MAINTENANCE MANUAL

TP3665

TP4163

VMC SERIES II
VERTICAL MACHINING CENTERS

Manual No. M-379C
Part No. M C-0009500-0379

Litho in U.S.A.
August, 2003

- 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 the maintenance of Hardinge Series II Vertical Machining Centers equipped with Fanuc or Siemens controls. Wherever possible, photographs of each control are displayed during maintenance procedures.

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 and 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 THIS INFORMATION CAREFULLY BEFORE STARTING OPERATION, MAINTENANCE, OR REPAIR ON HARDINGE VMC SERIES II VERTICAL MACHINE CENTERS

The technicians who use this manual should have a general knowledge of machine maintenance and repair. This general knowledge coupled with the following manual will greatly reduce or eliminate machine downtime.

When machine maintenance is performed by persons not familiar with the operation of this equipment, the machine operator's manual for machines equipped with a Fanuc control (M-400) or the operator's manual for machines equipped with Siemens control (M-406) must be consulted when instructions require that the machine be run.

- 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's). Refer to the applicable section of the MSDS's supplied with your machine when handling, storing, or disposing of chemicals. Store MSDS's of other chemicals used with this Hardinge 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. Because 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.

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

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 ALLOW the operation or repair of equipment by untrained personnel.

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.

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 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.

DISCONNECT MAIN ELECTRICAL POWER before attempting repair or maintenance.

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

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

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 changer 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. 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 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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CHAPTER 1 - POWER-UP PROCEDURE

- CAUTION -

The recommended operating temperature range is 50° to 95° F [7° to 35° C] ambient.

MACHINE EQUIPPED WITH A FANUC CONTROL

- NOTE -

Information relating to machines equipped with a Siemens control begins on page 1-4.

POWER-UP PROCEDURE

- NOTE -

It is important that the power-up procedure is followed as described to ensure safe, accurate, and repeatable machine operation.

1. Turn main disconnect switch “A”, Figure 1.1, ON.
2. At the rear of the machine, slide valve “B”, Figure 1.2, upward to turn the machine air ON.
3. Check the air filter bowl; it drains automatically but may need to be cleaned.
4. Check the coolant level. Add coolant, if necessary.

- CAUTION -

When pressing the Control ON push button, DO NOT press any other push buttons or keys until the position or alarm screen is displayed. Some push buttons and keys are used for control maintenance or special operation commands.

5. Press the Control ON push button and wait until the control display screen is ON.
6. Pull the Emergency Stop push button OUT to release the Emergency Stop condition.

Figure 1.1 - Main Disconnect Switch

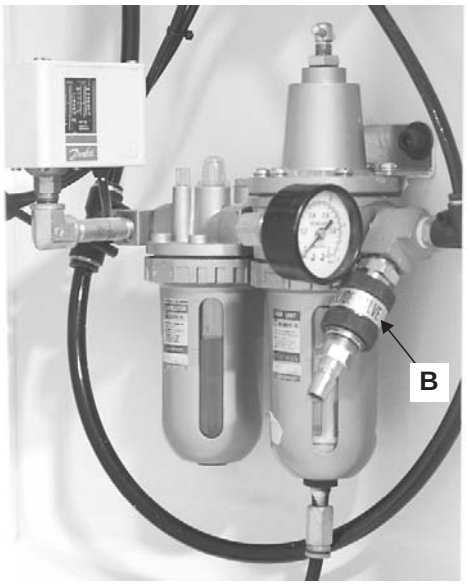

Figure 1.2 - Filter/Regulator/Lubricator

7. If necessary, release the Emergency Stop push button that is located next to the manual index push buttons for the tool changer magazine(s).
8. Be sure that the coolant guard doors are closed.
9. The machine is now ready for the Zero Return (Reference Home) procedure.

- NOTE -

High-performance high-speed machines require additional spindle and oil-air start up procedures. Refer to “Spindle Warm-Up Procedures”, on page 1-6.

ZERO RETURN (HOME) THE AXES

- CAUTION -

When zeroing the axes with the Zero Return (Reference Home) procedure, be certain that no interference exists between the machine table, workpiece on the table, and spindle tooling.

DO NOT attempt to Home the machine axes if the tool changer magazine(s) is (are) not at the Home position.

- NOTE -

If necessary, switch to JOG mode to move the axes to a safe location for axes motion; then, switch back to Zero Return mode to perform the Homing procedure.

1. Verify that the tool magazine is at the Home (retracted) position. If there is a second tool magazine, verify that it is at Home also.
2. Select JOG mode.
3. If necessary, move the axes to a safe location for axes motion.
4. Set the Jog Feedrate switch to the desired feedrate.

- NOTE -

Each axis must travel continuously at least one full inch [25.4 mm] before it returns to Home.

The Zero Return (Home) position is not the same as the tool change position.

5. Use the -Z push button to jog the spindle at least 1 inch [25.4mm] toward (minus, downward) the table.
6. Use the +X push button to jog the table approximately 1 inch [25.4mm] in the plus direction.
7. Use the -Y push button to jog the table approximately 1 inch [25.4mm] in the minus direction.

8. Select Zero Return mode.
9. Press the +Z push button; the spindle will move to the spindle HOME position.
10. Press the -X push button; the table will move to the X HOME position.
11. Press the +Y push button; the table will move to the Y HOME position.
12. If the machine is equipped with an optional rotary table, press the +B push button to index the rotary table to the Home position.

POWER-DOWN PROCEDURE

- CAUTION -

DO NOT power down the machine while Edit mode is active. Powering down the machine while Edit mode is active will result in the loss of all macro programs and machine parameters.

If data is lost, all macro programs and parameters must be loaded into the control memory from the backup disc supplied with the machine.

1. Be certain that “Cycle Start” is not active. The Cycle Start push button light will be OFF.
2. Be sure the program has been completed and that the spindle and slides are stationary.
3. Press the Emergency Stop push button.
4. Press the Control OFF push button.

- CAUTION -

If the machine is a high-performance high-speed machine, make certain that the Labyrinth air seal air pressure “C”, Figure 2.3, is left ON for 15 minutes after the spindle has stopped to allow the spindle interior to cool to room temperature without drawing in coolant and contaminants.

5. At the rear of the machine, slide valve “B”, Figure 1.2, downward to turn the machine air OFF.
6. Turn main disconnect switch “A”, Figure 1.1, OFF.

MACHINE EQUIPPED WITH A SIEMENS CONTROL

- NOTE -

Information relating to machines equipped with a Fanuc control begins on page 1-1.

POWER-UP PROCEDURE

1. Verify the hard disk at the back of the operator's control panel is set to the "Operating" position as follows:

   A) Swing the control panel out to gain access to the back of the panel.

   B) Unthread the screws to lift off the cover at the back of the panel.

   C) Rotate the hard disk to the "Operating" position (counterclockwise to vertical).

   D) Install the cover before trying to power up the machine.

- NOTE -

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

2. Close the main guard door.

- NOTE -

The main disconnect switch is located on the power case on the right end of VMC 600 machines.

The main disconnect switch is located on the power case at the back of all other VMC Series II machines.

3. Turn main disconnect switch "A", Figure 1.1, ON.
4. At the rear of the machine, slide valve "B", Figure 1.2, upward to turn the machine air ON.
5. Check the air filter bowl; it drains automatically but may need to be cleaned.
6. Check the coolant level. Add coolant, if necessary.

- NOTE -

The machine will power up in the ShopMill mode.

Wait for alarm "3000 ↓ Emergency Stop" to be displayed before proceeding to step 7.

7. Pull Emergency Stop push button "C", Figure 1.3, out and release it to allow the machine to power up.

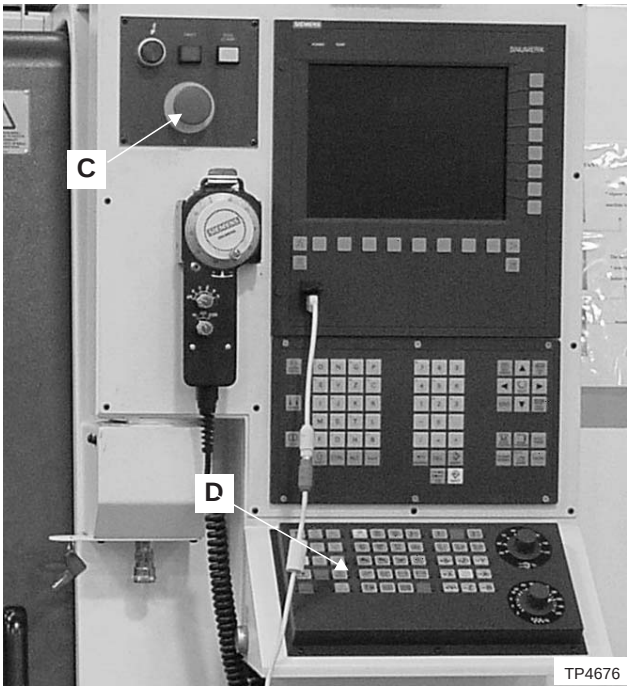

Figure 1.3 - Siemens Operator Control Panel

8. On operator control panel “D”, press the Reset push button to clear the Emergency Stop condition.

- NOTE -

The Feed Stop indicator light will be on when Feed Stop is active.

9. Press the Feed Stop push button to deactivate the Feed Stop function.
10. Press the Axis Home push button to Zero Return all the axes at the same time. The Axis Home indicator light will start flashing and the X, Y and Z axes will automatically Home (go to the Home position for each axis).
11. Press the Manual push button to put the machine in ShopMill manual mode.

- NOTE -

High-performance high-speed machines require additional spindle and oil-air start up procedures. Refer to “Spindle Warm-Up Procedures”, on page 1-6.

POWER-DOWN PROCEDURE

1. Press the Emergency Stop push button.
2. Turn main disconnect switch “D”, Figure 1.1, OFF.
3. Pull main air valve “B”, Figure 1.2, downward to turn the machine air supply OFF.

- CAUTION -

If the machine is a high-performance high-speed machine, make certain that the Labyrinth air seal air pressure “F”, Figure 1.4, is left ON for 15 minutes after the spindle has stopped to allow the spindle interior to cool to room temperature without drawing in coolant and contaminants.

SPINDLE WARM-UP PROCEDURES

- CAUTION -

Failure to properly warm up the spindle can result in spindle failure.

Never run the spindle over 50 percent of the maximum rated speed without a tool holder installed in the spindle.

- NOTE -

Spindle warm-up is only required on High Speed machining centers.

High Speed machining centers are equipped with an automatic timer that will inhibit spindle operation for 5 minutes after the machining center has been powered up. The purpose is to ensure proper lubrication of the spindle bearings. Perform the appropriate spindle warm-up after the 5 minute period has expired.

High Speed machining centers equipped with a 12,000 RPM spindle are available with either grease lubrication or oil-air lubricator “E”, Figure 1.4.

1. On machining centers equipped with oil/air spindle lubrication, make certain that oil-air lubricator “E”, Figure 1.4, is ON. Allow 5 minutes BEFORE proceeding to step 2.
2. On machining centers equipped with oil/air spindle lubrication, turn spindle labyrinth air seal pressure valve “F” ON. The recommended pressure setting is 7.4 psi [0.5 bar].
3. Perform the appropriate spindle warm-up, depending on how long the machining center has been idle.

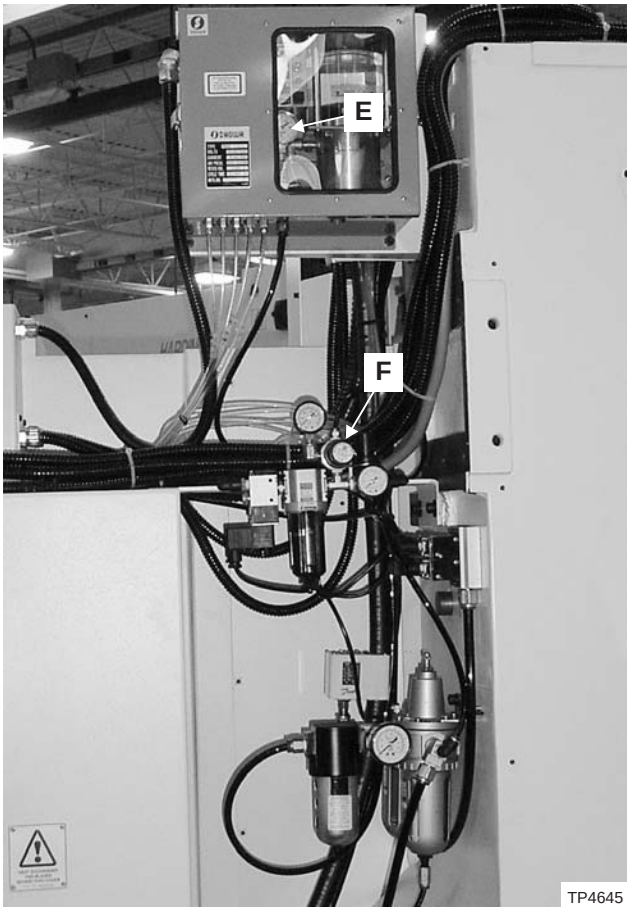

Figure 1.4 - High-Performance Spindle Lubrication System - Air and Lubricator

SHORT TERM SPINDLE WARM-UP

- CAUTION -

Short term spindle warm-up should only be used if the machining center has been idle LESS than 2 weeks. Refer to Long Term Spindle Warm-Up if the machine has been idle 2 weeks or more.

Use Manual Data Input mode to run the spindle at 25 percent of the maximum spindle speed for 15 minutes.

Once the spindle warm-up is completed, the machine is ready for operation.

LONG TERM SPINDLE WARM-UP

- NOTE -

Use the appropriate procedure in this section if the machine has been idle 2 weeks or more.

Machine with Oil-Air Spindle Lubrication

Use Manual Data Input mode to run the spindle at 25 percent of the maximum spindle speed for 30 minutes; then, 50 percent of the maximum spindle speed for 60 minutes.

Once the spindle warm-up is completed, the machine is ready for operation.

Machine with Grease Spindle Lubrication

Use Manual Data Input mode to run the spindle at 25 percent of the maximum spindle speed for 20 minutes; then, 50 percent of the maximum spindle speed for 30 minutes.

Once the spindle warm-up is completed, the machine is ready for operation.

- NOTES -

CHAPTER 2 - AIR SYSTEM

- WARNING -

When the air system's components require maintenance, the machine must be powered down. Refer to Chapter 1 for the appropriate power-down procedure.

INTRODUCTION

Factory air to the machine goes through a filter/regulator/lubricator system to set the air pressure, remove contaminants from, and add oil to the machine air supply. If the factory air has excessive moisture, a heavy-duty air dryer must be added to the incoming air line. The high-performance spindle machines may have an air dryer.

The incoming air line must have a minimum inside diameter of 3/8 inch [9.5 mm]; however, if the air line is especially long, a larger diameter hose may have to be installed. The air volume requirement for a standard machine is approximately 16 scfm [453 lm] at 70 psi [4.9 bars]. Machines with other air operated options require a higher volume of air; the high-speed spindle requires 23 scfm [650 lm] at 75 psi [5.2 bars]. Maximum air flow and full scfm (service cubic feet per minute) is required for proper machine operation.

Connect the air source or add an air lock-out valve; turn the air ON and set the regulator at a consistent pressure from 59 psi to 73 psi [4.1 to 5 bar] or high-performance spindle machines near 90 psi [6.2 bar]. The air pressure switch is preset at 58.8 psi [4 bar] or 87 psi [6 bar]. If the pressure falls below this, an alarm message appears and the machine is put in an Emergency Stop condition.

AIR CONTROL ASSEMBLY

The air control assembly, shown in Figures 2.1 and 2.2, is mounted at the rear of the machining center, on the left side of the tower.

The assembly consists of a filter/regulator, lubricator, and pressure switch. It distributes air to the tool changer (magazine) and spindle area. Additional switches and solenoid valves are added to the manifold assembly as air options are added to the machine.

The air regulator knob must be set to a consistent air pressure between 59 psi and 73 psi [4.1 and 5 bars]. If the pressure falls below 58.8 psi [4 bars], an alarm message appears on the control display and the program goes into Emergency Stop.

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Figure 2.1 - Air Filter/Regulator and Lubricator (VMC600 II Machining Center)

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Figure 2.2 - Air Filter/Regulator and Lubricator (All other Series II Machining Centers)

COMPONENT REPLACEMENT

REPLACE THE FILTER/REGULATOR FILTER

The filter/regulator filter bowl drains automatically and check the air system bowls once a week for contaminates.

1. Power down the machine.
2. Make certain that the air lock-out valve is OFF or factory air is disconnected. Lock the valve in the OFF position.
3. Clean the air filter/regulator filter as follows:
   A) Make certain that the machine is powered down and that the air lock-out valve is OFF or disconnected.
   B) Twist ring “A”, Figure 2.3, above the outer shell on the filter/regulator counterclockwise to release the shell and bowl from the head. Drain any water and contaminants from the bottom of the bowl.
   C) Wipe the bowl clean with a lint-free cloth and check the O-ring for damage. Replace the O-ring or bowl if necessary.
   D) Clean or replace the filter as necessary. To release the filter, unscrew the nylon fixture. Thread the new filter on the nipple until it is tight.
4. Mount the bowl on the head as follows:
   A) Put the plastic bowl into the shell.
   B) Align the bowl in the head and press the shell up into place. Rotate the ring on the outer shell clockwise until it latches to seat the O-ring.
   C) Pull down on the bowl to confirm that the bowl is in place.
5. Unthread screw “B” and fill the lubricator with the appropriate oil. Thread the screw on and tighten it.

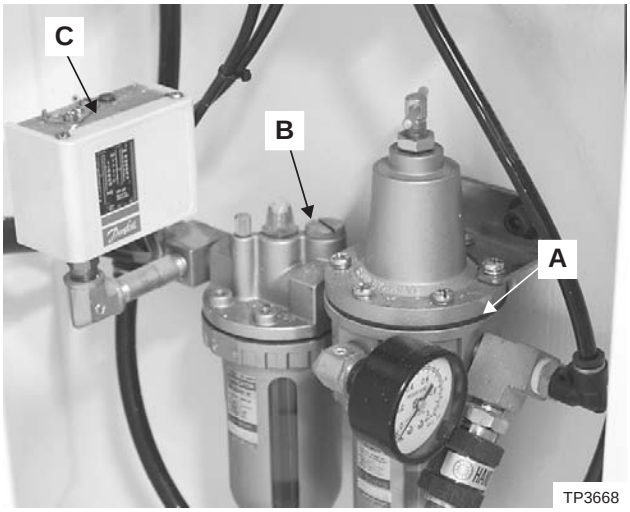


Figure 2.3 - Air Filter/Regulator/Lubricator

Machine component	Filter/Regulator/ Lubricator combination
Lubricant characteristic	1)Viscosity: ISO VG32 2)Viscosity index: above 95 3)Anti-rust, anti-oxidation 4)Good Stability
Lubrication method	Oil feeder
Lubrication frequency	As needed, 1/yr.
Tank capacity	0.3 Liters
Recommended grade of lubricant	1)CPC Circulation Oil R32 2)Mobil D.T.E Heavy Mediurn 3)Daphne Super Multi Oil 68 4)Shell Turbo OilT68 5)Esso Auto A68

REPLACE THE AIR CONTROL ASSEMBLY COMPONENTS

Any of the air control assembly components can be replaced if they become damaged. The air control assembly can also be replaced as a unit.

1. Power down the machine. If there is an air lock-out valve, make certain that it is OFF.
2. Disconnect the main air line from the air lock out valve.
3. If pressure switch “C”, Figure 2.3, has a junction box/switch box, disconnect the wiring cable as follows:
   A) Unthread the screw and remove the junction box cover.
   B) Make a diagram of the wire connections for re-assembly in the junction box.
   C) Pull the wire connection from the terminals.
4. Disconnect the air line(s) from the air manifold.
5. Unthread the screws and remove the air assembly unit from the panel.
6. Unthread and remove the component being replaced.
7. If there are O-rings, make certain that the O-rings are in place and mount the new component.
8. Mount the air assembly unit on the panel. Tighten the screws that fasten it in place.

- NOTE -

Use just enough sealant to secure the fitting when fastening the air lines to the manifold((s). Do not apply sealant to the first few threads.

9. Fasten the air line(s) to the manifold.
10. Connect the wiring cable as follows:
    A) Connect the wires to the terminals per the diagram from step#3.
    B) Install the cover on the junction box and tighten the screws.
11. Connect the main air line and turn the air source on.
12. Power up the machine. Set the regulator to an operating pressure between 59 psi and 73 psi [4.1 and 5 bars].
13. Zero Return (Home) the table and spindle.
14. Check the air system bowl for contamination, moisture, or air leaks and correct any problems as necessary.

REPLACE THE PRESSURE SWITCH

Pressure switch “C”, Figure 2.3, is designed to send a signal to the control and an alarm message appears on the control display when the air pressure falls below 58.8 psi [4 bars].

1. Power down the machine. Make certain that the air lock out valve is OFF or disconnect the air source.
2. If the pressure switch has a junction box, disconnect the wiring cable as follows:
   A. Unthread the screw and remove the junction box cover.
   B. Make a diagram of the wire connections for re-assembly in the junction box.
   C. Pull the wire connection from the terminals.
3. Unthread the pressure switch from the manifold. The switch is tightened to the manifold with light torque pressure; however, a wrench may be necessary to unthread it.

- NOTE -

Use just enough sealant to secure the fitting when fastening the pressure switch to the manifold. Do not apply sealant to the first few threads.

4. Thread a new pressure switch on the manifold and tighten it to 50 lb-in [5.6 N•m].
5. Connect the wiring cable as follows:
   A. Connect the wires to the terminals per the diagram from step 2.
   B. Install the cover on the junction box and tighten the screws.
6. Power up the machine.
7. Set the regulator to an operating pressure between 59 psi and 73 psi [4.1 and 5 bars] except the high-speed spindle machines which must be set at 75 psi [5.2 bars].
8. Zero Return (Home) the table.
9. Check the air system bowl for contamination, moisture, or air leaks and correct any problems as necessary.

REPLACE A SOLENOID VALVE

1. Power down the machine. Make certain that the air lock out valve is OFF or disconnect the air source.
2. Refer to the schematic chart on the panel (tag) to identify which valve needs to be replaced.

- NOTE -

Two screws attach each individual valve to the manifold. The screws are offset and located near the middle of the valve. Refer to Figure 2.4.

3. Unthread the screws and remove the identified solenoid valve(s).
4. Check the valve and manifold for O-rings.

- NOTE -

It is not necessary to remove the electrical connection or air line from valves that are not being replaced.

5. Unthread the screw that secures the electrical connection to the solenoid valve being replaced. Pull the connection straight off to release it from the valve.
6. Unthread the air line from the fitting on the valve being replaced. If necessary, remove the pneumatic fitting from the valve.
7. Thread an air fitting to the new valve. Use sealant to secure the fitting but do not apply it to the first few threads.
8. Mount the new valve to the manifold. Check valve O-rings; replace any that are worn.
9. Support the new valve and fit the electrical connection to it. Secure the connection with its screw.
10. Fasten the air line to the fitting on the bottom of the valve.
11. Power up the machine.
12. Set the regulator to an operating pressure between 65 psi and 73 psi [4.4 and 5 bars], except the high-speed spindle machines which must be set at 75 psi [5.2 bars].

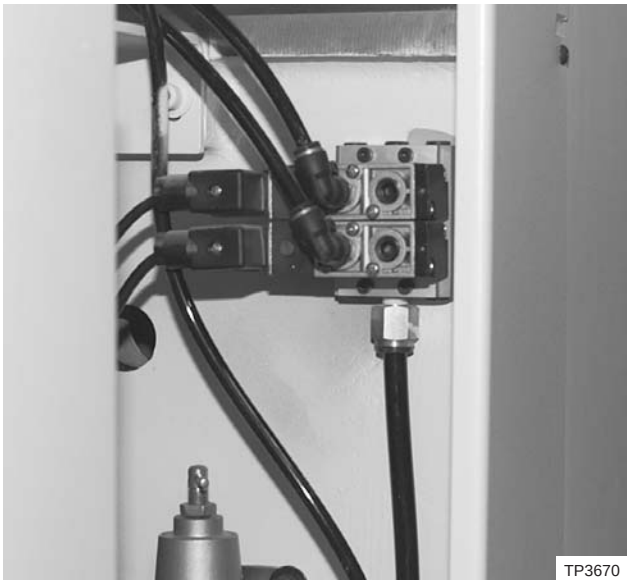


Figure 2.4 - Air Solenoid Valves

Valve List	Function
Spindle Air Blow	Air blast when unclamped
Chip Air	Groove clean when oriented
Spindle Tool	Unclamp/Clamp

Solenoid Valve Tags

13. Zero Return (Home) the table.

14. Check the air system bowl for contamination, moisture, or air leaks and correct any problems as necessary.

-NOTE -

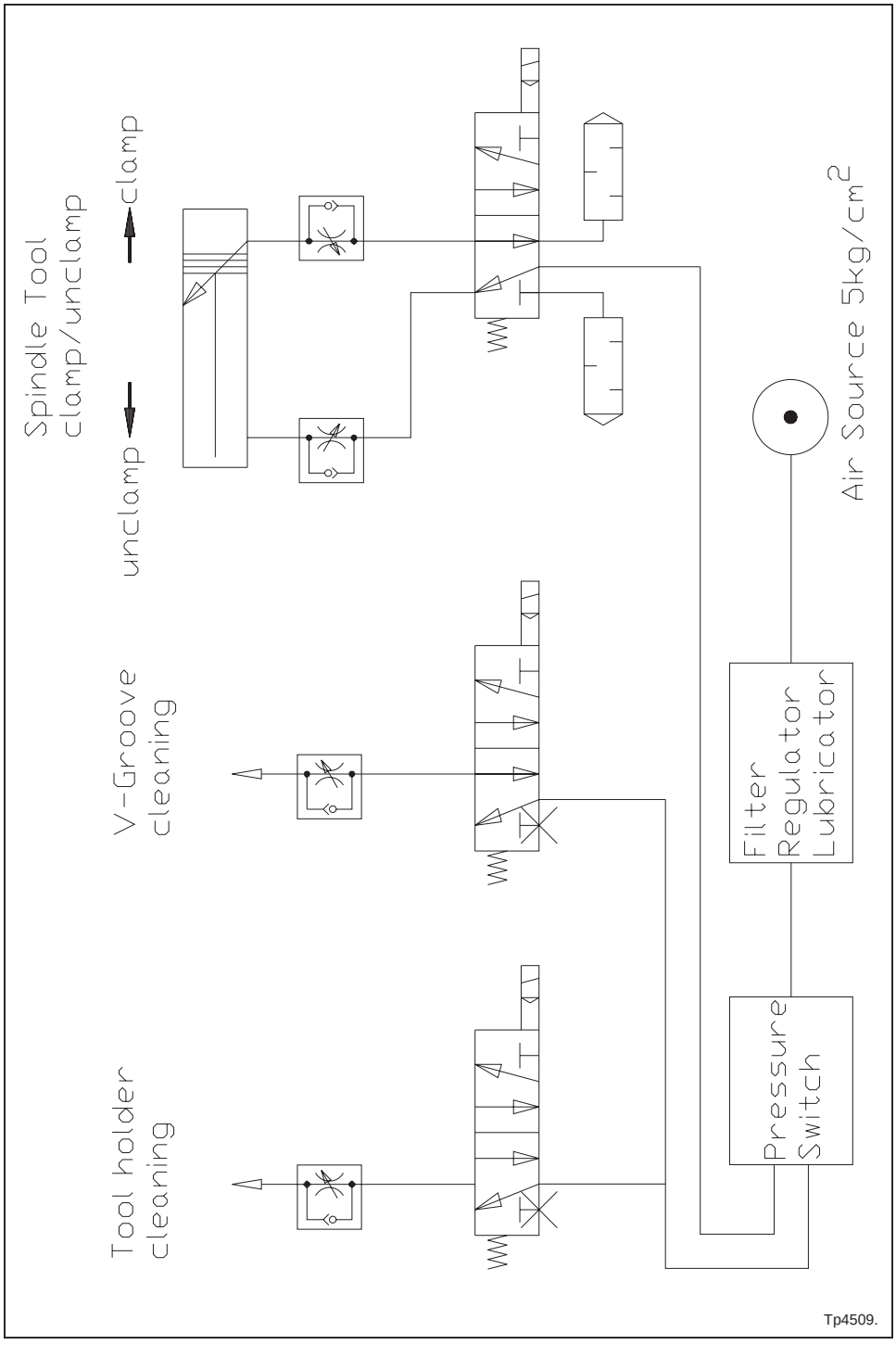
Solenoid valves that have adjustable force thumb screws act as flow valves. They have a lock (jam) nut to secure the setting after the flow rate has been set.

14. Test the function of the option and adjust it as necessary.

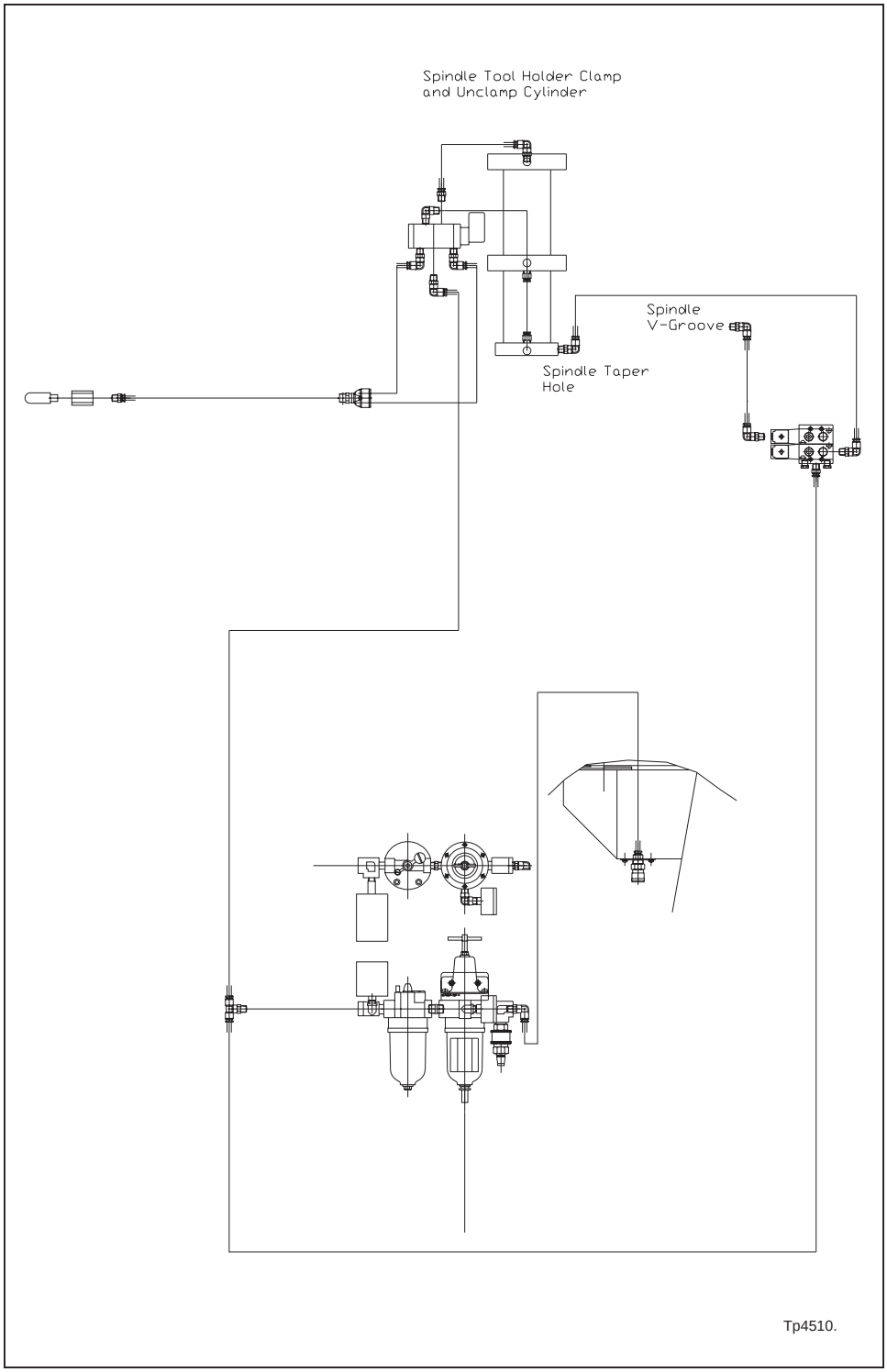
- NOTE -

Refer to the pneumatic schematic on the next page.

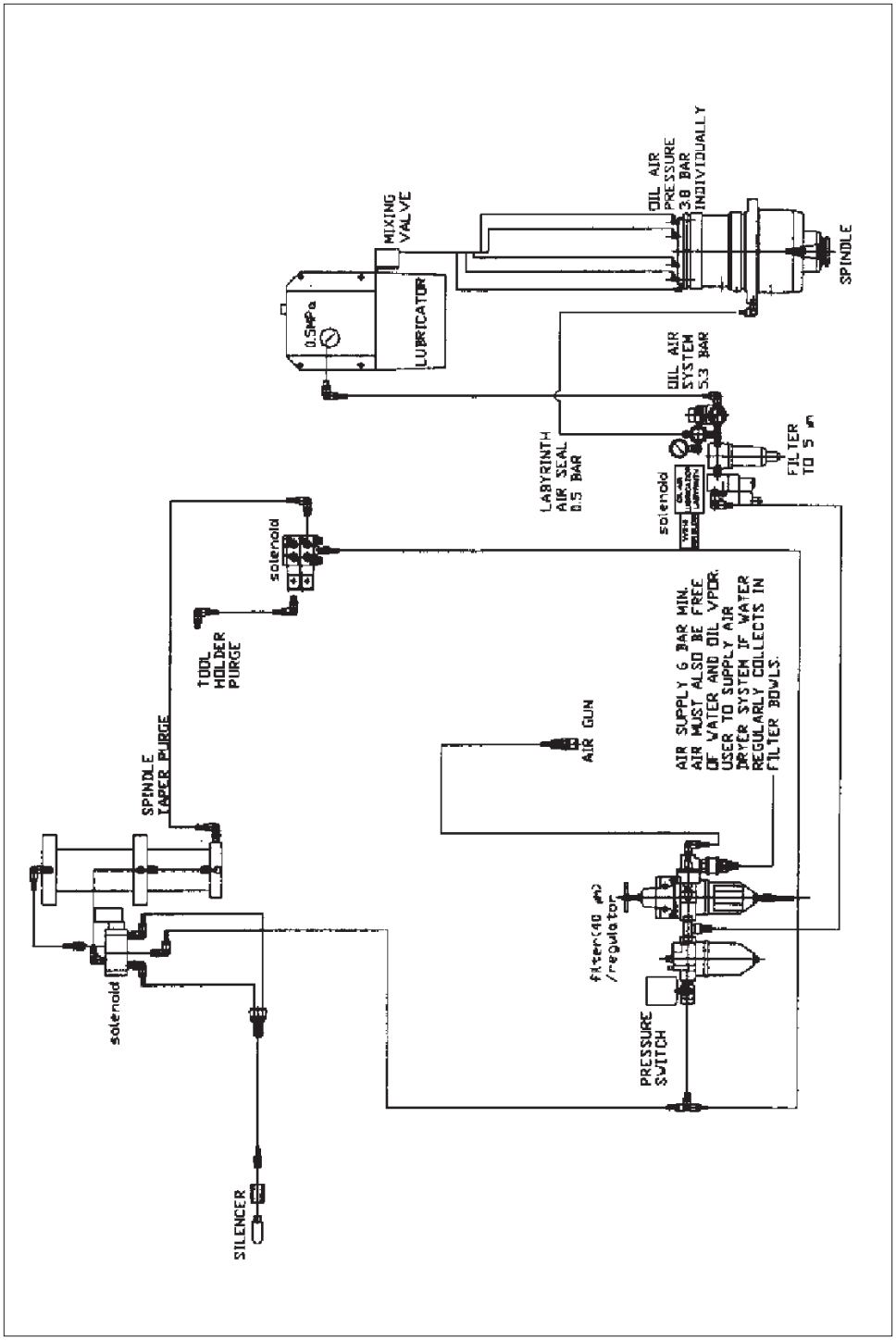
Pneumatic Schematic



Pneumatic Diagram



High-Performance High-Speed Pneumatic Diagram



AIR SYSTEM FOR OPTIONAL OPTICAL SCALES

Optical scales is an option that enhances the accuracy of the control to make more consistent parts. Although there is little maintenance to the optical scales as they are located under the axes way covers, a constant flow of clean air purges dust and moisture from the scales. A small filter/regulator and coalescing filter module, mounted on the rear of the column, cleans and dries the air before it is used to protect the scales. If the factory air has excessive moisture, an air dryer must be added to the incoming air line.

The air pressure switch is set at the factory and should not be adjusted. If the inlet air pressure is between 58 and 102 psi [4 and 7 bar], then, the outlet air pressure should be 14.5 psi [1 bar]. When the outlet air pressure is lower than 10 psi [0.7 bar], the air filters must be cleaned or replaced.

- CAUTION -

Due to the exposed location at the rear of the machine, care must be taken not to bump or damage the filter/regulator and coalescing filter module.

CLEAN OR REPLACE THE OPTICAL SCALE AIR FILTERS

1. Power down the machine.
2. Make certain that the air lock-out valve is OFF or factory air is disconnected. Lock the valve in the OFF position.
3. Clean the optical scale air filter/regulator filters as follows:

- NOTE -

The filter in shell “D”, Figure 2.5, has a coarse 3 m element (Hardinge part number NV 00116140110) while the filter in shell “E”, has a fine 0.03 m element (part number NV 00116140110).

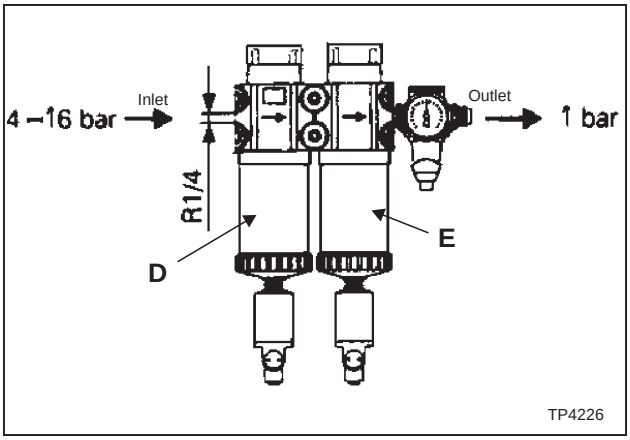


Figure 2.5 - Optical Scale Filter/Regulator Air Module

A. Use the provided spanner (hook) wrench to unthread the outer shell from the head to gain access to each filter.

B. Drain any water and contaminants from the bottom of the shell.

C. Wipe the shell clean with a lint-free cloth and, if there is an O-ring, check it for damage. Replace the O-ring or shell if necessary.

D. Clean or replace the filter(s) as necessary. To release the filter, unscrew it.

E. After the filter is cleaned or replaced, thread it on the nipple until it is tight.

F. Thread the shells on and tighten them.

G. Pull down on each shell to confirm that each is in place.

4. Make certain that the factory air is connected or unlock the air lock-out valve as necessary to have air.
5. Power up the machine and check the air pressure at the regulator. Make adjustments as necessary.

- NOTES -

CHAPTER 3 - COOLANT SYSTEM

- WARNING -

When the coolant system requires maintenance, the machine must be powered down. Refer to Chapter 1 for the appropriate power-down procedure.

- CAUTION -

Whenever cutting fluids are used, it is essential to follow the manufacturer's recommendations on the selection and maintenance for that particular fluid.

INTRODUCTION

Hardinge machining centers are designed using the latest technology and highest quality materials available. However, due to the ever increasing number of cutting fluid (coolant) selections available, it is impossible to test material compatibility with each and every coolant. The two most popular types of cutting fluids are cutting oils and water-based coolants. Be prepared to fill the tank assembly with the approved coolant to the FULL line of the sight gauge after the coolant tank is in place.

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]

WATER-BASED COOLANTS

Water-based coolants are a cutting fluid which, when improperly specified or maintained, can affect the life of a machine and the quality of the parts made on it. Water-based coolants are designed to suppress rusting, enhance cutting, increase tool life, promote heat dissipation, and be economical to use.

Some water-based coolants may cause machine corrosion problems and be incompatible with machine components, especially if the fluid is not maintained correctly. Poorly maintained coolants may result in rancidity, poor tool life, staining, rusting, and foaming, which affect machine performance and may cause health problems such as dermatitis. Water-based coolants must be correctly specified according to the machined materials and ensure compatibility with the machine's components. Refer to the list of common materials used in the manufacture of Hardinge machines which is located at the end of Appendix One.

It is extremely critical to follow the coolant manufacturer's recommendations when using a water-based coolant. Maintaining coolants per the manufacture's recommendations will increase the machine's useful life and will minimize corrosion, rusting, staining, and health problems such as dermatitis.

PREPARING THE COOLANT SYSTEM

- NOTE -

The following procedure is used if the machining center has been moved after the initial installation and the coolant tank has been emptied.

1. Roll the coolant tank into the opening under the front of the machining center.
2. Adjust the chip trays (screens) on each end or chip conveyor and check inside the work area to see that coolant will drain back into the trays/conveyor and coolant tank.
3. Install the coolant hose and tighten the clamps.
4. Pour the coolant directly into the work area to drain into the coolant tank. Fill the tank with the approved coolant to the FULL line of the sight gauge. Always check for cutting fluid leaks and correct them as necessary.

   Make any adjustments before powering up the machine and turning the coolant ON.

CARE AND MAINTENANCE

- NOTE -

A properly selected and maintained coolant will ensure the best performance from the coolant and machining center.

A daily check of the concentration and pH will help keep the coolant at its optimum performance level. Limit the growth of anaerobic bacteria which cause the rancid odors and feed on the additives in the coolants.

Make-up coolant should be added when needed and according to the manufacturer's recommendation. This make-up coolant is necessary to provide additional fresh coolant which contains the essential additives required to keep the coolant performing properly.

Clean and replace the coolant per the coolant manufacturers recommendations. Proper cleaning of the machine is very important before refilling the tank with fresh coolant. Dispose of the used coolant properly. Bacteria live and cling to all wetted surfaces in the machine. Special cleaners, usually available from your coolant supplier, are recommended to flush the system before refilling. These cleaners will kill the bacteria left after draining the machine. It also is recommended that a thorough cleaning, which includes scraping and removing any sludge found on the bottom and hidden in the top panels of the coolant tank, be completed before circulating cleaner through the system.

CONCENTRATION

Proper concentration control is essential for optimal tool life, corrosion control, and inhibiting bacterial growth. Water soluble coolants lose water by evaporation during normal operating conditions which tends to increase the coolant concentration over a normal work shift. The coolant concentration must be checked each day.

The coolant concentration must be kept within the specified range determined by the coolant manufacturer. Failure to maintain the coolant concentration within this range may result in poor performance from that fluid. Lean concentrations can lead to rust, rancidity, short tool life, and other problems. Rich concentrations can result in foam, residues, health problems such as dermatitis, and increased coolant costs.

pH

pH is a measure of a solution's alkalinity or acidity. There are two common methods used to determine pH. One method is the use of special pH test paper and the other is a pH meter.

Water based coolants are designed to run within the pH range determined by the manufacturer. The pH of water based coolants typically runs on the alkaline side of the pH scale. A drop in pH indicates a growth of bacteria. These anaerobic bacteria live on the additives found in the coolants. When these bacteria feed on the oils they release an acidic by-product which eventually drives the coolant towards a lower pH level. Typically, the pH range is between 8.5 and 9.2.

WATER QUALITY

The water quality is also an important factor toward achieving optimum coolant performance. Water that contains dissolved minerals, bacteria, and other impurities (hard water) can sometimes adversely affect the coolant selected. An indication of water related problems is the formation of a soap like scum which adheres to sumps and filters. It is best to consult with your coolant representative to determine your requirements.

CHIP REMOVAL

The coolant tank assembly is mounted on wheels and the coolant pumps are mounted on brackets at the rear corners of the machine. The tank can be disconnected from the coolant hoses and rolled from under the machine for easy access. The tank assembly has chip trays that screen the metal chips and allows the coolant to drain through and recycle.

- WARNING -

Use a rake and suitable container to remove metal chips from the chip trays. Injury may result from attempting to remove chips without a rake. Dispose of the chips in an environmentally safe manner.

1. Power down the machine.
2. Wait a minute to allow most of the coolant to drain back into the tank.
3. Open the coolant guard doors; sweep metal chips from the table and way covers into the coolant tank. Rake out as many of the chips as possible.
4. If the machine does not have a chip conveyor, carefully slide chip tray “A”, Figure 3.1, and “B”, Figure 3.2, out the side from the corners of the coolant tank.

- NOTE -

Chips can also be removed by disconnecting the coolant hoses from the tank, rolling the tank out from under the machine, and thoroughly cleaning the chip trays. When completed, return the tank under the machine and reconnect the coolant hoses.

5. Rake or dump the chips into a suitable container and dispose of them properly. Thoroughly clean the chip trays before returning them to the corners of the coolant tank.
6. Check and maintain the coolant. Fill the coolant tank as necessary.

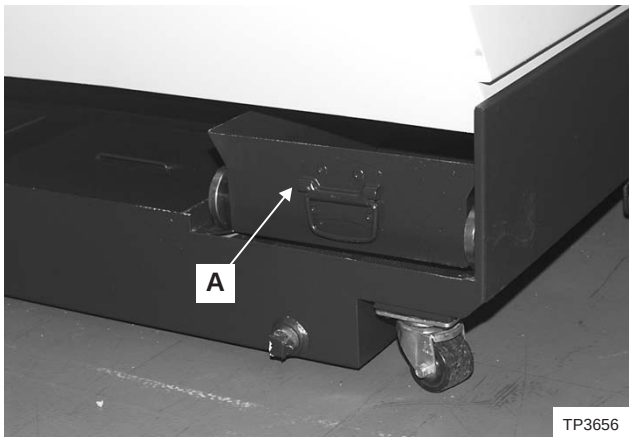


Figure 3.1 - Left Side Chip Tray

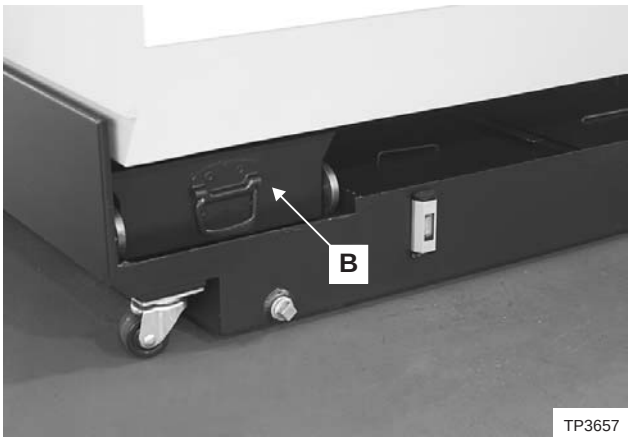


Figure 3.2 - Right Side Chip Tray

CLEANING THE COOLANT TANK AND FILTERS

Clean the coolant tank at least once every six months or more frequently if the materials being cut contaminate the coolant. Clean the coolant tank whenever changing the type or brand of coolant.

1. Power down the machine.
2. Wait a minute to allow the coolant to drain into the tank.

- WARNING -

Use a rake and suitable container to remove metal chips from the chip trays. Injury may result from attempting to remove chips without a rake. Dispose of the chips in an environmentally safe manner.

3. Open the coolant guard doors and sweep metal chips from the table and way covers into the coolant tank.
4. If the machine does not have a chip conveyor, carefully slide chip tray “A”, Figure 3.1, and “B”, Figure 3.2, out the side from the corners of the coolant tank.
5. Disconnect the coolant hoses from the coolant tank, if necessary; move the tank into an area that is convenient to remove the metal chips.
6. Rake or dump the chips into a suitable container and dispose of them properly
7. At both ends of the coolant tank, remove the pipe plug to drain the coolant or pump the coolant from the tank. Completely empty the tank.
8. Lift the chip pans from the tank. Clean them thoroughly.

- WARNING -

Wear protection and be careful when removing coolant and metal chips from the coolant tank.

9. Remove any coolant still in the tanks and wipe the coolant tank clean.
10. Be aware of how the filter screens are mounted in the coolant tank. Lift the screens from the slots.
11. Shake out the metal chips and wipe the filter screens clean.

- NOTE -

Dispose of the chips, coolant, and cleaner in an environmentally safe manner.

12. Wash the coolant tank and filter assembly with a cleaner recommended by the coolant manufacturer to remove any bacterial contamination. Flush or pump the cleaner from the tank and screens. Remove any chips and wipe the tank and screens clean.

- NOTE -

Do not force the filter assembly into the frame. There is only one way for it to fit.

13. Place the filter screens in their slots in the tank.

14. Return the tank to the opening under the machine. Adjust the chip trays on each end or chip conveyor and check inside the work area to see that coolant will drain back into the trays/conveyor and coolant tank.
15. If necessary, connect the coolant hoses. Check the coolant hoses to the machine for kinks or distortion and straighten them as necessary.
16. Pour the coolant directly into the work area to drain into the coolant tank. Fill the tank with the approved coolant to the FULL line of the sight gauge.
17. Always check for cutting fluid (coolant) leaks and correct them as necessary.

CLEANING THE COOLANT IN-LINE Y FILTER

Beginning in August, 2000 some machines have a coolant in-line Y filter and valve between the back of the tank and coolant pump. The in-line Y filter must be checked for cleanliness every day and cleaned as necessary. Whenever there appears to be a drop in coolant pressure, the in-line Y filter must be cleaned.

1. Power down the machine and allow the coolant to drain back into the tank and for the coolant pressure to drop to zero.

- NOTE -

Depending upon the valve configuration, ball valve “C”, may be in front of the in-line Y filter (as shown in Figure 3.3) or behind it.

2. Close ball valve “C”, Figure 3.3, (handle perpendicular to the coolant line) and wipe filter cap “D” clean with a lint free cloth.
3. Unthread the filter cap from the filter housing.
4. Note how the filter element is in the housing and pull it straight it out.
5. Clean the filter element or, if necessary, replace it. Make certain that all the particles are out of the screen.
6. Put the filter element all the way down into the filter housing and thread the cap in to seal the filter. Open the ball valve (handle parallel to the line as shown).

   After the machine is powered up, check for coolant leaks around the filter cap and tighten it as necessary.

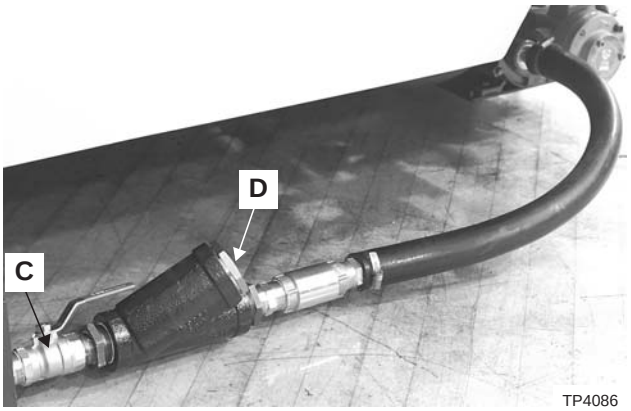


Figure 3.3 - In-Line Y Filter and Valves

COOLANT DIRECTIONAL BALLS

Five coolant directional balls are located on the spindle face, equally spaced around the tool. Refer to Figure 3.4.

The directional balls are mounted in Nylon cups; to adjust the directional position of the coolant balls, put a hex wrench or dowel up into the coolant ball orifice and move the ball. Move the direction of the other balls as necessary.

Figure 3.4 - Spindle Face

COOLANT/CHIP FLUSH

The adjustable hoses shown in Figure 3.5 can be set at any length or angle to flush chips toward the chip recovery screens. After powering down the machine, separate any ball link, remove or add links as necessary and re-attach the separated links by snapping them together.

The angle on the flexible hoses may be adjusted by forming the links until the desired position is obtained to move the chips toward the front of the machine.

Figure 3.5 - Coolant/Chip Flush
Adjustable Hoses

THRU-SPINDLE COOLANT [Option]

The thru-spindle coolant option must be factory installed. This unit is left in place at all times; the spindle can be run even though the coolant is not active.

The most important maintenance aspect of having thru-spindle coolant is having very clean coolant. There are three coolant filters on machines equipped with the thru-spindle coolant option: two in-coolant-line filters and the filter screens in the coolant tank.

The in-line filter is a Y filter mounted on the back of the coolant tank in the coolant return line. The in-line Y filter must be cleaned whenever there appears to be a drop in the thru-spindle coolant pressure. Refer to page 3-6 for information on cleaning the in-line Y filter.

Spin-on canister filter “E”, Figure 3.6, is mounted near the coolant pump on the right side of the tower (facing the rear of the machine). The spin-on canister filter must be replaced whenever there appears to be a drop in the thru-spindle coolant pressure.

The coolant tank screens must be checked for cleanliness every day and cleaned as necessary. Refer to “Cleaning the Coolant Tank and Filters”, page 3-5, to check and clean the coolant tank screens.

REPLACING THE IN-LINE SPIN-ON CANISTER FILTER

1. Make certain that the machine is powered down and that the coolant pressure has dropped to zero.
2. Wrap the filter head with a rag to catch coolant as filter canister “E”, Figure 3.6, is removed. Unthread the filter from its mounting nipple.
3. Wipe the mounting nipple with a lint free cloth and check to make certain that the filter seal is removed from the mounting surface.
4. Fill the replacement filter one-half full with fresh coolant and wipe a light coat of oil completely around the seal on top of the filter.
5. Thread the replacement filter on the mounting nipple until contact is made, then, thread it on one-quarter to one-half of a turn further.
6. After the machine is powered up, check for coolant leaks around the filter head and tighten the canister as necessary.

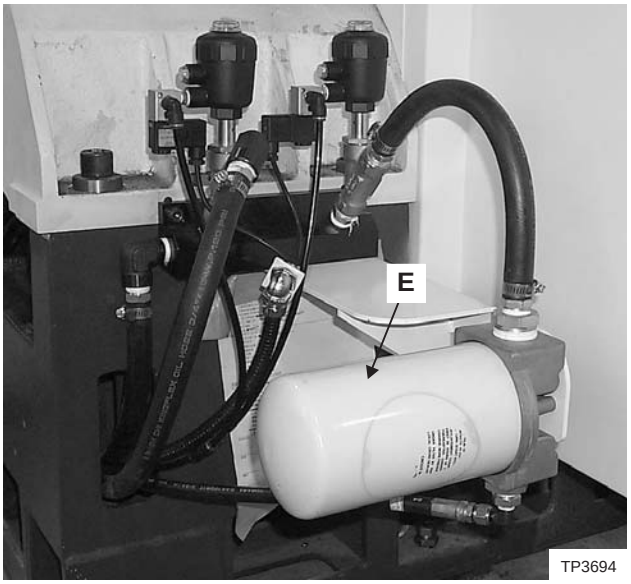


Figure 3.6 - Thru-Spindle Spin-On Canister Filter

- NOTES -

- NOTES -

CHAPTER 4 - LUBRICATION

IMPORTANCE OF LUBRICATION

Running conditions of this machine depend heavily upon the lubrication management. Make certain that the lubrication system is checked frequently to keep the machine in proper working condition.

AXES WAY GREASE LUBRICATION

Grease is used to lubricate the guideways along the X, Y, and Z axes as well as the axes ballscrew nuts. Kluber ISOFLEX® NBU 15 or NCA 15 grease, recommended by Hardinge, has good abrasion and adhesion properties.

- NOTE -

Make certain all the sliding surfaces are lubricated well by jogging the axes several times before resuming automatic operation.

Check the grease lubrication system monthly and add grease as necessary. The system cannot be over greased. Recommended lubrication is every 600 hours or approximately 4 months of operation.

1. Wait for the cycle to end and make certain that the spindle is stopped.

   - NOTE -

   From the front of the machine, the Z axis cover is just above the coolant guard on the tower, Figure 4.1.

   The X and Y axes cover is located on the front of the way cover inside the coolant guard doors, Figure 4.2.

2. Unthread the screws and remove the covers to uncover the axes grease fittings.

   - NOTE -

   VMC1250II and 1500II machines are equipped with two sets of Y axis grease fittings. The two sets of fittings are positioned approximately 39 inches [990 millimeters] apart.

3. Jog the X axis until the Y axis grease fittings (lower set, Figure 4.2) are uncovered. The X axis grease fittings are attached and move with the X axis jog.

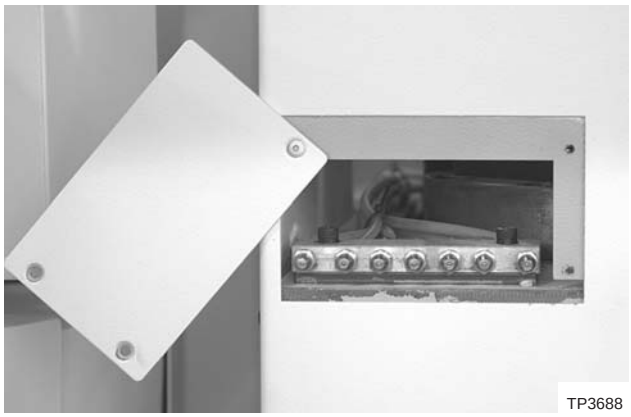


Figure 4.1 - Z Axis Grease Fittings at Front of Tower

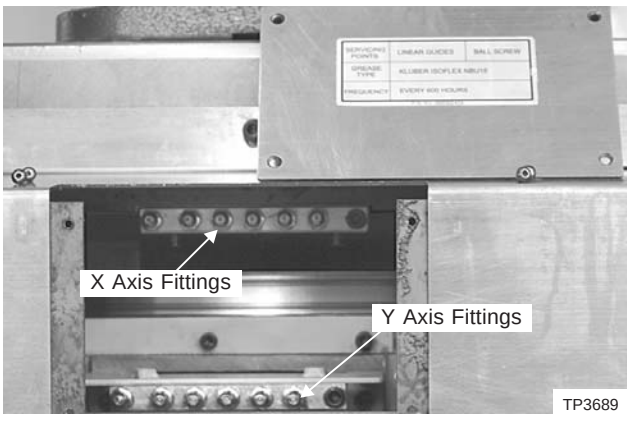


Figure 4.2 - X and Y Axes Grease Fittings at Front of Way Cover

4. Attach the grease gun (supplied with machine) to the grease nipple and pump in grease until resistance is felt; then, one more pump of grease. Repeat the process for each grease nipple on all axes.
5. Wipe the nipples clean of excess grease.
6. Align the cover for each opening and secure them with their screws; continue with machine operation or maintenance.

   If grease was added because there was an alarm fault (”600 hour lube alarm”), clear the alarm after the control has been powered up.

   Fanuc Control: Press the Reset and Feed Hold push buttons at the same time to clear the alarm.

   Siemens Control: Press and hold the Reset push button for 5 seconds or until the alarm is cleared.

TOOL KNOCKOUT PISTON LUBRICATION

Add the specified oil to the air/oil tool-knockout piston oil cup “A”, Figure 4.3, located on the knockout piston near the top of the machine. The oil in this cup should be replenished at least once every six months; however it is recommended that the piston oil cup be checked every month.

OIL SPECIFICATION

CHARACTERISTICS

Viscosity :ISO VG68
Viscosity index: above 95
Anti-oxidation,
Anti-corrosion,
Anti-rust,
Anti-emulsion

RECOMMENDED OILS

B.P.Energol NT 68
Mobil Vactra Oil No.2
Esso Febis K68
Shell Tonna Oil T68
Chevron Way Lubrica NT68

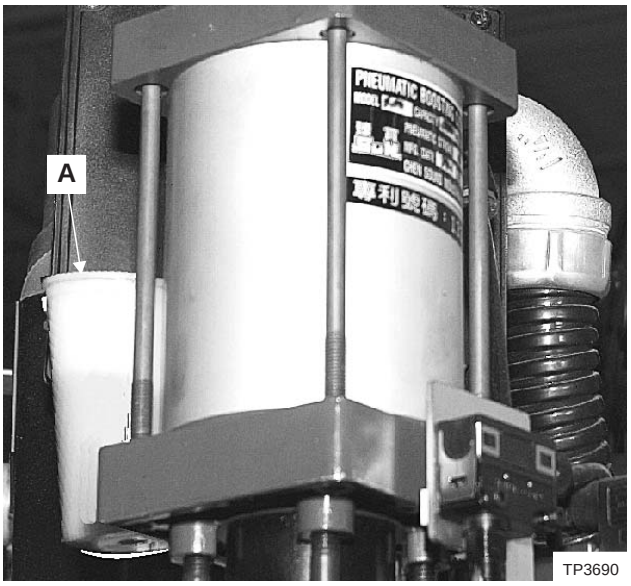


Figure 4.3 - Tool Knockout Lubricator Cup

ADDING OIL TO THE LUBRICATION CUP

1. Wait for the cycle to end and make certain that the spindle is stopped.
2. Power down the machine.
3. Locate the oil cup at the top of the machine.
4. Inspect the cover to be sure the vent hole is not plugged.
5. Unfasten the cover of the oil cup and fill the cup. Install the cover.
6. Power up the machine.

TOOL CAROUSEL RAIL LUBRICATION

Tool carousel grease fitting “B”, Figure 4.4, is in a seam on top of the carousel. If there are two carousels on the machine, there will be a fitting on each carousel. The grease fitting can best be seen when the tool carousel is at the retract position (furthest from the spindle).

The grease fitting can be viewed from the left end of the machine by looking up into the seam that is nearly centered on that end. if there is a second carousel, go to the other end of the machine and the grease fitting will be centered in the seam on that end.

Add Kluber ISOFLEX® NCA 15 grease to the tool carousel rail each 600 hours of machine operation.

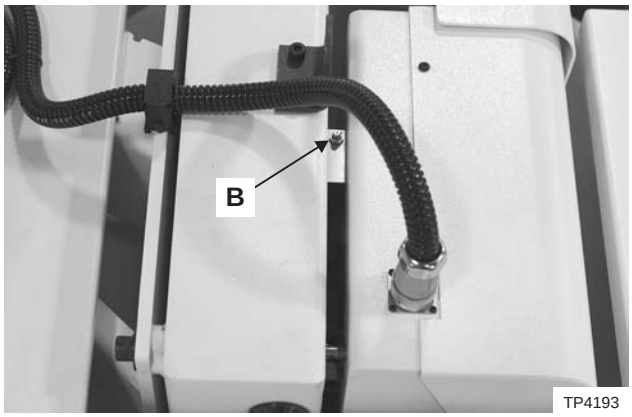


Figure 4.4 - Carousel Grease Fitting

ADDING GREASE TO THE TOOL CAROUSEL RAIL

1. Wait for the cycle to end and make certain that the spindle is stopped. Make certain that the carousel is in the retract position.
2. Power down the machine.
3. Locate the grease fitting at the top of the machine.
4. Wipe the fitting(s) clean of any dirt or contaminants.
5. Attach a grease gun (supplied) to the grease nipple and pump in grease until resistance is felt; then, one more pump of grease. If there is a second carousel, repeat the process.
6. Wipe the nipple(s) clean of excess grease.
7. Continue with machine operation or maintenance.

SPINDLE BEARING LUBRICATION

The bearings in the spindle in the standard machine are designed to last the life of the machine; therefore, no maintenance is required.

HIGH-SPEED SPINDLE AIR-OIL LUBRICATION

High-performance high-spindle machines are available with an air-oil spindle lubrication system. This configuration requires an air operating pressure of 75 psi [5.2 bar]. The air-oil lubrication system is located at the rear of the machine between the power case and the column, as shown in Figure 4.5. The labyrinth air seal has a separate air regulator mounted with the air regulator for the air-oil lubricator.

- NOTE -

It is especially important to maintain the main air assembly filter/regulator and coalescing filter as well as the additional air-oil lubrication system. Drain the bowls daily and correct any moisture problem.

The air-oil lubricator is active any time the air is ON and the CNC control is ON. It supplies oil to the spindle bearings whenever the spindle is running.

The tank contains approximately 0.85 liters of pre-filtered Mobil DTE-797 oil when filled, which allows about 0.3 liters of the oil to be available for use. The run time for one full spindle lubricator tank is approximately 5230 hours. The pump cycle time is preset at the factory to pump oil every 48 minutes. The oil must be filtered through a 3 micro or better filter before being used.

When the machine is powered up and an “Oil Air ERR.” message is displayed with the control forced into single block mode operation; first, check the oil level and, second, make certain that there is air pressure to the system. Fill the lubricator tank when necessary to clear this message and re-enable the lubricator system.

FILL THE AIR-OIL LUBRICATOR TANK

1. Locate the lubricator tank and tank filler cap.
2. Wipe away any oil and contaminants from the tank cover and filler cap.

- CAUTIONS -

Leave the filler tube screen in place. Do not tamper with the snap ring.

Use Mobil DTE-797 oil pre-filtered through a 3 micro or better filter. Oil obtained from Hardinge, part number MC-0010912-01, has already been filtered within specification.

3. Remove the filler cap and slowly fill the tank with pre-filtered Mobil DTE-797 oil. Wait a full 5 minutes to allow any air in the oil to escape.
4. Install the filler cap. Continue with maintenance or operation.

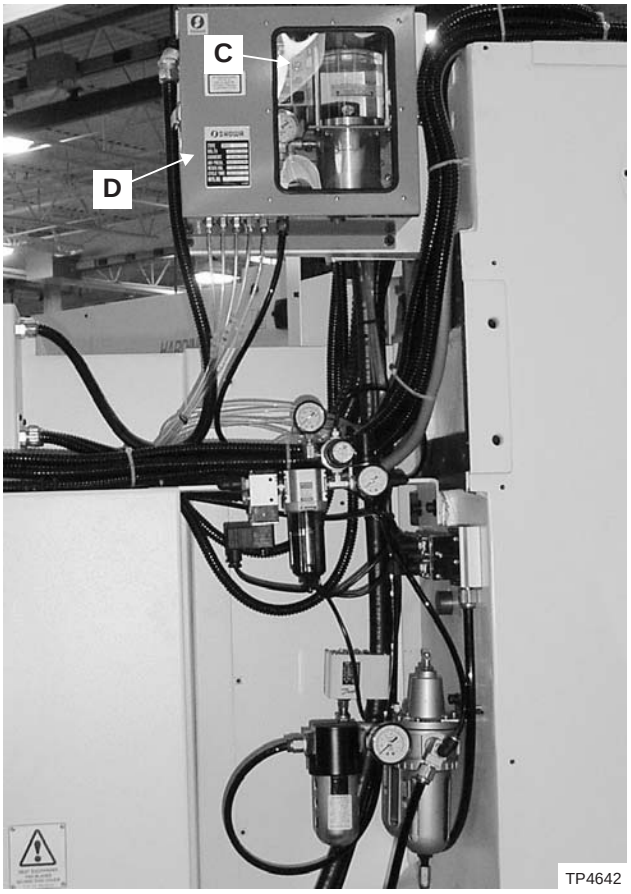


Figure 4.5 - High-Speed Spindle Lubrication System - Air and Lubricator

VERIFY SPINDLE LUBRICATION STATUS

Check and correct the air-oil lubricator components as follows:

1. Open two latches and lift off front cover “D”, Figure 4.5.

– NOTES -

The mixing block (metering unit) is mounted in the lower left corner with the air-oil feeder lines and air line connected to the bottom.

The main air line is the larger diameter line. The smaller line supplies oil to the mixing block.

2. Check the oil lines and oil pressure.
3. Check the air pressure from the main air panel to the controller and mixing block.
4. Check the air pressure from the mixing block to spindle.

The air-oil lubrication lines from the mixing block (metering unit) to the spindle must be at least 16.5 feet [5m] long and the same length, within 1 inch [25mm], of each other. Loosely wind the excess line in 5 loops with a 2.38 inch [60mm] minimum loop diameter. Install loops at a mid-way point between the spindle and lubricator, no closer than 3.3 feet [1 meter] to the spindle.

The spindle air-oil lubricator system consists of a Showa/MOA-5-1, 3X4 or a Vogel lubricator tank with oil pump and air metering, air regulator, oil and air lines with air valve and pressure switch, a mixing block (metering unit), air-oil lines from the mixing block, and air-oil discharge ports. Any of the components can be replaced after powering down the machine, removing the covers as necessary, and replacing just that component. When any of the needle valves in the mixing block become damaged or clogged, replace the mixing block assembly.

Check the spindle air-oil lubricator system at the beginning of each shift for any unusual noise or vibration. Check the lubricator oil lines and air lines for kinks or leaks. The pressure switch mounted on the air valve at the bottom of the lubricator tank is preset at the factory to 75 psi [5.3 kg/cm^2]

The controller to the left of the air-oil lubricator tank indicates system conditions through three LED’s “C”, Figure 4.5. The controller and tank are replaced as a unit. Each LED indicates the following:

Top (MAIN) LED is the power supply and timer (CK). It indicates that power is supplied to the IC controller and, when it is green, the timer is functioning normally.

Middle (LUBE) LED indicates low oil level (FS). It is lit when the float switch (FS) indicates that there is enough oil.

Bottom (FAILURE) LED indicates when the air pressure is too low, when there is not enough oil or any other part of the system fails. Fill the oil, check the system, and press the Reset push button.

SET THE AIR-OIL LUBRICATOR AIR REGULATOR

1. The machine must be powered up; main air filter/regulator turned ON and set to machine operating pressure; from 77 to 87 psi [5.3 to 6.0 bar].

- NOTE -

The gauge mounted in the controller on the air-oil lubricator tank is set at 0.5 MPa. Adjust this setting if the factory air pressure fluctuates during the day.

2. Pull up or out on the air-oil lubricator regulator knob, adjust the air pressure while watching the controller gauge along side the tank; then, press the knob back in place to lock it.

3. If the air fault light is or has been on, press the Reset push button.

The mixing block (metering unit) is mounted in the lower left corner, just inside front cover “D”, Figure 4.5, with the air-oil feeder lines and air line connected to the bottom of the block. The block receives a constant supply of oil while each of the five needle valves in the block set the air flow and mixes air with the oil.

INSPECT THE AIR AND OIL LINES AND SET THE AIR FLOW IN THE MIXING BLOCK

1. Power down the machine and lock out the power.

2. Remove the front and right side headstock covers.

3. Open two latches and lift off front cover “D”, Figure 4.5.

4. Inspect the air-oil lines for kinks, blockage, "dry line" or contaminants.

- NOTE -

Hardinge cuts the length of the air-oil lubrication lines from the mixing block to the spindle at 16.5 feet [5 meters]. Any replacement lines must be cut at the same length within 1 inch [25 mm] of the existing lines.

If it is necessary to replace a line, unwind it from the other loops. Do not shorten the line to a length less than 16.4 feet [5 m] or use any short line. Keep all the lines within specified lengths.

5. Carefully inspect the air-oil lines and replace any lines as necessary.

6. Set the needle valves on the mixing block (metering unit) for air flow as follows:

A) Make certain that the main air filter/regulator lock-out valve is OFF. Lock out the air valve.

B) Loosen the lock nut on the valve screw and unthread it to the top of the valve screw.

- NOTE -

Unthread each valve screw when an air pressure gauge (next instruction) is going to be installed and used in a line.

C) Use an air pressure gauge with a "Tee" fitting. Install the air pressure gauge “Tee” fitting in the lubrication line of lubrication fitting #1, no more than 4 inches [100 mm] from the fitting.

D) Adjust the lubricator air pressure needle valve for port #1 so that the air pressure gauge at the spindle reads 55 to 58 psi [3.8 to 4.0 bar].

E) Repeat this procedure for each of the five lubrication lines. Each individual adjustment will affect each of the other lines, so re-check each line and adjust as necessary until all lines are at the specified pressure. Make sure to remove the pressure gauge from the lubrication line before operating the spindle.

F)

Secure each valve screw and thread the lock nut down. Tighten each lock nut against the mixing block.

G) Unlock the main filter/regulator lockout valve and turn it on.

- NOTE -

If any needle valve is clogged or contaminated, replace the mixing block.

7. Power up the machine
8. Press the Reset push button.
9. Inspect the oil and air lines for leakage and inspect each line from the mixing block to the spindle for oil velocity. A very small stream of oil will move at approximately 5mm/sec.
10. Power down the machine, mount and latch the air-oil unit cover and mount the headstock covers.

SPINDLE LABYRINTH AIR SEAL

- CAUTION -

The air pressure must be left ON for 15 minutes after the spindle has stopped to allow the spindle interior to cool to room temperature without drawing in coolant and contaminants.

High-speed spindle machines equipped with an air-oil spindle lubricator are also equipped with a labyrinth air seal system. This system provides positive air pressure at the spindle nose to help prevent contaminants from entering the spindle bearings.

Cleanliness of the air supply is critical for preventing damage to the bearings. 2-way solenoid valve “E”, Figure 4.6, located on left side of air-oil solenoid valve, is provided in the air supply for ON/OFF control of the labyrinth air seal.

The labyrinth air seal air pressure (7.4 psi [0.5 bar]) must be ON before cutting fluid is turned ON, during operation of the spindle and during spindle cleaning.

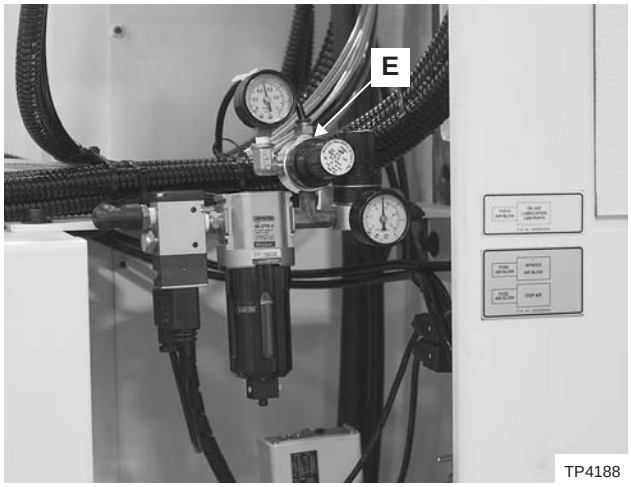


Figure 4.6 - Labyrinth Air Seal Air Regulator

HIGH-TORQUE GEAR BOX LUBRICATION

The gear box on the high-torque spindle machines requires a closed-loop circulation of lubrication. This system consists of a tank, pump, heat exchanger (radiator and fan) and the gear box. The heat exchanger helps stabilize and keep the gear box at a constant operating temperature. The oil level must be checked each 2000 hours (approximately one year) of operation and the oil must be changed every two years. Select the oil from the table on the next page.

ADDING OIL TO THE HIGH-TORQUE GEAR BOX TANK

1. Wait for the cycle to end and make certain that the spindle is stopped. Jog the spindle down to its lowest point (-Z position).
2. Power down the machine.
3. Unthread the screws and lift off the sheet metal cover above and around the spindle column to expose the spindle drive and high-torque mechanisms.
4. Open the right side door and locate gear box tank “F”, Figure 4.7.

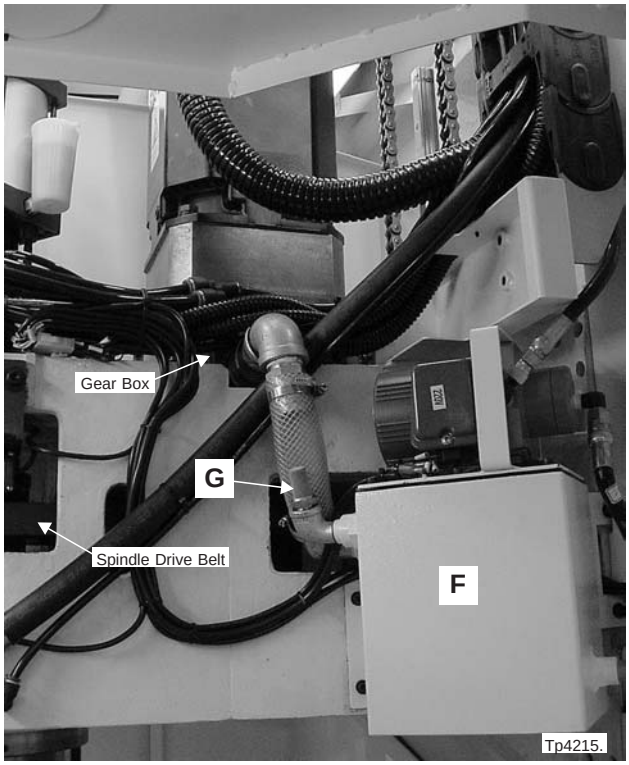


Figure 4.7 - High-Torque Gear Box Tank

- NOTE -

Select the oil from the table below.

Some tanks may have a filler cap; if there is a filler cap, clean the cap and area around the cap, open the cap and add oil until the tank is full.

5. Unthread tank vent “G”, and add oil until the tank is full.
6. Thread the vent on until it is snug.
7. Check the hoses for any kinks or leaks and correct any problems as necessary.
8. Mount the spindle sheet metal cover and tighten the screws.
9. Power up the machine and continue with machine operation or maintenance.

Machine Component	High-Torque Gear Box tank
Lubricant characteristic	1)Viscosity: ISO VG32 2)Viscosity index: above 95 3)Anti-rust, anti-oxidation 4)Good Stability
Lubrication method	Oil circulation
Lubrication frequency	As needed, 1/yr.
Tank capacity	.95 qt. [1.0 Liter]
Recommended grade of lubricant	1)CPC Circulation Oil R32 2)Mobil D.T.E Heavy Medium 3)Daphne Super Multi Oil 68 4)Shell Turbo Oil T68 5)Esso Auto A68

CHANGING THE OIL IN THE HIGH-TORQUE GEAR BOX TANK

- NOTE -

The oil in the high-torque gear box must be replaced every two years.

1. Wait for the cycle to end and make certain that the spindle is stopped. Jog the spindle down to its lowest point (-Z position).
2. Power down the machine.
3. Unthread the screws and lift off the sheet metal cover above and around the spindle column to expose the spindle drive and high-torque mechanisms.
4. Open the right side door and locate gear box tank “F”, Figure 4.7.
5. Unthread the screws that fasten the tank top to the tank. The tank top has the lubricator pump mounted on it.
6. Carefully pry the top from the tank and set it aside.
7. Pump or wipe the oil from the tank until it is empty.

   Wipe the tank clean with a lint-free cloth.
8. Install the tank top and tighten the screws that fasten the top to the tank.

- NOTE -

Select the oil from the table on the previous page.

Some tanks may have a filler cap; if there is a filler cap, clean the cap and area around the cap, open the cap and add oil until the tank is full.

9. Unthread tank vent “G”, and add oil until the tank is full. The tank will hold approximately 1 liter of fluid.
10. Thread the vent on until it is snug.
11. Check the hoses for any kinks or leaks and correct any problems as necessary.
12. Mount the spindle sheet metal cover and tighten the screws.
13. Power up the machine and continue with machine operation or maintenance.

- NOTES -

CHAPTER 5 - MISCELLANEOUS

CHANGING THE CONTROL BATTERIES (Fanuc Control Only)

- CAUTION -

A fresh battery pack must be installed at least once a year. Failure to perform this maintenance will result in the loss of control information.

Battery Specifications

Manufacturer:	Sanyo
Battery Number	CR17450SE-R
Voltage Rating:	3 volt
Battery Type:	Lithium

1. Power up the machine. Refer to the power-up procedure beginning on page 1-1.

- WARNING -

High voltage AC will be present in the power case when the main disconnect switch is ON.

2. Turn interlock bypass “A”, Figure 5.1, as indicated to allow the power case door to be opened with the power ON.
3. Open the power case door.

- WARNING -

Hold the battery cover by the top and bottom and squeeze the cover while pulling it off.

4. Remove battery cover “B”, Figure 5.2.

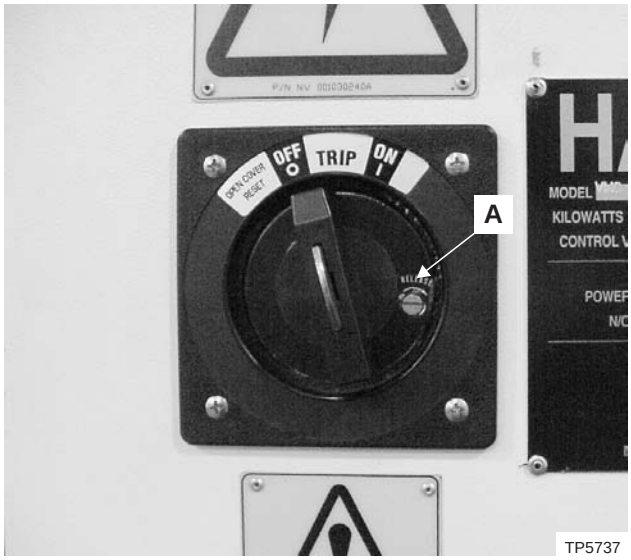


Figure 5.1 - Control Battery Unit Cover

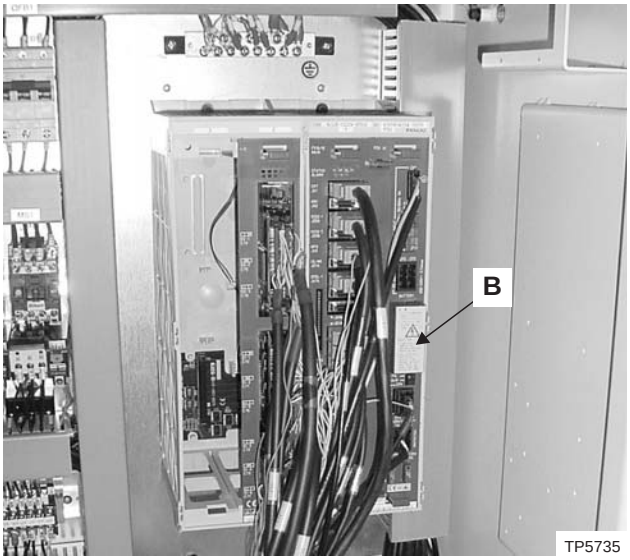


Figure 5.2 - CNC Control Unit

5. Verify the replacement battery pack matches the battery pack being removed.
6. Disconnect the old battery pack from receptacle “C”, Figure 5.3.
7. Connect the new battery pack.
8. Install the battery pack and cover.
9. Close and secure the power case door.
10. Properly dispose of the old battery pack.

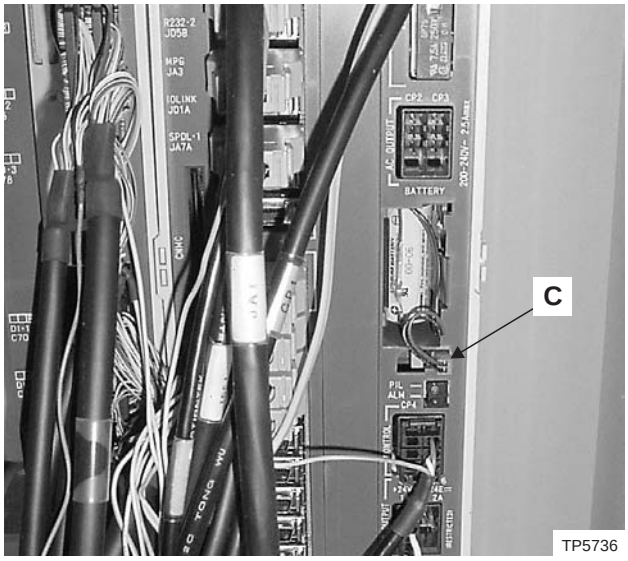


Figure 5.3 - Control Battery Connection

CLEANING THE POWER CASE HEAT EXCHANGER AIR FILTER

The power case is cooled by a heat exchange system. The heat exchanger provides the cooling and environmental protection necessary for proper operation of the printed circuit boards. This air unit employs a closed loop design which circulates air inside the power case while sealing out potentially contaminated, external air.

The heat exchanger is located either on the door exterior or near the top of the power case. Air is moved inside the power case while external air is drawn across the corrugated metal (heat exchange) plate. Clean air filter “D”, Figure 5.4, on the heat exchanger or above the power case.

1. Power down the machine.
2. Clean the power case heat exchanger air filter as follows:
   A) Use the tab on the filter to lift the air filter up, slide the bottom out and pull it down to remove the air filter from its frame.
   B) Wash the air filter clean in detergent and water. Blow it out with compressed air and allow it to air dry.
   C) Make certain that the air filter is dry; put the filter, with tab down, up into the top of its frame, press it in and drop it into the bottom of the frame.
3. Power up the machine.

Figure 5.4 - Air Filter on Heat Exchanger

WORK LIGHT LAMP REPLACEMENT

The work light is mounted to an arm from the ceiling. It is a 24 volt, 70 watt, Series HGW - halogen lamp. A 60 or 50 watt, Series HGW halogen lamp may be used. The work light is turned ON when the machine is ON.

- WARNING -

DO NOT perform any work on work light electrical components while the electrical power is ON.

The work light lens may be hot.

Never touch the glass portion of the halogen bulb with bare hands.

1. Open the main coolant guard doors and; then, power down the machine. Lock out the main disconnect switch. If necessary, unlatch and open the right side access door.
2. Wipe the work light and work light arm clean.
3. At the rear of the lamp, unthread the six screws and lift the rear cover off.
4. Pinch together the wire retaining clip and unfasten it from the bracket; swing it back. Lift halogen bulb “E”, Figure 5.5, from the socket. Disconnect the bulb wire.
5. Connect the new bulb wire and install the halogen bulb in the socket by fastening the retaining clip.
6. Make certain that the O-ring is in place; mount the cover and thread in the screws.
7. Close the main coolant guard doors.
8. Power up the machine. The light will come on when the machine is powered up.

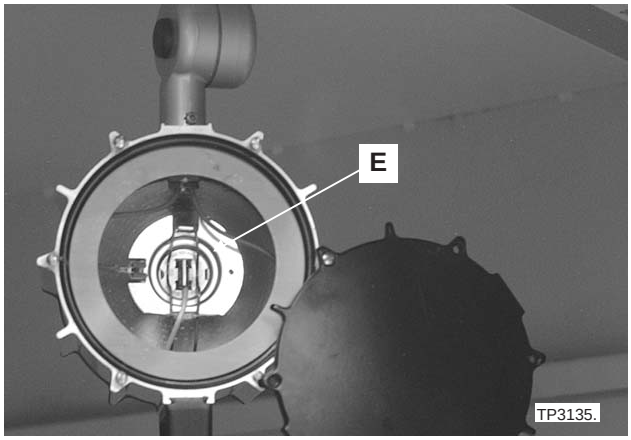


Figure 5.5 - Work Light
(Rear Cover Removed)

SPINDLE BELT TENSION

- NOTE -

Refer to the page 5-7 for information on adjusting spindle belt tension on a machine equipped with the high-torque option.

Check the drive belt tension frequently across all belts approximately at the midpoint between pulleys, as shown in Figure 5.6.

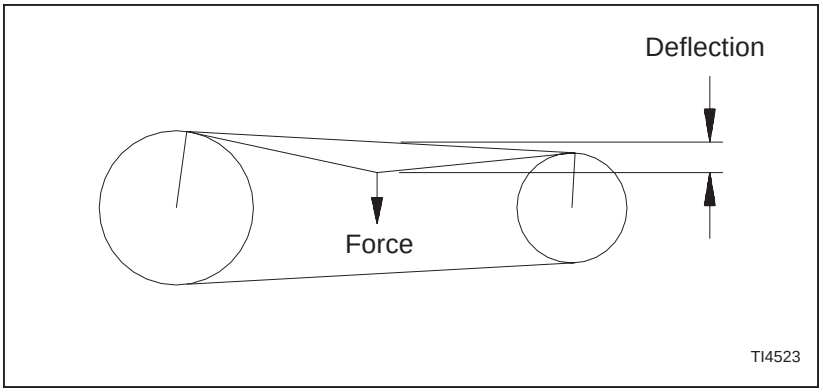


Figure 5.6 - Spindle Belt Deflection

SPINDLE BELT TENSION SPECIFICATION

Standard Spindle Drive

Belt Condition	Force	Deflection
New Belt	6.6 lb-f [3 Kg-f]	.108 in. [2.75 mm]
Belt Used in Excess of 1000 Hours	5.5 lb-f [2.5 Kg-f]	.108 in. [2.75 mm]

High Speed Spindle Drive [Option]

Belt Configuration	Belt Condition	Force	Deflection
3 Strand Belt	New Belt	5.1 lb-f [2.3 Kg-f]	.165 in. [4.2 mm]
	Belt Used in Excess of 1000 Hours	4.4 lb-f [2.0 Kg-f]	.165 in. [4.2 mm]
2 Strand Belt	New Belt	3.5 lb-f [1.6 Kg-f]	.165 in. [4.2 mm]
	Belt Used in Excess of 1000 Hours	3.1 lb-f [1.4 Kg-f]	.165 in. [4.2 mm]

ADJUSTMENT PROCEDURE

1. Wait for the cycle to end and make certain that the spindle is stopped.
2. Power down the machine.
3. Loosen four mounting screws “G”, Figure 5.7, on the motor plate and two nuts of adjusting screw “F”.
4. Adjust the belt tension by tightening or loosening adjusting screw “D”.
5. Lock the adjusting bolt by tightening the two nuts together.
6. Tighten the four mounting screws on the motor plate.

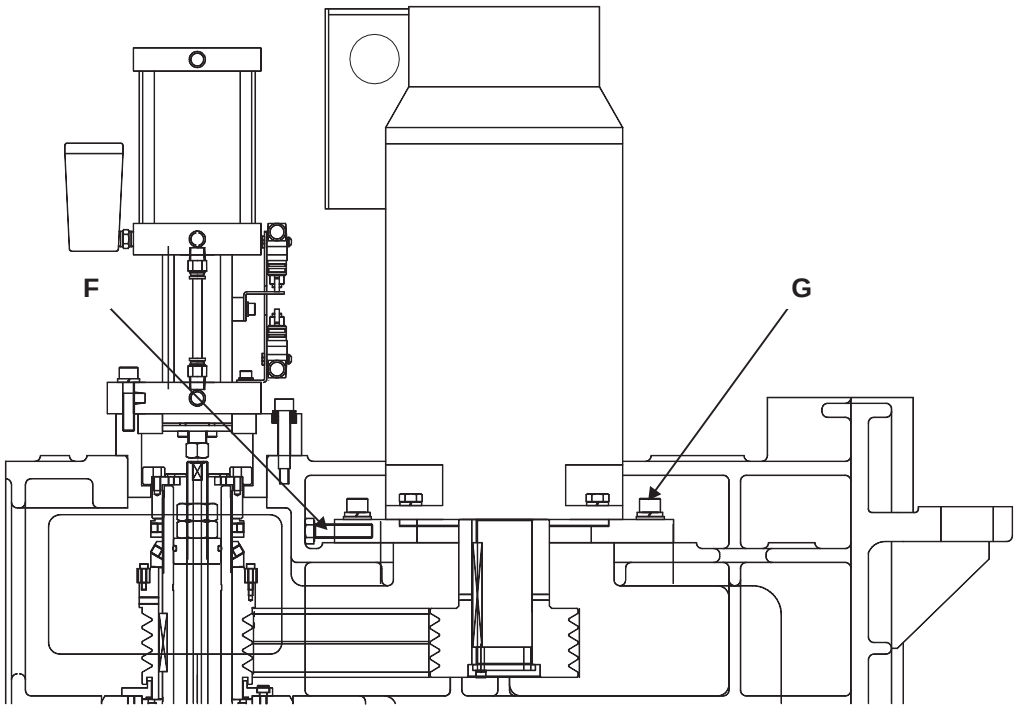


Figure 5.7 - Spindle Belt Tension Adjustment
(Machine Not Equipped with High Torque Option)

HIGH-TORQUE SPINDLE BELT TENSION

- NOTE -

Refer to the page 5-5 for information on adjusting spindle belt tension on a machine NOT equipped with the high-torque option.

The spindle drive belt connects high-torque gear box “I”, Figure 5.8, to the spindle pulley. Check the drive belt tension at least once a week during the first month of operation or more frequently if spindle performance is inconsistent. Check the belt tension approximately every 1000 hours of operation after the first month of operation. Read the drive belt tension near the midpoint between pulleys, as shown in Figure 5.6.

SPINDLE BELT TENSION SPECIFICATION

Belt Condition	Force	Deflection
New Belt	20 lb-f [9 Kg-f]	.172 in. [4.37 mm]
Belt Used in Excess of 1000 Hours	15 lb-f [6.8 Kg-f]	.172 in. [4.37 mm]

ADJUSTMENT PROCEDURE

1. Wait for the cycle to end and make certain that the spindle is stopped. Jog the spindle down to its lowest point (-Z position).
2. Power down the machine.
3. Remove the sheet metal cover above and around the spindle column to expose the spindle drive and high-torque mechanisms.
4. Open the right side door and locate the spindle belt through access opening “K”, Figure 5.9. Apply the force and check the belt deflection here.
5. When necessary to adjust the belt, loosen four mounting screws “H”, Figure 5.8, on the gear box flange and locking nut on adjusting screw “J”.

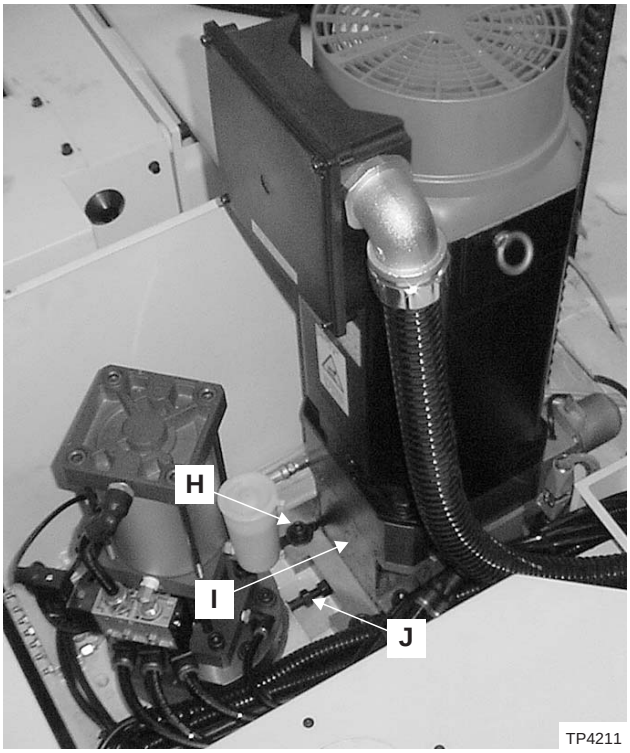


Figure 5.8 - High-Torque Gear Box and Adjustment Screws (shown with Fanuc motor)

6. Adjust the belt tension by tightening or loosening adjusting screw “J”.
7. After the belt has been adjusted, lock the adjusting screw.
8. Torque four mounting screws “H” to 74 lb-ft [100 N•m].
9. Mount the spindle sheet metal cover.

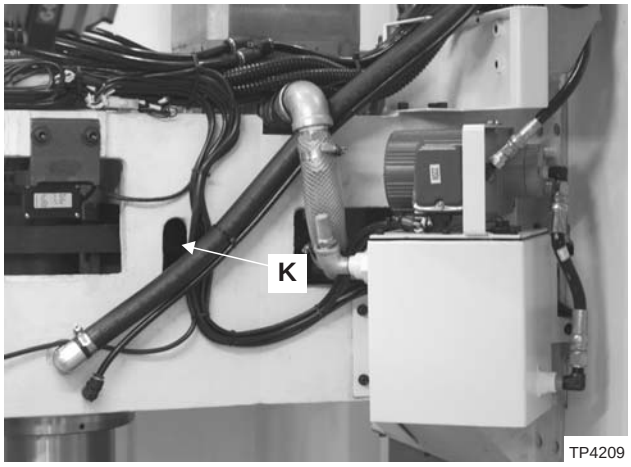


Figure 5.9 - High-Torque Belt Access

OVERTRAVEL (OVER-LIMIT) FAULT RECOVERY PROCEDURE

Whenever an axis travels past its software limit, the axis must be reset before the machining cycle can continue.

1. Select Jog mode.

- NOTE -

Yellow EM push button “L”, Figures 5.10 and 5.11 is an overtravel bypass switch that allows the operator to jog an axis or axes out of an overtravel condition.

2. Press **and hold** yellow EM push button “L”, Figure 5.10 or 5.11.
3. Use the axis directional push button(s) to move the axis or axes out of the overtravel condition.
4. Release the yellow EM push button.
5. Home (zero return) all axes.
6. Verify the machining cycle.

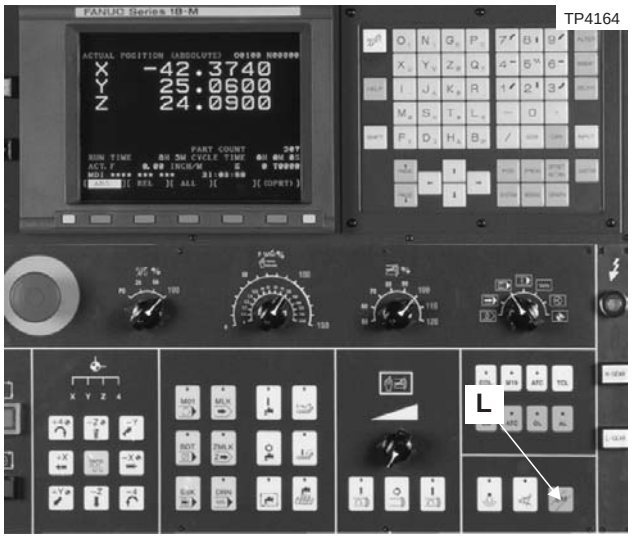


Figure 5.10 - EM Push Button (Fanuc Control)

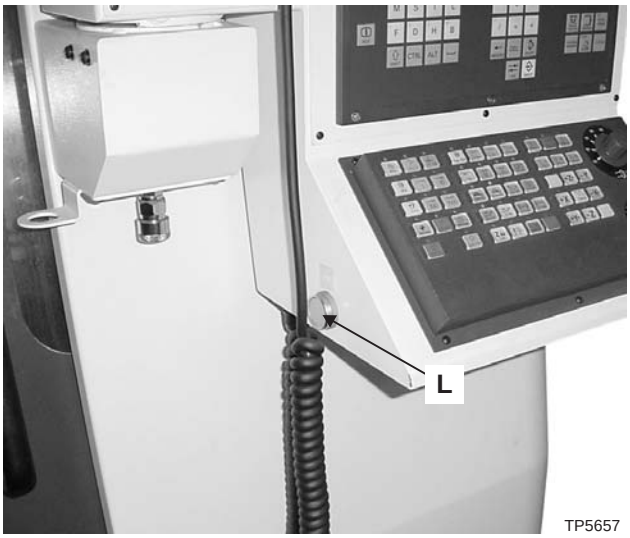


Figure 5.11 - EM Push Button (Siemens Control)

RESETTING THE Z AXIS HOME POSITION

Occasionally it is necessary to reset the Z axis zero return (reference Home) position; the Z axis is the elevation (up/down motion) of the spindle.

MACHINE EQUIPPED WITH A FANUC CONTROL

- NOTE -

Refer to page 5-14 for the procedure used on machines equipped with a Siemens control.

1. Power up the machine.
2. Remove any Z axis offset values in the control.
3. Verify that the tool magazine(s) is (are) at the Home (retracted) position.
4. In Emergency Stop or in Manual Data Input mode, set PWE (parameter write enable) to 1 as follows:

   MACHINES WITH A FANUC 0M-D CONTROL
   OR HARDINGE/FANUC CONTROL SYSTEM II

   A) If necessary, press Emergency Stop.
   B) Press the Parameter key.
   C) Press the Parameter soft key.
   D) Page down to Parameter Write Enable.
   E) Key in: 1
   F) Press the Input key.

   MACHINES WITH A FANUC 0i-M OR 18-M CONTROL

   A) If necessary, press Emergency Stop.
   B) Press the Offset Setting key.
   C) Press the Setting soft key.
   D) Move the cursor to Parameter Write Enable.
   E) Key in: 1
   F) Press the Input key.
5. Turn Keyset ON:
   A) Press Operator key.
   B) Press the Operator soft key.
   C) Cursor to the Keyset field.
   D) Move the cursor to select ON.

6. Change the Z axis grid shift parameter to 0:

   MACHINES WITH A FANUC 0M-D CONTROL
   OR HARDINGE/FANUC CONTROL SYSTEM II

   A) Put the control into Manual Data Input mode.

   B) Press the Parameter key.

   C) Press the Parameter soft key.

   D) Press the NO. key. (NO. will flash on the control display screen.)

   E) Key in: 510

   F) Press the Input key. The cursor will be positioned at parameter 510.

   G) Key in: 0.

   H) Press the Input key.

   MACHINES WITH A FANUC 0i-M OR 18-M CONTROL

   A) Put the control into Manual Data Input mode.

   B) Press the System key.

   C) Press the Parameter soft key.

   D) Key in: 1850

   E) Press the Number Search soft key.

   F) Move the cursor to the Z data field.

   G) Key in: 0.

   H) Press the Input key.

7. Power down the control; wait a minute, then, power it up. While pressing the Cancel and P keys, turn the control ON.

8. After the control comes all the way ON, release the Cancel and P keys.

9. Home all axes.

10. Check the Relative position display as follows:

    A) Press the Position key.

    B) Press the Relative soft key.

    At this time the Relative position should read:
    X 0.0000
    Y 0.0000
    Z 0.0000

11. Using Jog or Handle mode, position the Z axis so the arrows on the Z axis way cover and the sheet metal are aligned.

12. Record the Z axis position from the Relative display.

13. Update the Z axis grid shift parameter as follows:

    MACHINES WITH A FANUC 0M-D CONTROL
    OR HARDINGE/FANUC CONTROL SYSTEM II

    A) Select Manual Data Input mode.

    B) Press the Parameter key.

    C) Press the Parameter soft key.

    D) Press the NO. key. (NO. will flash on the control display screen.)

    E) Key in 510

    F) Press the Input key.

    G) Enter the Z Position recorded in step 12.

    H) Press the Input key.

    MACHINES WITH A FANUC 0i-M OR 18-M CONTROL

    A) Put the control into Manual Data Input mode.

    B) Press the System key.

    C) Press the Parameter soft key.

    D) Key in: 1850

    E) Press the Number Search soft key.

    F) Move the cursor to the Z data field.

    G) Enter the Z Position recorded in step 12.

    H) Press the Input key.

- NOTE -

The control display screen will display 000 P/S alarm.

14. Power down the control; wait a minute, then, power it up; press and hold the Cancel and P keys while turning the control ON.

15. After the control comes all the way ON, release the Cancel and P keys.

16. Do a normal axes Zero Return (Home) procedure.

17. In Emergency Stop or in Manual Data Input mode, set PWE (parameter write enable) to 0 as follows:

    MACHINES WITH A FANUC 0M-D CONTROL
    OR HARDINGE/FANUC CONTROL SYSTEM II

    A) If necessary, press Emergency Stop.

    B) Press the Parameter key.

    C) Press the Parameter soft key.

    D) Page down to Parameter Write Enable.

    E) Key in: 0

    F) Press the Input key.

    MACHINES WITH A FANUC 0i-M OR 18-M CONTROL

    A) If necessary, press Emergency Stop.

    B) Press the Offset Setting key.

    C) Press the Setting soft key.

    D) Move the cursor to Parameter Write Enable.

    E) Key in: 0

    F) Press the Input key.

18. Press the Reset key.

19. Check the tool change height and adjust it as necessary.

MACHINE EQUIPPED WITH A SIEMENS CONTROL

- NOTE -

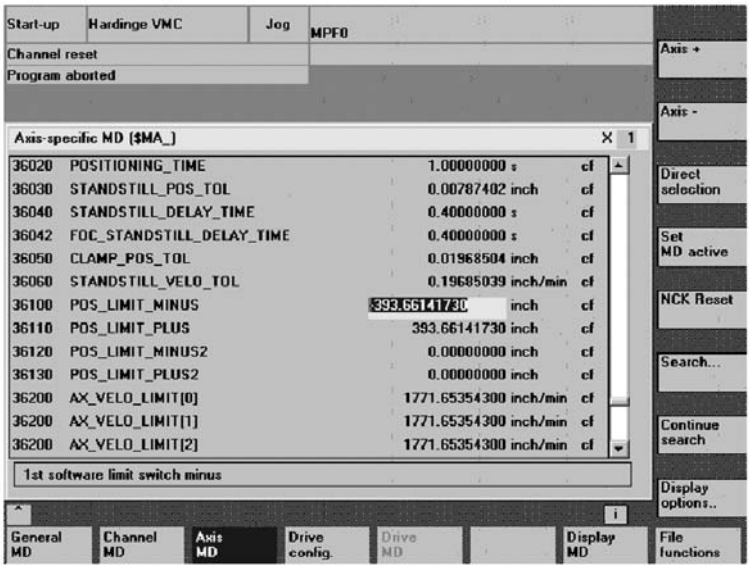
Refer to page 5-10 for the procedure used on machines equipped with a Fanuc control.

1. Reference the axis.
2. Use the handwheel or jog the axis to the required reference point and record the value on the display. Make sure that “MCS” or “Machine” co-ordinates are active.

- NOTE -

The standard software limit for all linear axes is 2mm beyond the reference point; therefore, it will be necessary to temporarily increase the software limit to move the reference point beyond this position.

3. Press Menu Select & the horizontal Start-up soft key to access the Startup area.
4. Press the vertical Machine data & Axis MD soft keys to access axis specific machine data.
5. Select the Z axis from the vertical Axis + or Axis - soft keys.
6. Search for MD36110.
7. Record the current value.
8. Increase the value as required.
9. Press the vertical Set MD active soft key to activate the modified value. (Refer to Figure 5.12)



TI5658

Figure 5.12 - Axis Software Limit Machine Data

10. Press [Menu Select] & the horizontal [Start-up] soft key to access the Startup area.
11. Press the vertical [Machine data] & [Axis MD] soft keys to access axis specific machine data and
12. Select the Z axis from the vertical [Axis +] or [Axis -] soft keys.
13. Search for MD34080.
14. If the motor encoder is the active position feedback device, adjust MD34080[0] by the value recorded in step 7.

    If a linear scale is used, adjust MD34080[1] by the value recorded in step 7. (Refer to Figure 5.13)
15. Press the MCP [Reset] key to activate the modified value in MD34080 and reference the axis.
16. The new reference position is now set. If the Z axis software limit was changed, restore the original value, which was recorded in step 7.
17. With the software limits restored, check that the axis travels to each software limit without tripping the emergency stop hard limits. If an emergency stop limit is reached, adjust the software limits as required.

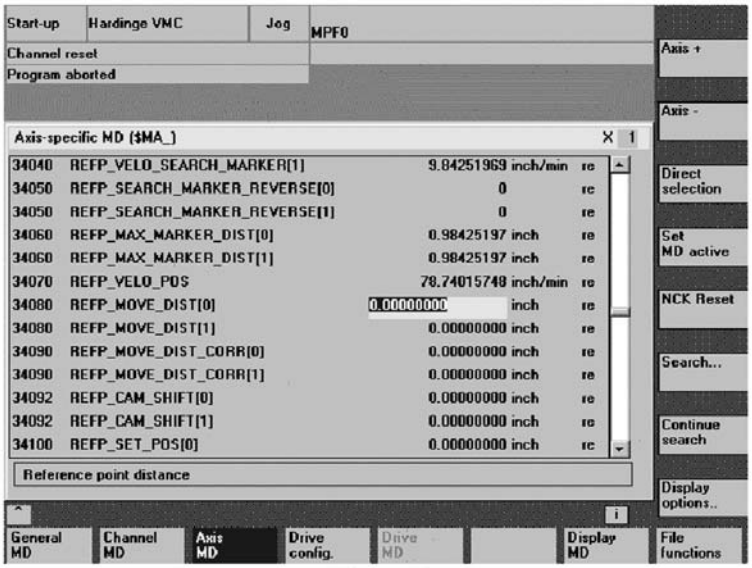


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Figure 5.13 - Axis Reference Shift Machine Data

- NOTES -

APPENDIX ONE - PREVENTIVE MAINTENANCE SCHEDULE

INTRODUCTION

VMC Series II vertical machining centers are designed to provide minimal downtime and insure long machine life when the following schedule of preventive maintenance is applied. Modular construction and easy access to components help to monitor each of the systems of the machine. Pressure sensors and control alarms alert the operator through the control display when systems malfunction. Circuit breakers and fuses with LED's provide visual confirmation of the electrical status of each circuit.

The access covers and doors, along with the sheet metal housings, have been designed to be removed easily when service is required. Open access covers and doors or remove sheet metal panels to gain access to system components. Any component can be removed from the frame when extensive service or replacement is necessary.

- CAUTION -

Do not use caustic or abrasive cleaners on this machine.

Maintaining a clean machine is part of any good maintenance program. Machines should be periodically wiped with lint-free cloths soaked with a petroleum-based solvent. If the machine is operated in an atmosphere that causes surfaces to rust quickly, wipe these surfaces with a lint-free cloth soaked in mineral oil.

NEVER USE COMPRESSED AIR TO CLEAN DIRT OR CHIPS FROM THE MACHINE. Air pressure could force dirt particles and other foreign material past seals and wipers.

MAINTENANCE SCHEDULE

The following maintenance times are approximate and components may need attention more frequently if excessive environmental pollution is present. Preventive maintenance frequency is for single shifts and should be increased proportionally when work is for two or three shifts per day.

8 Hours

- Check air line filter bowls . . . . . Chapter 2
- Check coolant level and thru-spindle coolant pressure . . . . . Chapter 3
- Check cutting fluid (coolant) concentration and pH . . . . . Chapter 3
- Clean thru-spindle coolant tank screens . . . . . Chapter 3
- Check coolant filters . . . . . Chapter 3

40 Hours

- Remove chips from coolant tank (as necessary) . . . . . Chapter 3
- Check heat exchanger air filter, clean as necessary. . . . . Chapter 5
- Wash machine and wipe clean

160 Hours

- Check and clean air line filter . . . . . Chapter 2
- Check tool knockout piston lubrication . . . . . Chapter 4
- Check power case for contaminants

480 Hours

- Adjust the spindle drive belt tension . . . . . Chapter 5

600 Hours

- Add X, Y, and Z axes way grease . . . . . Chapter 4
- Add tool carousel rail grease . . . . . Chapter 4
- Check tool knockout lubrication cup for oil . . . . . Chapter 4
- Check spindle drive belt for wear and tension . . . . . Chapter 5

1000 Hours

- Clean and flush coolant system and change coolant . . . . . Chapter 3
- Check coolant hoses for cracks, bad fittings, and kinks . . . . . Chapter 3
- Check spindle drive belt for wear and tension . . . . . Chapter 5
- Check and tighten all electrical plugs and connections

2000 Hours

- Tool knockout piston oil . . . . . Chapter 4
- Check high-torque spindle gear box lubrication . . . . . Chapter 4
- Check spindle oil-air lubricator oil . . . . . Chapter 4
- Change control batteries . . . . . Chapter 5
- Check spindle drive belt for wear and tension . . . . . Chapter 5
- Check all push buttons and switches

4000 Hours

- Change oil in high-torque gear box . . . . . Chapter 4

Non-Metallic Materials Typically Found in Hardinge Machine Construction

nitrile
neoprene
fluorocarbon rubber
urethane
silicone rubbers
cork-nitrile composites
polyurethane enamel
acetal plastics
polycarbonates
nylons
phenolic plastics
polyethylene
PVC
PTFE (polytetrafluoroethylene)

- NOTES -

APPENDIX TWO - PHOTOGRAPHS

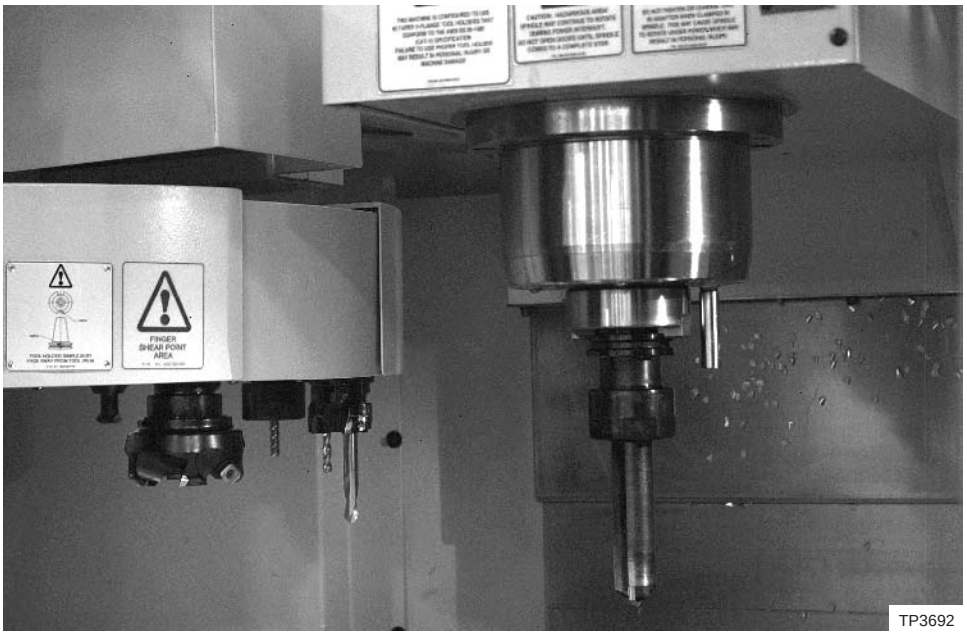

Figure A2.1 - Spindle and Tool Carousel

Figure A2.2 - Tool Station (some numbers are on top, other numbers are on the edge or bottom)

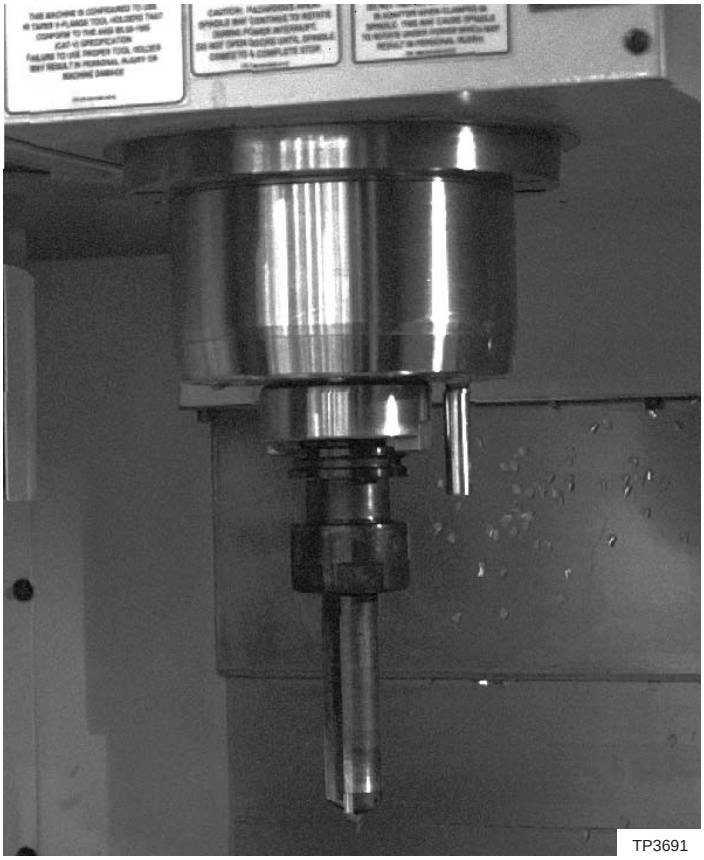

Figure A2.3 - Spindle with Tool

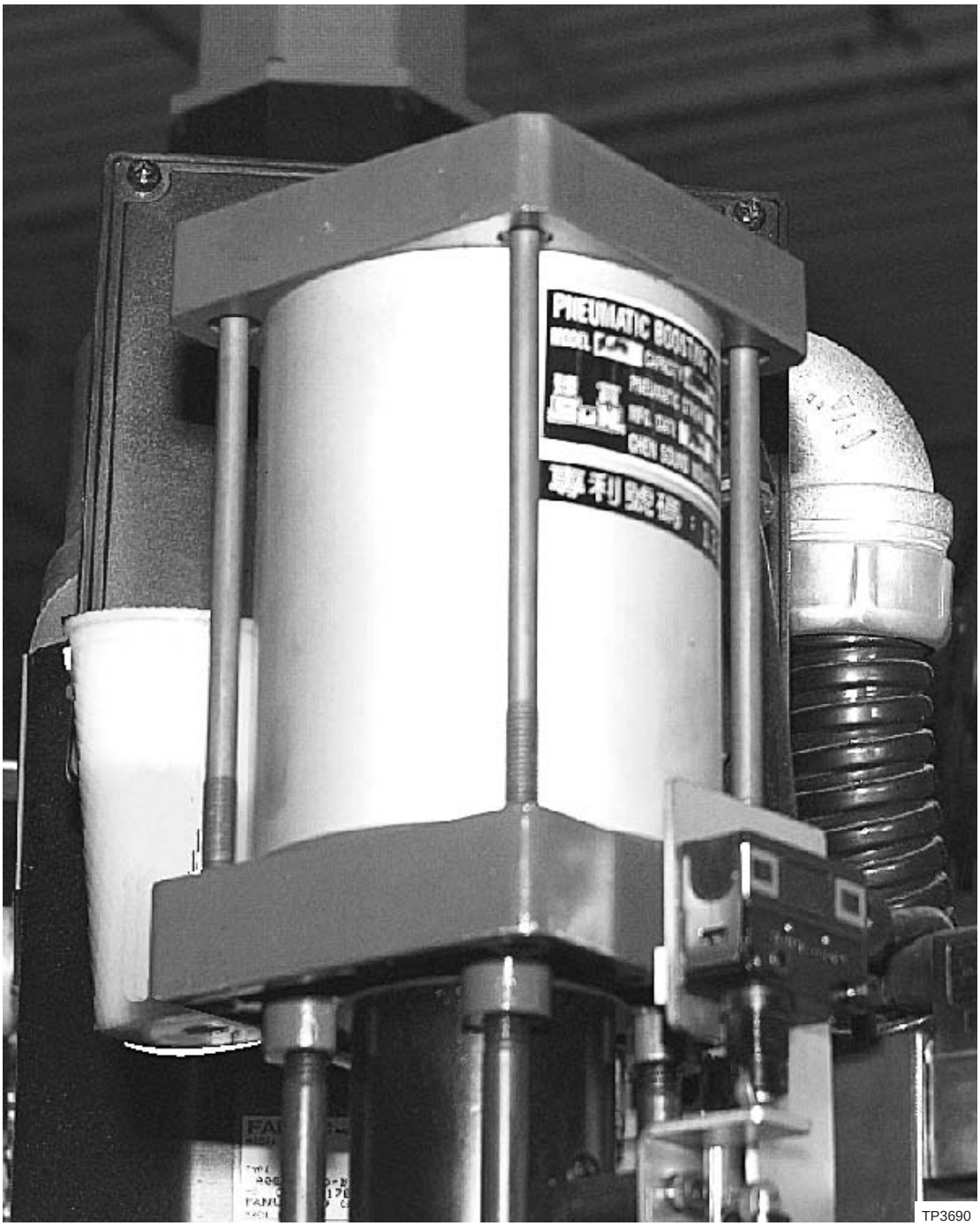

Figure A2.4 - Tool-Knockout Cylinder,
Lubrication Cup, and Spindle Drive Motor

Figure A2.5 - Z Axis Grease Nipple Block

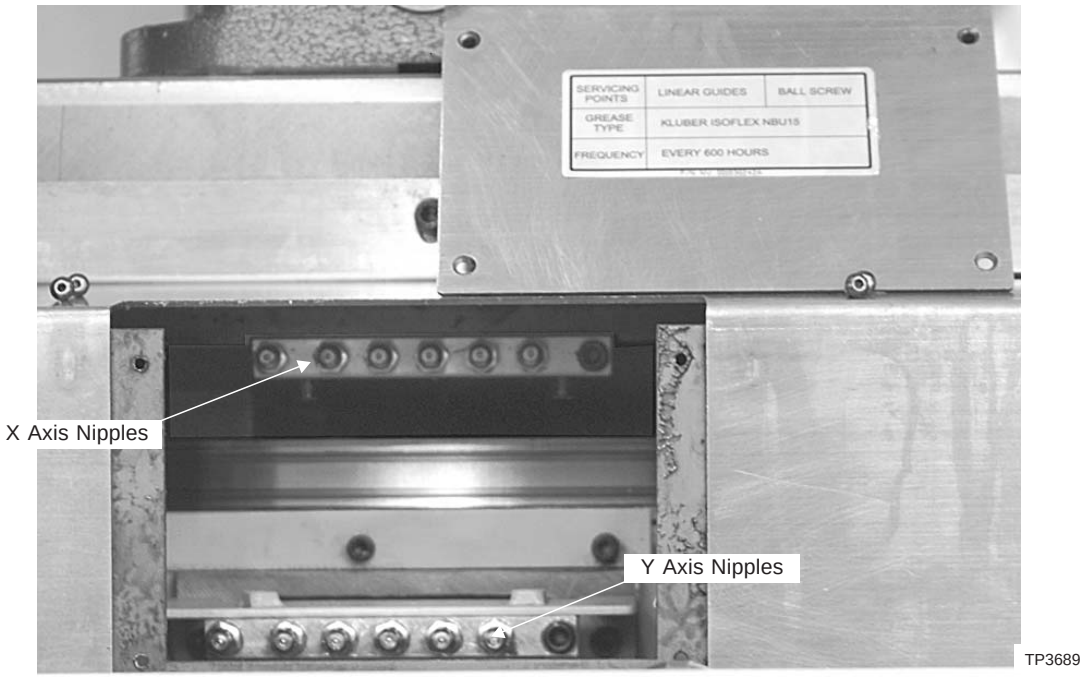

Figure A2.6 - X and Y Axis Grease Nipple Blocks,
Jog the X Axis Until Both Sets of Grease Nipples are Uncovered
(VMC1250II and 1500II machines are equipped
with two sets of Y axis grease fittings)

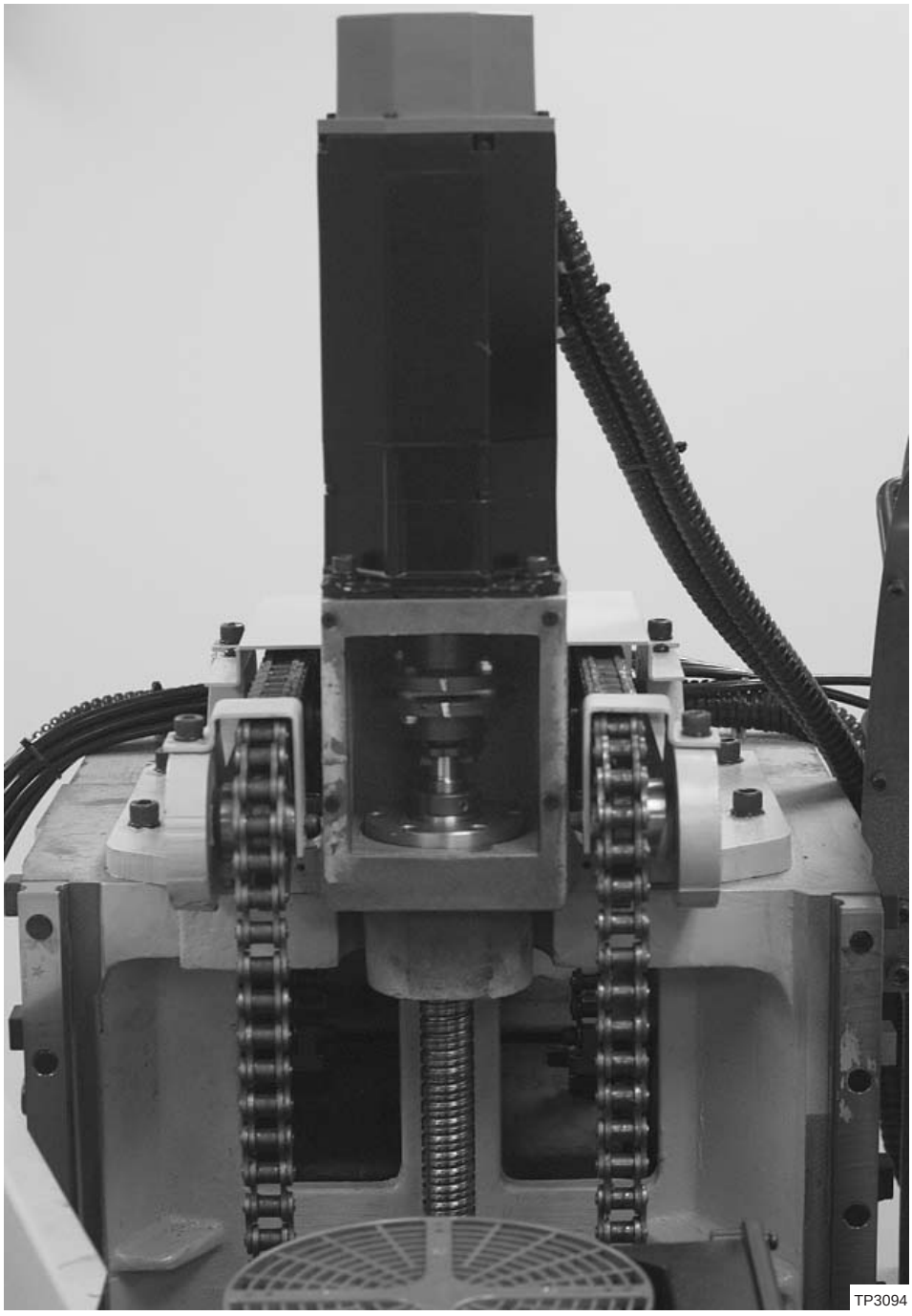

Figure A2.7 - Z Axis Drive Motor (Fanuc),
Coupling, and Counterweight Chains

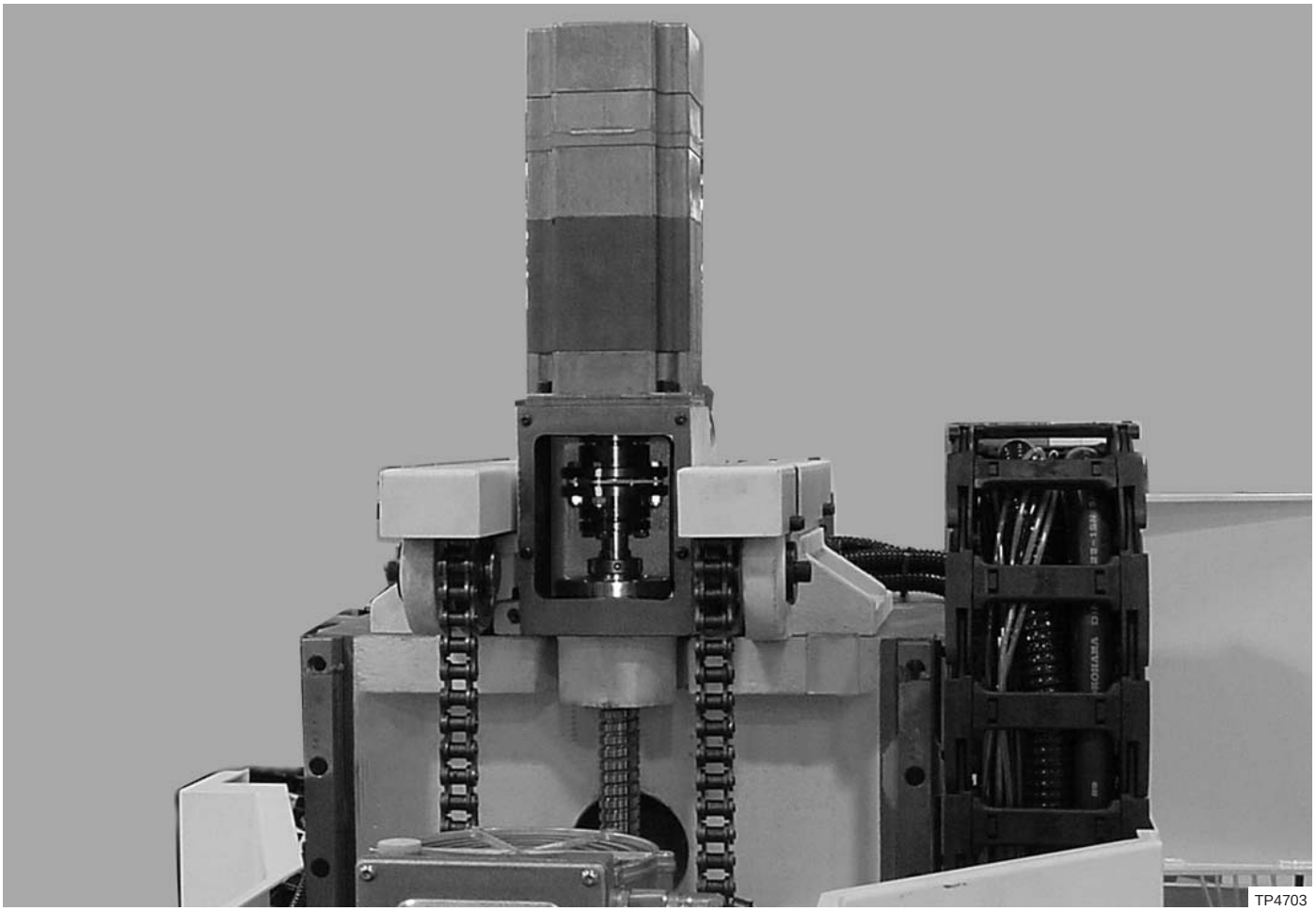

Figure A2.8 - Z Axis Drive Motor (Siemens),
Coupling, and Counterweight Chains

Figure A2.9 - Outside Power Case Door and Heat Exchanger on Standard Machines

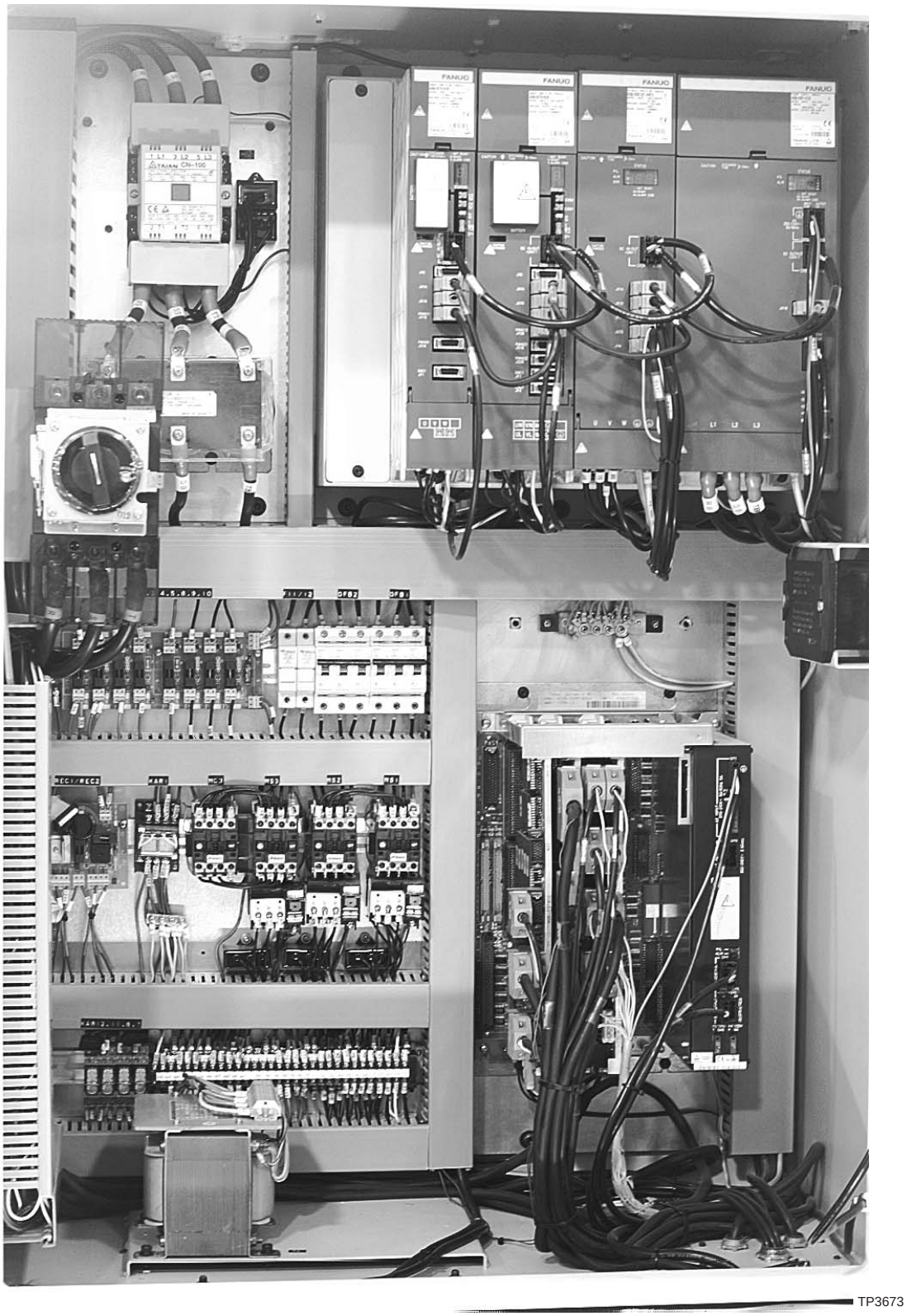

Figure A2.10 - Fanuc Power Case Interior
on Standard Machines

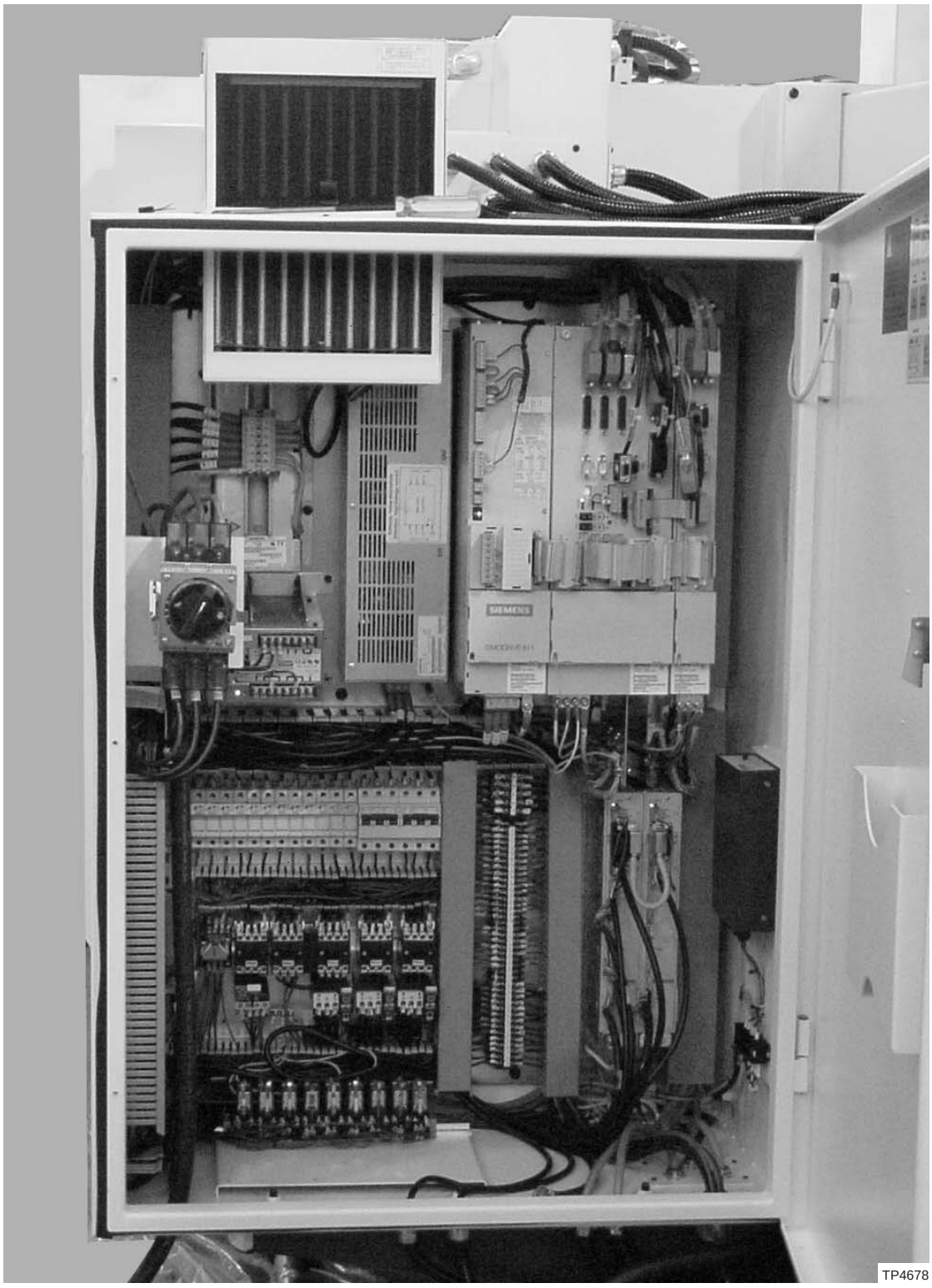

Figure A2.11 - Siemens Control Power Case Interior

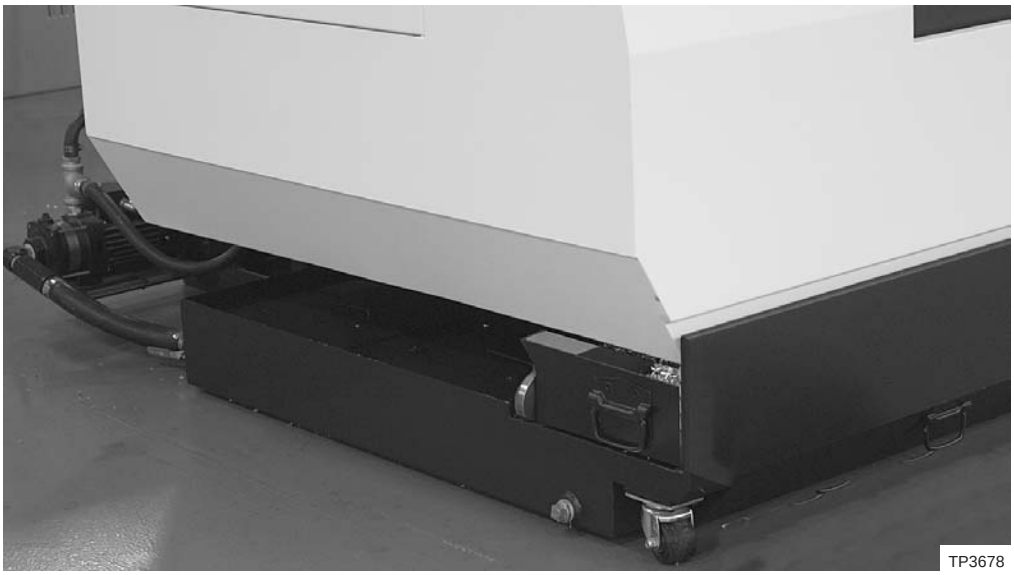

Figure A2.12 - Coolant Tank, Chip Tray, and Coolant Pump

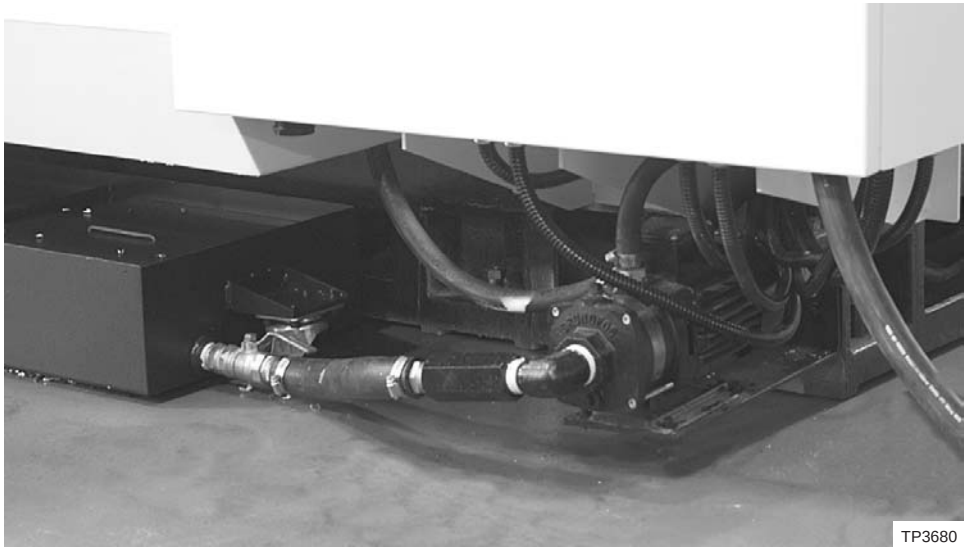

Figure A2.13 - Coolant Pump Under Power Case

After August, 2000 some machines have an in-line “y” filter between the coolant tank and pump. Refer to the next page.

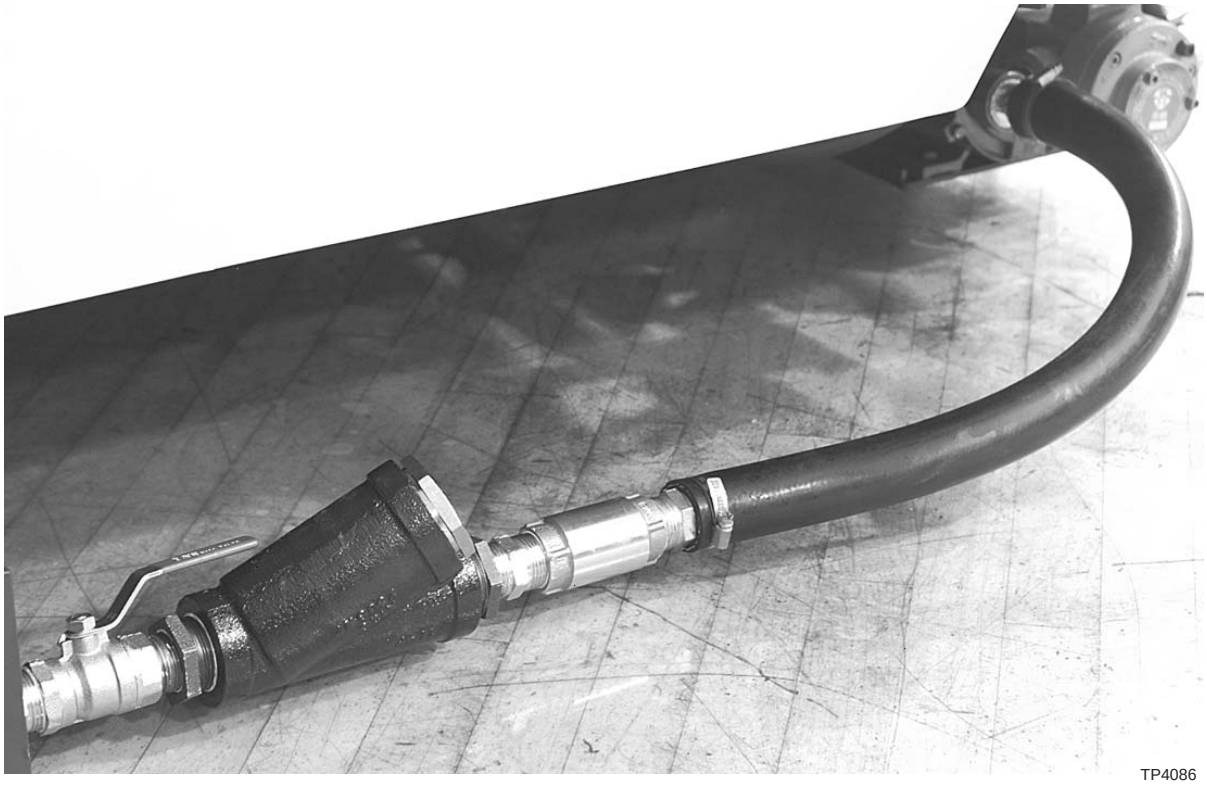

Figure A2.14 - In-Line “Y” Filter and Valves

Depending upon the valve configuration, the ball valve may be switched with the check valve on either side of the “Y” filter. Also the hose on VMC600 II machines may be longer than the hose shown in the photograph.

TP3669

Figure A2.15 - Air Control Assembly Behind Power Case and Mounted on the Side of the Tower (VMC600II Machine)

TP3664

Figure A2.16 - Air Control Assembly Mounted Near the Right Side of the Power Case and on the Side of the Tower (VMC800II through VMC1500II Machines)

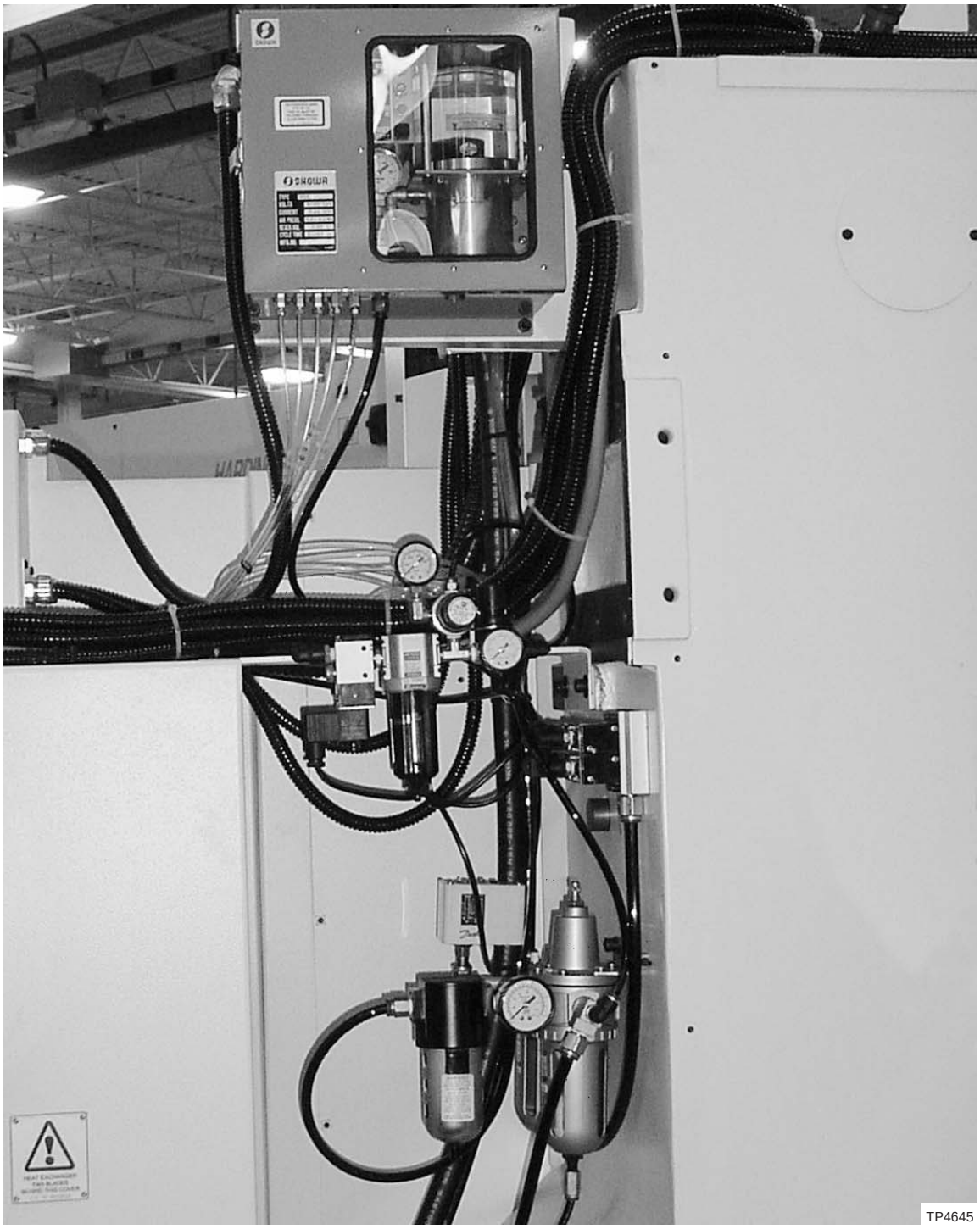

Figure A2.17 - High-Speed Spindle Lubrication System
SHOWA Air and Lubricator

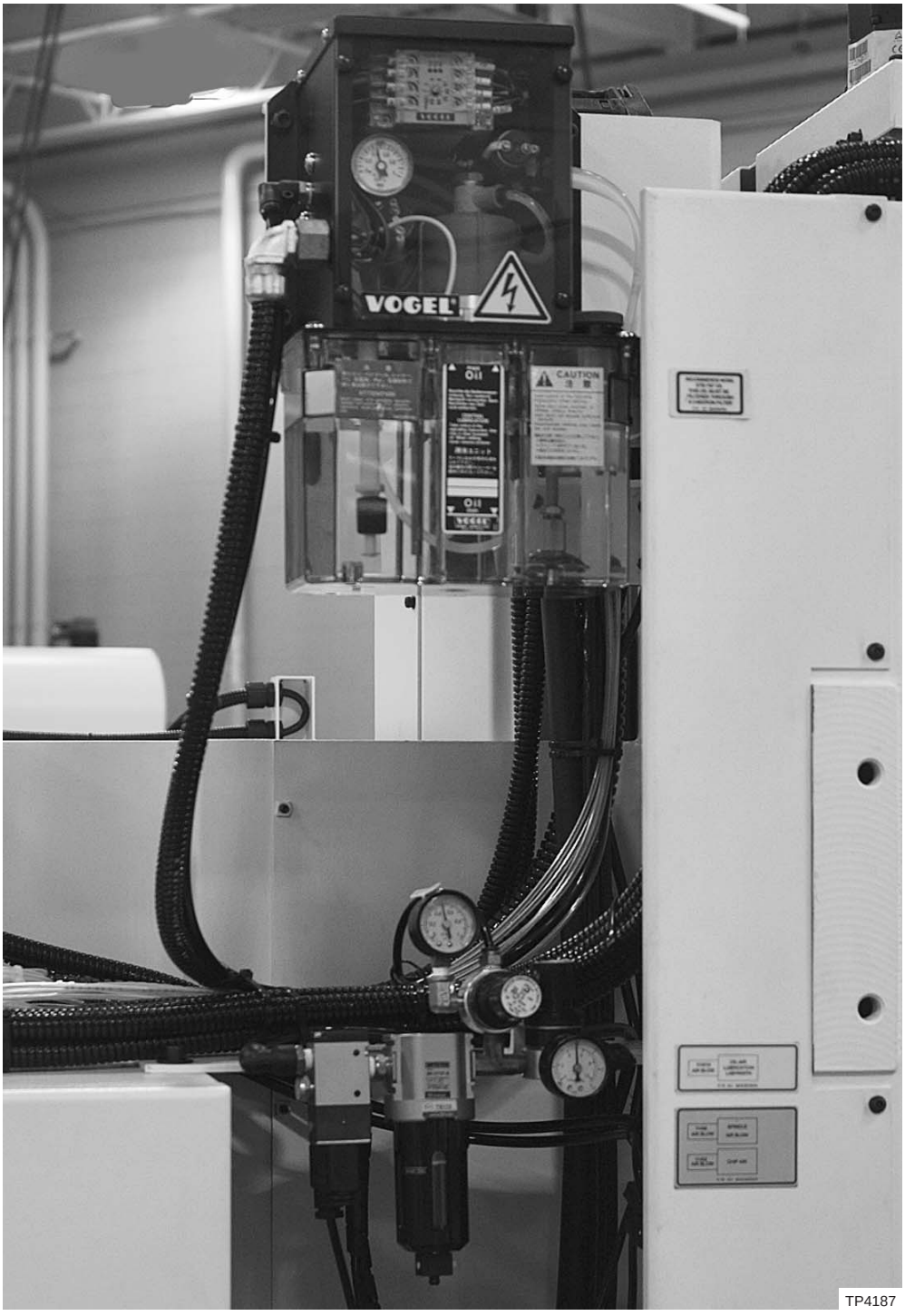

Figure A2.18 - Early High-Speed Spindle
VOGEL Lubrication System

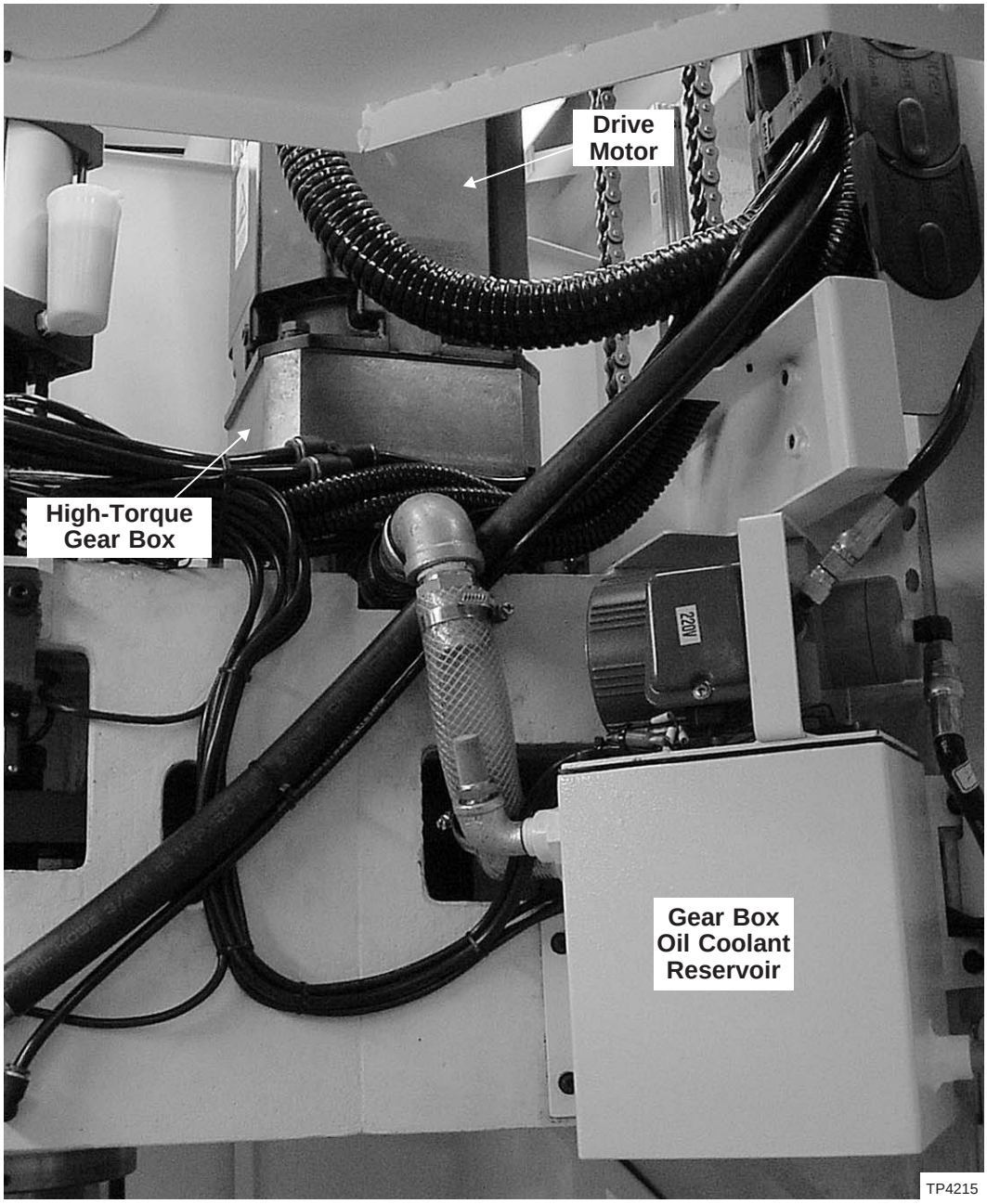

Figure A2.19 - High-Torque Spindle
Gear Box and Oil Coolant Reservoir

- NOTES -

- NOTES -

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