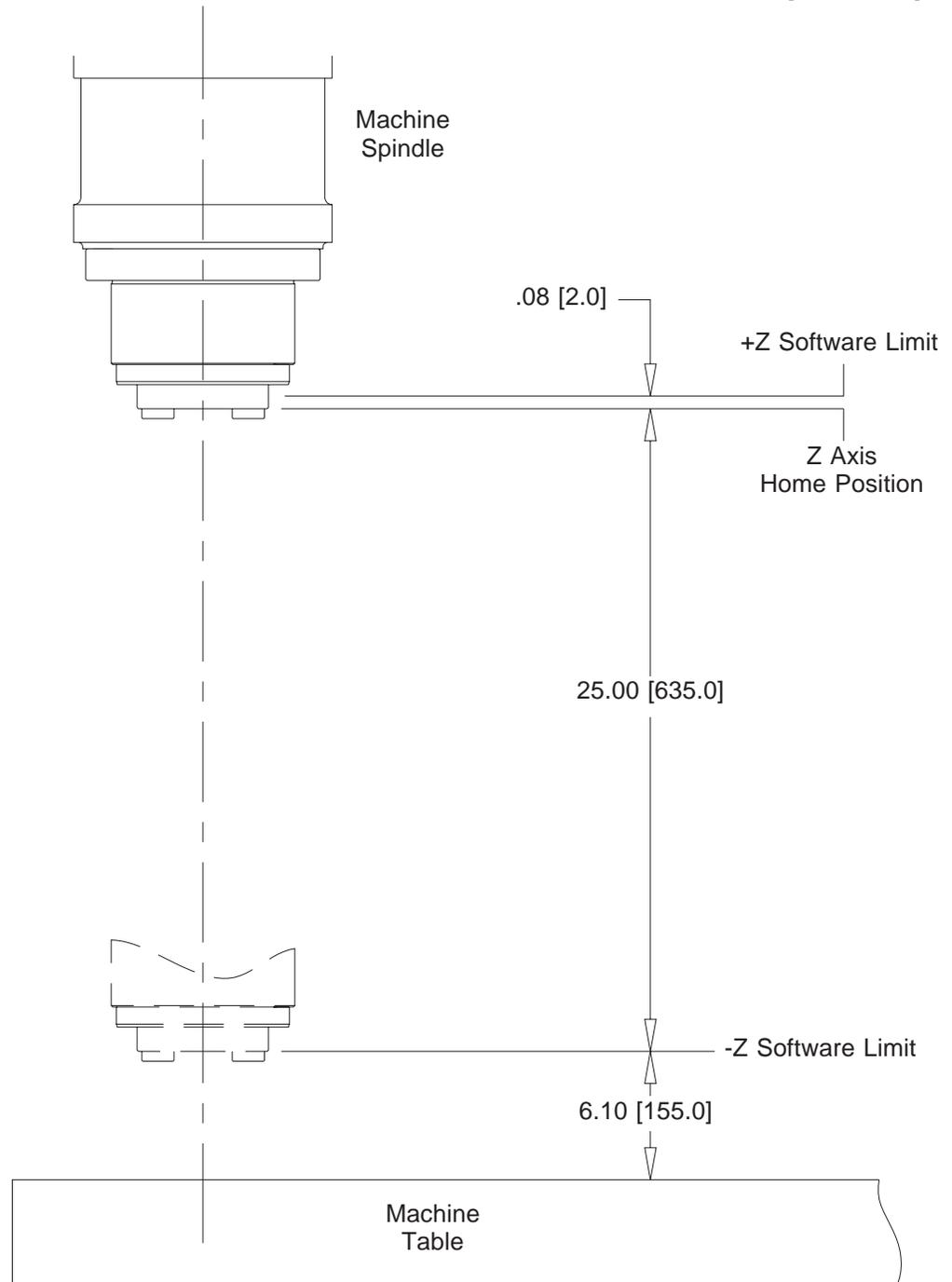
NOTE: All dimensions shown in inches [millimeters].



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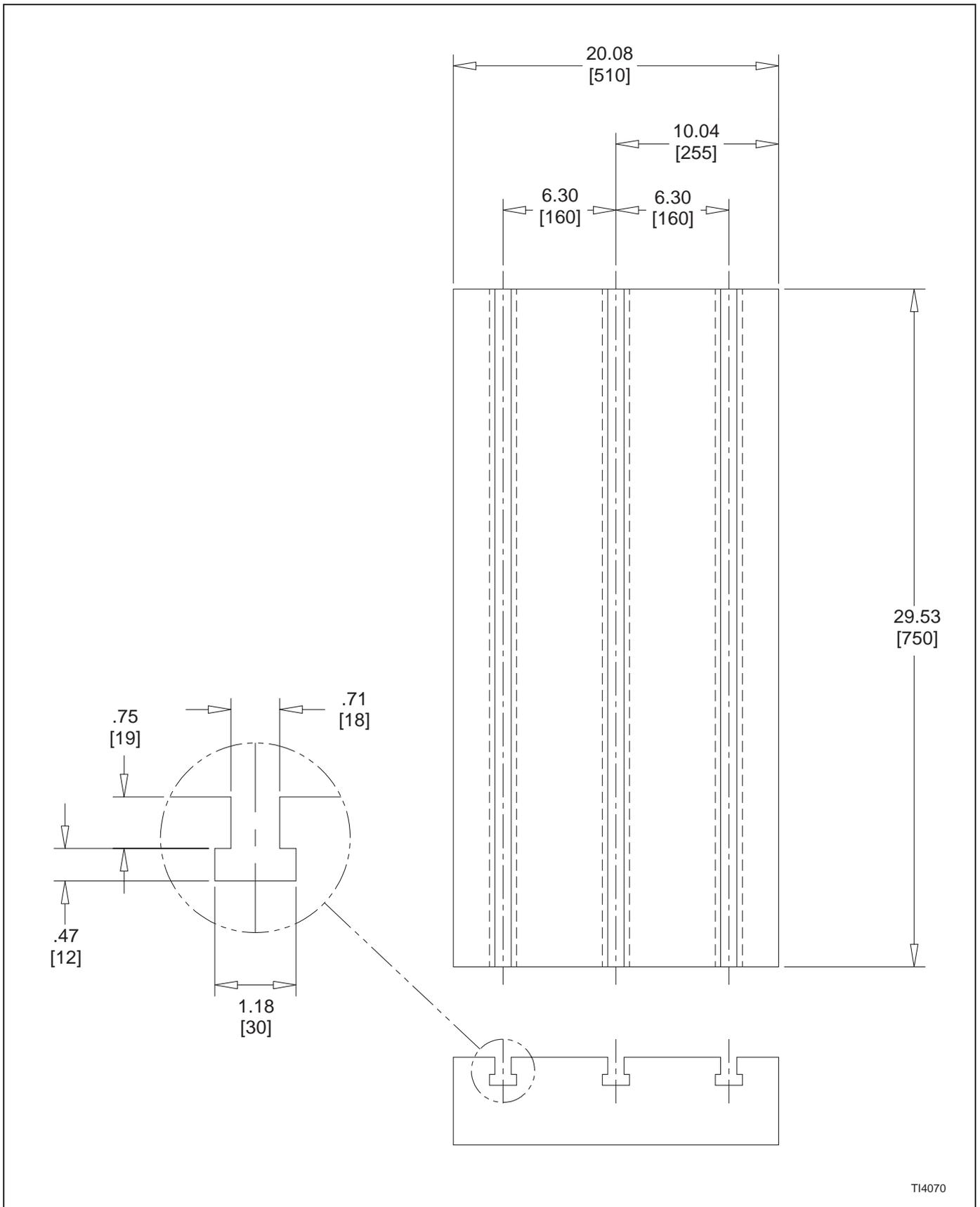
Figure A.8 - Z Axis Travel Specifications  
(VMC600II, VMC800II, and VMC1000II Machining Centers)

NOTE: All dimensions shown in inches [millimeters].



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Figure A.9 - Z Axis Travel Specifications  
(VMC1250II and VMC1500II Machining Centers)



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Figure A.10 - Tool Slot Locations and Configuration  
(VMC600II Machining Center)

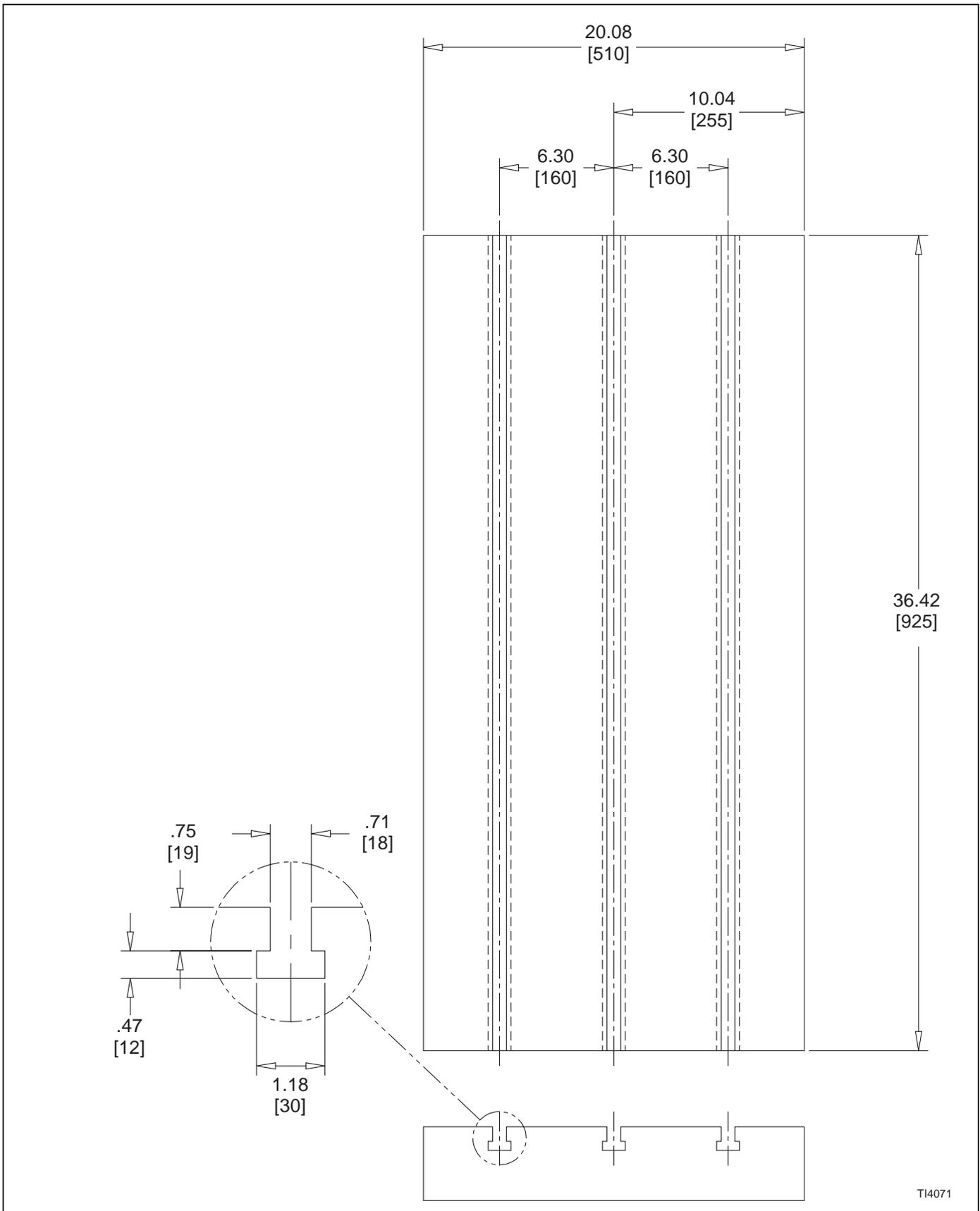


Figure A.11 - Tool Slot Locations and Configuration  
(VMC800II Machining Center)

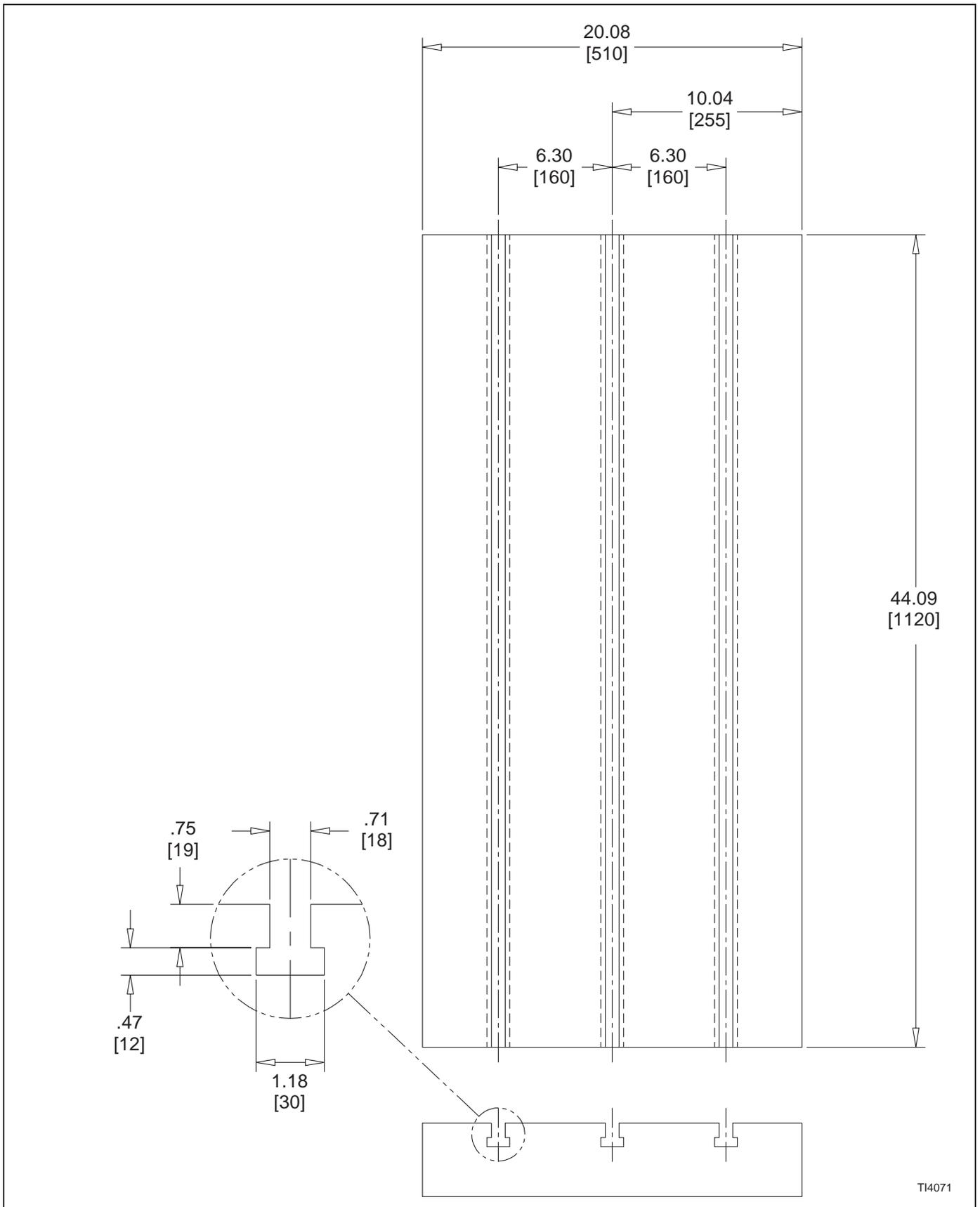
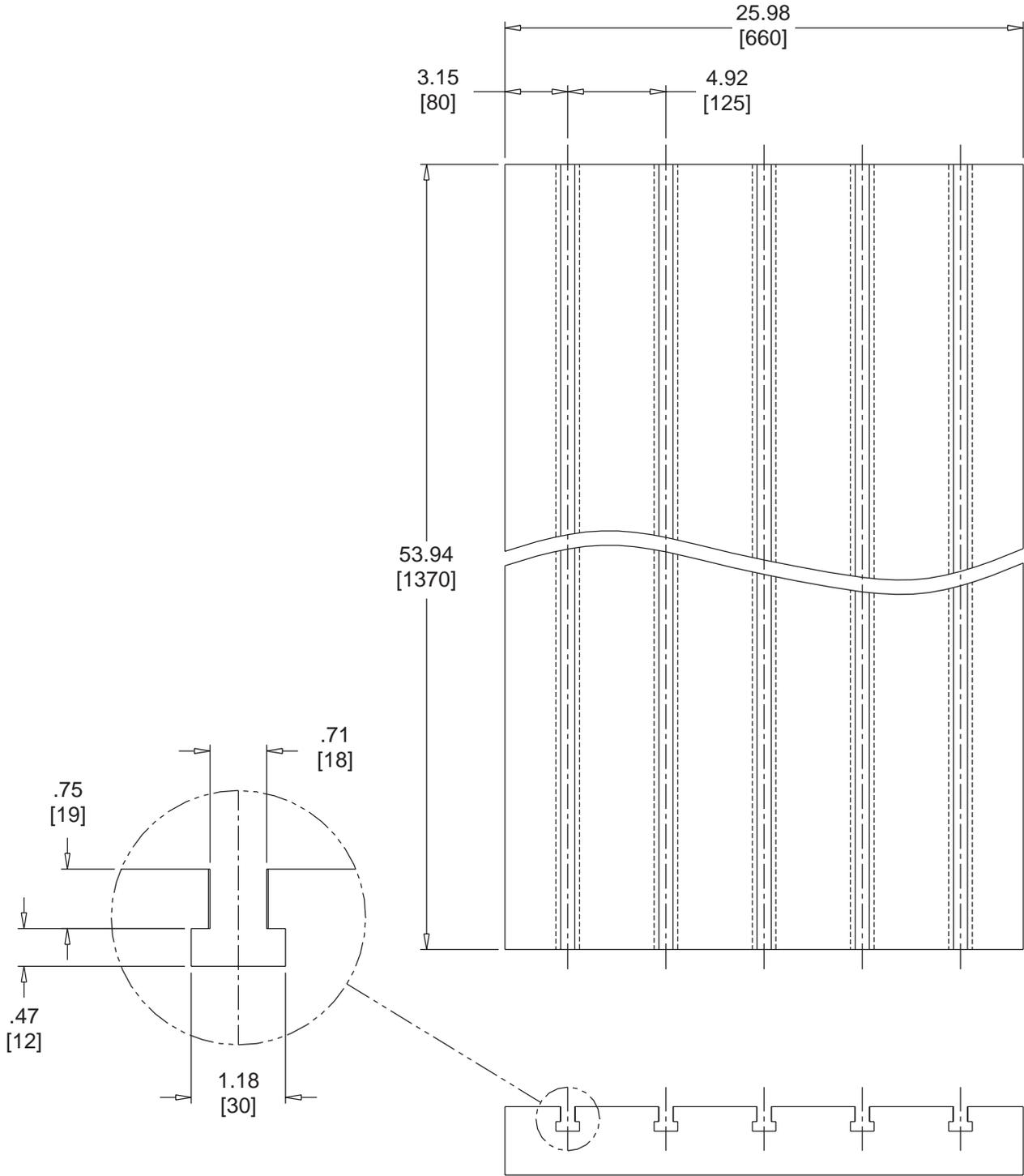


Figure A.12 - Tool Slot Locations and Configuration  
(VMC1000II Machining Center)

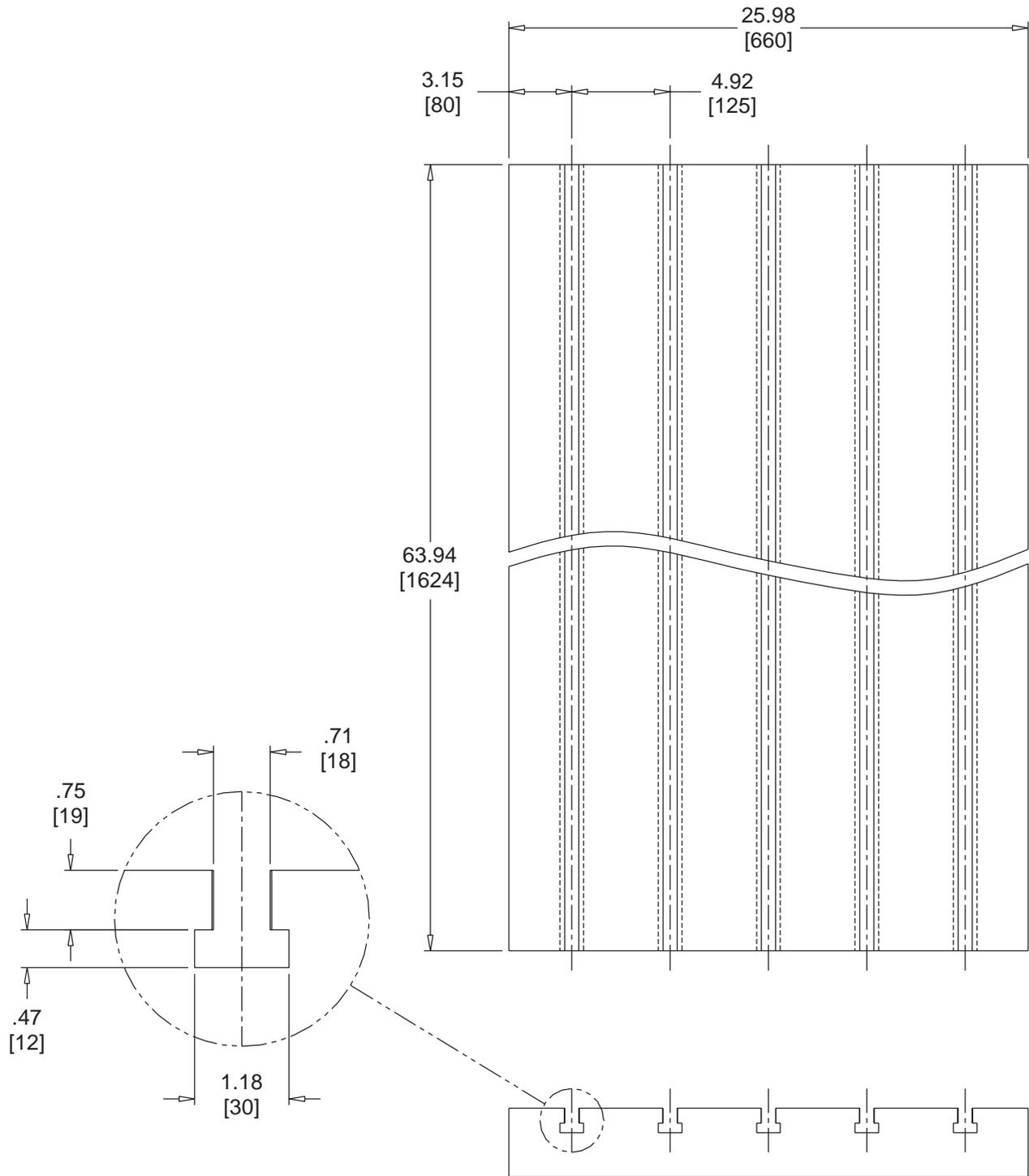
NOTE:  
All dimensions shown in inches [millimeters].



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Figure A.13 - Tool Slot Locations and Configuration  
(VMC1250II Machining Center)

NOTE:  
All dimensions shown in inches [millimeters].



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Figure A.14 - Tool Slot Locations and Configuration  
(VMC1500II Machining Center)

- NOTES -

- NOTES -



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