



MAINTENANCE AND SAFETY MANUAL FOR i-SERIES MACHINES

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MAINTENANCE CHECKLIST



Do not attempt to access the machine enclosure while machine power is on. Observe proper lock-out/tag-out procedures before performing any maintenance inside the machine enclosure.

Daily (Every 8 - 10 Hours)

<input type="checkbox"/> Perform operational checks.	4 - 2
<input type="checkbox"/> Check and maintain all lubricant levels.	4 - 4
<input type="checkbox"/> Warm up the machine.	4 - 5
<input type="checkbox"/> Check the condition of tools.	4 - 5
<input type="checkbox"/> Inspect the enclosure windows.	4 - 5
<input type="checkbox"/> Grease the chuck.	4 - 5
<input type="checkbox"/> Check the USB port.	4 - 6
<input type="checkbox"/> Check and maintain autolube lubricant levels.	4 - 10
<input type="checkbox"/> Check and maintain electro-spindle air-oil lubricant levels.	4 - 15
<input type="checkbox"/> Check and maintain motorized spindle air-oil lubricant levels.	4 - 16
<input type="checkbox"/> Lubricate the non-motorized spindle taper.	4 - 17
<input type="checkbox"/> Check the spindle for leakage.	4 - 17
<input type="checkbox"/> Perform Pre-lube and Warm-up Spindle cycles for the High Speed (18000 RPM) Motorized Spindle or the High Speed (18000 RPM) Electro-spindle.	4 - 18
<input type="checkbox"/> Check the FRL or FR unit air pressure.	4 - 28
<input type="checkbox"/> Check the auto moisture drain on FRL.	4 - 29
<input type="checkbox"/> Check the hydraulic pressure of the trunnion table clamping system (if equipped).	4 - 30
<input type="checkbox"/> Check the coolant level.	4 - 36
<input type="checkbox"/> Clean the chip conveyor (if equipped) chip screens.	4 - 38
<input type="checkbox"/> Clean the tool changer arm's tool lock pins and tool gripper fingers.	4 - 41
<input type="checkbox"/> Maintain the spindle chiller system (if equipped).	4 - 43
<input type="checkbox"/> Inspect for leaks in spindle chiller.	4 - 43
<input type="checkbox"/> Check the spindle chiller (if equipped) working environment ventilation and ambient temperature.	4 - 46
<input type="checkbox"/> Check the trunnion table (if equipped) clamping system's incoming pneumatic lines.	4 - 49
<input type="checkbox"/> Clean the trunnion table.	4 - 49
<input type="checkbox"/> Check the trunnion rotary-axis oil level.	4 - 50
<input type="checkbox"/> Check the trunnion tilt-axis oil (if equipped).	4 - 52
<input type="checkbox"/> Clean the C-Axis rotary table (if equipped).	4 - 54
<input type="checkbox"/> Clean the coolant collector filter.	4 - 58

Weekly (Every 40 - 50 Hours)

<input type="checkbox"/> Check each tool holder for damage.	4 - 6
<input type="checkbox"/> Clean the filter inside the heat exchanger.	4 - 7
<input type="checkbox"/> Check oil level of unclamp cylinder cup and fill.	4 - 17
<input type="checkbox"/> Check the Tool Clamping System pull force.	4 - 17
<input type="checkbox"/> Check the Tool Clamping System collet chuck.	4 - 17
<input type="checkbox"/> Check the auto moisture drain on the Filter and Regulator Unit.	4 - 29
<input type="checkbox"/> Clean the coolant filters.	4 - 37
<input type="checkbox"/> Inspect the chiller solution level (if equipped).	4 - 44
<input type="checkbox"/> Inspect the spindle chiller tank air filter and water filter (if equipped).	4 - 44
<input type="checkbox"/> Remove air from spindle chiller circulating system.	4 - 45

❑ Check the spindle chiller (if equipped) liquid in the tank or in the system. . . .	4- 46
❑ Check the CTS coolant filter (if equipped).	4- 48
❑ Check the oil level for the trunnion clamping system.	4- 49
❑ Check the oil level for the B-Axis tilt mechanism.	4- 53
❑ Check the oil level for the C-Axis rotary table.	4- 54

Monthly (Every 150-200 Hours)

❑ Apply grease to tool holders.	4 - 7
❑ Inspect limit switches and dog fasteners.	4 - 7
❑ Inspect conduit, connectors, cabling, and external wiring.	4 - 8
❑ Add a rust preventative to the autolube system.	4 - 9
❑ Maintain the autolube fluid level and check the filler filter screen.	4- 12
❑ Manually activate the autolube system.	4- 13
❑ Check the Tool Clamping System alignment dimension in release position with the clamping unit under pressure in the unclamp position.	4- 17
❑ Check the Tool Clamping System operating sequence.	4- 17
❑ Perform a spindle run-in.	4- 22
❑ Check the turret oil level.	4- 56
❑ Open the Steady Rest drain if compressed air is used. Ensure that air can pass through.	4- 63

Every 3 Months (Every 500 Hours)

❑ Measure the ground impedance (resistance to true earth).	4 - 7
❑ Replace the Tool Clamping System O-ring.	4- 17
❑ Check the FRL air filter element.	4- 28
❑ Drain moisture from the lines of the Filter and Regulator Unit or the FRL. . . .	4- 29
❑ Check the hydraulic system oil level.	4- 33
❑ Replace coolant and coolant filters.	4- 37
❑ Clean the chip conveyor (if equipped)	4- 38
❑ Check the ATC oil level.	4- 41
❑ Replace the CTS coolant filter (if equipped).	4- 48
❑ Inspect and clean the TMM i-Series coolant valve.	4- 59
❑ Inspect and clean the TMX i-Series coolant valve.	4- 61

Every 6 Months (Every 1000 Hours or as stated)

❑ Verify the machine is sitting level.	4 - 8
❑ Grease the outriggers.	4 - 9
❑ Add NGLI 1 grease to the Zerk fittings on the tool changer arm.	4- 41
❑ Grease the ATC magazine chain assembly	4- 41
❑ Grease the ATC magazine drum (if equipped).	4- 41
❑ Check the grease in the live-tooling turret gear box.	4- 56
❑ Clean the back of the live-tooling turret disk and the gasket.	4- 56
❑ Check the live-tooling turret power intake rotary seal.	4- 57

Annually (Every 2000 Hours or as stated)

❑ Clean the autolube reservoir tank and suction filter.	4- 14
❑ Replace the hydraulic oil and filter.	4- 34
❑ Replace the ATC oil.	4- 42
❑ Flush, clean, and refill the spindle chiller tank (if equipped).	4- 45
❑ Replace the trunnion rotary-axis oil.	4- 51
❑ Replace the trunnion tilt-axis oil (if equipped).	4- 52
❑ Replace the oil for the B-Axis tilt mechanism.	4- 53
❑ Disassemble and clean the Steady Rest.	4- 63
❑ Check the Steady Rest safety valve.	4- 63

Every 3 years or as stated

❑ Replace polycarbonate windows in enclosure doors.	4- 6
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DOCUMENTATION CONVENTIONS

This documentation uses several conventions to explain the safety features and emphasize key concepts. These conventions are described in this section.

Icons

This manual may contain the following icons:

Caution/Warning



The operator may be injured and the machine severely damaged if the described procedure is not followed.

Important



Ensures proper operation of the machine and control.

Troubleshooting



Steps that can be taken to solve potential problems.

Hints and Tricks



Useful suggestions that show creative uses of the WinMax features.

Where can we go from here?



Lists several possible options the operator can take.

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MACHINE STANDARDS

Hurco machinery conforms to several standards, which are described in this chapter.

CE Requirements

The information in this section ascertains Hurco's compliance with the European Community's machine safety standards as defined in the Foreword of the

- "prEN 12417 Machine Tools—Safety—Machining Centers" document"
- "prEN 12415 Machine Tools—Safety—Small Numerically Controlled Turning Machines and Turning Centers" document
- "prEN 23125 Safety of Machine Tools—Turning Machines" document
- "prEN 13788 for Multi-Spindle Automatic Turning Machines (where applicable)

"... This European standard has been prepared under a mandate given to CEN by the Commission of the European Communities and the Secretariat of the European Free Trade Association, and supports the essential safety requirements of the Machinery Directive to determine safety for new machining centres and turning centers.

"This standard has been prepared to provide one means of conforming with the essential requirements of the Machinery Directive and associated EFTA regulations.

"It was prepared by CEN/TC 143/WG4 – 'Safety of Machining Centres' under the direction of CEN Technical Committee 143 'Safety of Machine Tools.'..."

European Directives and Standards

Hurco machines installed in Europe must conform to the directives and standards accepted by the European community. Consult local authorities for additional safety directives and standards that may apply in your country.

Directives

The Directives are listed on the Declaration of Conformity provided with each machine sold in Europe.

Harmonized Standards

The Standards are listed on the Declaration of Conformity provided with each machine sold in Europe.

Other Standards

Machining Centers

- BS 5499 PartT5
- BS 5378 Part1

Turning Centers

- BS 5378 Parts1 & 3

ANSI Standards

In order to comply with the American National Standards Institute (ANSI®) for machines sold in the US, machine operations meet the accredited procedures listed in the

- ANSB11.23-2002 (R07), titled "Safety Requirements for Machining Centers and Automatic, Numerically Controlled Milling, Drilling and Boring Machines.""
- ANSB11.22-2002 (R07), titled "Safety Requirements for Turning Centers and Automatic, Numerically Controlled Turning Machines.

MACHINE COMPONENTS

This chapter describes the components that make up Hurco machine tools.

Overview

Hurco machining and turning centers use microprocessor-based, computer numerical control (CNC) digital control systems to send precise commands via part programs to control spindles and axis drive systems mounted on cast-iron frames to remove material from workpieces. Part programs are entered into the CNC control by the machine operator or toolpath programmer in either Conversational or Conventional NC (G-Code) format.

The machining centers described in this manual have either a vertical or horizontal spindle with programmable spindle speeds, multiple axes, and a multi-tool Automatic Tool Changer (ATC). Options are available to accommodate various machining applications.

The turning centers described in this manual have a multi-tool turret with two axes. Turning centers are available with other configurations, such as live-tooling and C-axis, a programmable tailstock, Y-axis motion, a long bed, and a sub-spindle. Options are available to accommodate various turning applications.

Closed loop servo drive systems and motors with rotary encoders power the mechanical drives that position the axes. The rotary encoders provide positioning feedback information to the control. Limit switches mounted on each axis determine end-of-travel and establish reference points for initial machine zeros.

The control positions an axis by sending a command to the appropriate servo drive, which in turn supplies voltage to the axis servomotor.

Refer to the *Mechanical and Electrical Manual* for component drawings for your machine.



Optimum machine performance is reliant upon installation conditions being within Hurco's recommended specifications (power supply, air supply, ambient air conditions, etc.).

Frame

The major structural assemblies of each machine are constructed of thick-walled, fine-grain cast iron. The cast iron is designed to produce superior cutting accuracy. This construction provides strength and excellent dampening characteristics, keeping deflection and resistance at a minimum during turning or machining.

Machining Centers

The machine base (including leveling bolts) is the substructure for the column, saddle, and table. The column is a rigid box type, and allows for machining a variety of part sizes. The base supports the table and preserves table flatness.

The machine table provides easy setup for a variety of part sizes. Please refer to the Work Area section of your machine's Specifications document for the following dimensions:

- X, Y, and Z-Axis lengths
- Spindle Nose to Table Surface measurement
- Table Working Surface area
- Number, Width, and Spacing of T-slots
- Maximum Table Load weight

Other table configurations have rotary axis capabilities.

- A-axis for rotation about the X-axis.
- B-axis for rotation about the Y-axis.
- C-axis for rotation about the Z-axis.

See the Model-specific Specifications document for rotary axis travel limits.

The cast iron head assembly is designed to produce superior cutting accuracy. Each machine has a vertical or horizontal spindle. Vertical head assemblies use a motor brake for the Z-axis, and horizontal head assemblies use a motor brake for the Y-axis. Other configurations provide a swivel head for the B-axis rotation of the spindle.

The axes guideways for most models are precision linear rails to minimize drag torque which results in greater accuracy and contouring capabilities. Please refer to the Positioning System section of the Specifications document for the type of Guideway.

Turning Centers

The machine base (including leveling bolts) is the substructure for the slant-bed turning centers. Please refer to the Work Area section of the Specifications document for your machine for the following dimensions:

- X and Z-Axis Travel
- Maximum Turning Diameter and Length
- Distance Between Centers
- Swing Over Cross Slide
- Chuck Size dimensions

The axes guideways are precision linear rails. Please refer to the Positioning System section of the Specifications document for your machine for the type of Guideway. The tailstock (if equipped) runs on box ways.

Other configurations include tailstock, steady-rest, sub-spindle, and Y-axis. See the Specifications document for your machine for details.

Enclosure

A full chip enclosure is standard in every Hurco machine tool. The enclosures have these features:

- Front sliding doors that lock when in Run mode or Automatic operations. The doors also lock with Power Off.
- Right side door for cleaning inside the enclosure.
- Left side door for access to ATC (machining centers) or spindle (turning centers) and for cleaning inside the enclosure.
- Full enclosure keeps chips and coolant contained inside the enclosure.

Chip management is handled by conveyor or auger to dispense chips out to the side of the machine. Coolant management system provides these functions (please refer to the Coolant and Chip Management section of the appropriate Specifications document for details):

- Flood coolant around cutting area
- Washdown coolant for interior of enclosure
- Exterior washdown gun for clean-up
- Exterior air gun for clean-up

Spindle and Drive System

Hurco machines have a either belt-driven, cartridge-type spindle or a motorized spindle. Spindles are precision-balanced, and made of high-grade alloy steel.

Please refer to your machine's Specifications document for these details about the spindle:

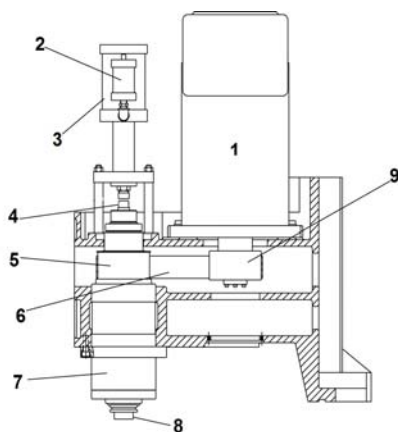
- Type
- Speed
- Taper
- Motor and Drive
- Peak Power and Torque
- Tool Retention Knobs (machining centers)
- Maximum Bar Capacity (turning centers))

Belt-Driven Spindle

The belt-driven spindle and drive system consists of a spindle, motor with encoder, pulley arrangement, and drive unit. Different size spindles, motors, and pulleys give each machine its unique cutting power specification. The belt-driven spindle shaft (inside the cartridge) is supported by ABEC-7 class angular grease packed contact bearings. The belt-driven spindle motor and spindle are coupled using a no-slippage gear belt.



Some i-Series machining centers offer an optional Coolant-thru Spindle (CTS) feature.



Vertical Spindle and Drive Components

- 1 Spindle Motor
- 2 Air/Oil Unit
- 3 Tool Release Cylinder
- 4 Drawbar
- 5 Spindle Pulley
- 6 Spindle Belt
- 7 Spindle Assembly
- 8 Tool Holder
- 9 Motor Pulley

Figure 2-1. Typical Components of Belt-Driven Vertical Spindle Configuration

For machining centers, heavy disc springs retain the tool holder in the spindle by clamping the tool holder pull stud via a drawbar. Pneumatics release the tool holder during a tool change. A dual-piston air cylinder supplies the necessary thrust force to the drawbar for tool release.

Motorized Spindle

Motorized spindles provide speed and power. The integral motor spindle uses a spindle chiller to maintain the temperature of the spindle during machining operations.

Spindle Drive Unit

The AC spindle drive unit controls the spindle motor or motorized spindle via a microprocessor using an encoder feedback for closed-loop control, ensuring more accurate speed control. The position of the spindle is monitored and encoded information is fed back to the CNC controller for position closed-loop control, such as tapping. The spindle drive unit controls the rotating speed, direction, and start/stop of the spindle motor or motorized spindle according to input signals from the CNC control. Velocity feedback is calculated based on the position feedback from a pulse encoder.

The following messages are output at terminals via relay contacts:

- Ready/Fault
- Heat Sink Temperature
- Motor Over-temperature
- Orient Complete
- Speed Agree
- Spindle Fault

Spindle Orientation

Spindle orientation stops the spindle at a fixed position via feedback signals either from an electronic or non-contact sensor assembly. For electronic orientation, The spindle is stopped at a fixed position via signals sent from an electronic encoder assembly.

Sensor Spindle Orientation

For non-contact, sensor orientation, a proximity switch is mounted near the spindle, and the orient target is set by a screw on the collar or a slot on the spindle shaft.

Tool Release Cylinder

Machining centers are equipped with a Tool Release Cylinder which activates a plunger on the drawbar to release a tool from the spindle. Tools are held in the spindle by grippers that grab the tool retention knob when the Tool Release Cylinder is in retract position. The Tool Release Cylinder has sensors that indicate Clamp, Unclamp to the CNC control. Other models may also have a sensor for clamp with no tool in spindle.

Air blows from the spindle taper when the spindle is unclamped. Any moisture in the air system will be detrimental to the taper, especially when the machine is stopped for an extended time.

Spindle Motor

Machines with belt-driven spindles are equipped with a 3-phase, 220 VAC spindle motor that is electronically controlled by the CNC control to provide maximum torque and power to the spindle. The torque and power characteristics vary with specific models. The spindle motor is fully enclosed, has no brushes to inspect or replace, and is air cooled.

Axes Motion System

AC servo drives and motors power the X, Y, and Z axes, as well as the A, B, C, and W axes, if equipped. Please refer to your machine's Specifications document for the following axis information:

- Axis Travel Dimensions
- Rapid Traverse Rates
- Feedback System
- Guideway System
- Maximum Cutting Feedrate

Axis Drive Units

AC axis drives control the rotating speed, direction, and start/stop of the axis motors via microprocessor using an encoder feedback for closed-loop control, ensuring more accurate speed and positioning control. To position an axis, the CNC control sends an analog command to the servo drive, which then supplies voltage to the axis motor.

Some axis drive units may have braking resistors or brake units on the vertical axes that dissipate electrical energy when axis motion stops and hold the axis in place when the axis is stopped.

Axis Motors

Axis velocity, position, and travel direction are controlled by the CNC control using AC axismotors. These motors are enclosed, transistor-driven, and self-cooled. Because they are designed without brushes, the motors are free from flashover and commutation loss. Axis motors are either belt-driven or direct drive to provide power to the precision ball screws.

Ballscrews and Bearings

The precision ballscrews are hardened and ground, double ballnut and are supported on both ends. The ballscrews are hardened and ground to minimize "drag torque" and reduce backlash. The axes positioning drives are supported at the drive-ends by ABEC-7 or greased class bearings.

Feedback Systems

Each axis motor is equipped with a rotary encoder that provides velocity and position feedback signals for each closed-loop system. Limit switches mounted on each axis are used to establish reference points for initial machine zeros and for determining end-of-travel. Alternatively, axes may be equipped with glass linear scales that provide velocity and position feedback to the CNC control.

Machine Electrical Cabinet

The electrical cabinet contains power circuitry and CNC electronics. The cabinet is attached to the machine column or base and connects to the machine systems via cable and harness assemblies. Power-related circuitry distributes power, while CNC-related electronics control machine operation (e.g., spindle speed and axis positioning).

Some models are equipped with an externally mounted transformer to convert 3 phase AC line voltage to 230VAC secondary output voltage to the main power disconnect. Primary components of the electrical cabinet are:

- Control Transformer and Power Supplies
- CNC Card Rack
- Remote Motion Block
- Input/Output (I/O) Components
- COMM Panel
- Contactors and Fuses
- Relays
- Axis and Spindle Drive Units



An industrial UPS (Uninterruptible Power Supply) kit is available as an option. The UPS contains a battery that can power the machine for an extended amount of time in the case of a power outage. Please contact Hurco or your Hurco Distributor for details.

Operating Temperature

Electrical cabinets are equipped with a standard heat exchanger and are designed to be operated in a facility with ambient temperatures from 0°C to 35°C (32°F to 95°F) and in non-condensing relative humidity up to 95%.



For shop temperatures higher than 35°C (95°F), an optional air conditioner must be used to ensure the electronics operate within their rated limits.

The electronics inside the electrical cabinet are designed to operate at internal cabinet temperatures from 0°C to 50°C (32°F to 122°F). An internally mounted temperature sensor is monitored by the software to post an alarm message if the internal temperature exceeds 55°C (131°F). If the electrical cabinet temperature exceeds 60°C (140°F), the CNC control will disable power to the axis and spindle drives, and prevent further operation of the machine until the internal temperature is below 50°C (122°F).

Control Transformer and Power Supply

A control transformer converts 230VAC to 115VAC for the CNC power supply and 115VAC for the field power supply.

CNC Power

The 115VAC output from the control transformer feeds the CNC power supply. Its 24V output is connected to a terminal block that distributes DC power to the following devices:

- Slice I/O logic circuitry
- CNC Card Rack
- Remote Motion Block (RMB)
- Console

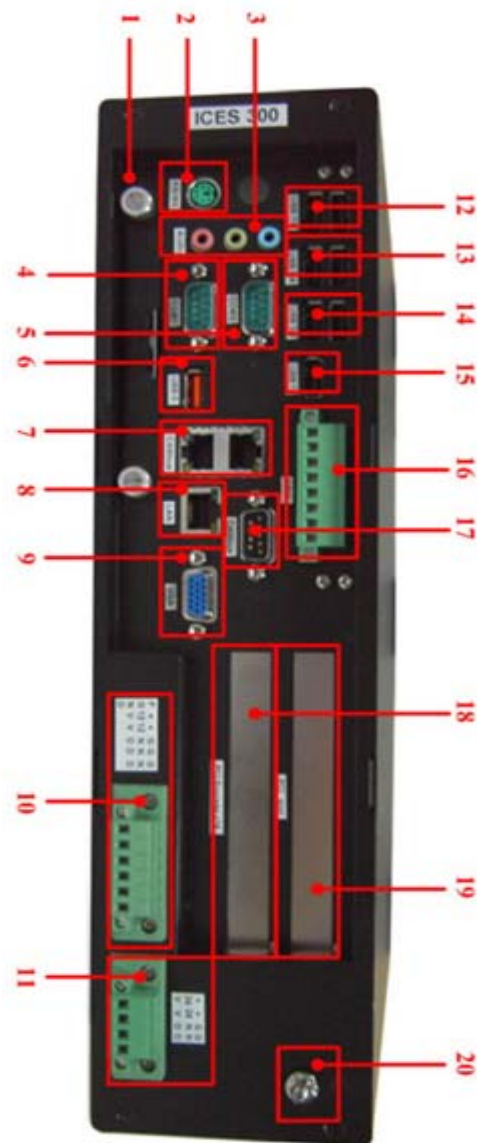
Field Power

The 115VAC output from the control transformer feeds the field power supply. Its 24V output provides power to sensors and relays via the Slice I/O and its associated terminal blocks. The field power rating varies by model and the number of auxiliary components equipped with the machine.

CNC Card Rack

The CNC card rack is Mini-ITX and contains the CPU module, carrier board, boot device, memory, video board, motion interface, and I/O controller.

The rack is installed in the electrical cabinet. The components inside the Mini-ITX card rack are not designed to be serviced. At no time should the access panel be removed or internal components replaced without direct authorization and supervision by Hurco. The Mini-ITX card rack is shown below.



1	SATA Drive Caddy
2	PS/2 Mouse/Keyboard, 6-pin MiniDIN Connector
3	High Definition Audio Connector
4	COM 1 with DB-9 Connector
5	COM 2 with DB-9 Connector
6	High Retention USB 2.0 Port (USB-0)
7	CANbus Interface RJ-45 x 2
8	Gigabit Ethernet RJ-45
9	Analogue VGA with DB-15 Connector
10	12V Power Output with 6-pin Terminal Block (Pin Definition from Left to Right: FG/12V/12V/GND/GND/GND)
11	24V Power Input with 4-pin Terminal Block (Pin Definition from Left to Right: 24V/24V/GND/GND)
12	USB 2.0 Port x 2 (USB-6/7)
13	USB 2.0 Port x 2 (USB-4/5)
14	USB 2.0 Port x 2 (USB-2/3)
15	USB 2.0 Port x 2 (USB-1)
16	External GPIO Interface with 8-pin Terminal Block
17	CANbus Interface DSub-9 Pin Connector x 1
18	PCI Express x 16 Slot (Support PEG Interface Board)
19	PCI Slot for PCI ZMP or PCI STP Board
20	Frame Ground (FGND)

Figure 2–2. Mini-ITX Card Rack

12V Console Power

The DC-DC converter within the Mini-ITX card rack converts 24VDC to 12VDC. The 6-position screw terminal connector on the card rack outputs 12VDC power for the console.

Processor

The Mini-ITX CNC contains a COM Express CPU with a 2 GHz Core 2 duo processor and 2 GB DDR2 667 Mhz maximum system memory.

Digital Watchdog

The Mini-ITX digital watchdog is located on the card rack carrier board or the processor board. The watchdog monitors the refresh or “heartbeat” of the host processor. The watchdog disables control power in the event the heartbeat should stop. If this occurs, the Main Slice I/O ES System Status LED illuminates to indicate an Embedded E-Stop: Host Watchdog Timeout condition. The same ES status LED will turn on if the RJ45 cable between the card rack and the Main Slice becomes disconnected.

PCI Express Video Board

The video board is a PCI Express x16 High Performance, Dual VGA.

PCI Motion Board

Machining centers use the ZMP PCI motion board. Turning centers use the HAL85164 PCI servo transducer motion board or the Sercos NCG card.

The motion control subsystem consists of two major component types: the PCI motion processor and one or more motion blocks, either a Remote Motion Block (RMB) or a Honda-8516H Breakout PCB. Each component is connected in a token ring network topology using shielded CAT5e cables terminated with RJ45 connectors (a.k.a. the SynqNet bus). The network complies with the 100Base-T physical standard, but uses a deterministic full-duplex protocol called SynqNet to communicate between the controller and its nodes. SynqNet is an open standard developed by Motion Engineering, Inc.

The PCI motion board is an intelligent DSP controller that accepts position/velocity/time commands from the CNC control, and sends velocity commands digitally via the SynqNet bus. The RMB or Honda-8516H Breakout PCB then converts the digital velocity command to an analog voltage compatible with the servo drive velocity input. Conversely, the incremental position data from the axis encoders is decoded by the RMB, and transmitted as an absolute position to the SynqNet bus. The PCI motion board receives the position feedback and passes it to the host computer via PCI bus. The PCI motion board uses the same position feedback in its fine interpolation algorithm to determine its velocity command.

Remote Motion Block (RMB) or Breakout Board

The system is equipped with either a Remote Motion Board (RMB) or Honda 85164 Breakout Board. Each RMB or Breakout Board supports four motors (command and feedback) and one encoder (feedback only). Hurco machines use a single RMB for a 3-axis (XYZ and S) configuration. An additional RMB is required for 4th-axis, 5th-axis.

Input/Output Components

Inputs and outputs are controlled by Slice I/O Components. The Slice I/O monitors machine sensors and controls electrical and electromechanical devices. The Slice I/O components are mounted on a DIN rail. The Slice I/O devices provide fewer connections, higher reliability, and a smaller footprint.

The standard 3-Axis configuration consists of a Main (Slice 0), a Slave (Slice 1) and another Slave (Slice 2). Each Slice component contains Diagnostic LEDs that indicate the status of all I/O points. The standard 4- or 5-Axis configuration consists of a Main (Slice 0), and 4 Slaves (1-4). Additional Slave Slice components may be added for other options, such as Probing.

The Main and Slave Slice components contain System Status LEDs and several Input and Output connections.

System Status LEDs on Main Slice 0 indicate the following when lit:

- **ES** (Embedded E Stop)—indicates the Host Watchdog Timer has expired or the RJ45 CANBus cable has become disconnected between the card rack and the Main Slice I/O module..
- **RST** (System Reset)—cycles on momentarily at power up, normally OFF during machine operation.
- **OT** (Over Temp)—turns ON if the electrical cabinet exceeds the threshold defined in Integrator Parameters; the default is currently 60° C (140° F).
- **ERR** (CAN Communication Error)—indicates when a CANBus communication packet is present. It is normal for this indicator to flash occasionally or not at all.
- **TX** (CAN Message)—indicates normal CAN message activity.

The Slave Slice I/O modules have binary Address LEDs and each Slave is assigned a unique address. See *Figure 2–3. Slice I/O, on page 2 - 14* for status LED and connection information for the Main and Slave Slice components.

COMM Panel

The Communication Panel located on the Electrical Cabinet is typically arranged with USB ports and an RJ45 network port.

- **USB Ports**—the Comm panel has two USB (Universal Serial Bus) ports. The USB port is a high-speed port that allows you to connect devices, such as jump drives, mouse and keyboards, and network components.
- **Network Port**—the 10/100Base-T (RJ45) connector is used with the UltiMonitor option. This option requires a Local Area Network (LAN or “network”) that supports the IEEE 802.3 Ethernet hardware standards. Contact your IT provider for guidance about proper LAN design and setup.

With UltiMonitor, you can communicate with other CNCs, and with PCs or file servers connected to your LAN using standard TCP/IP and FTP protocols. UltiMonitor also includes Extended Shop Floor (ESF) for remote machine monitoring and communication.

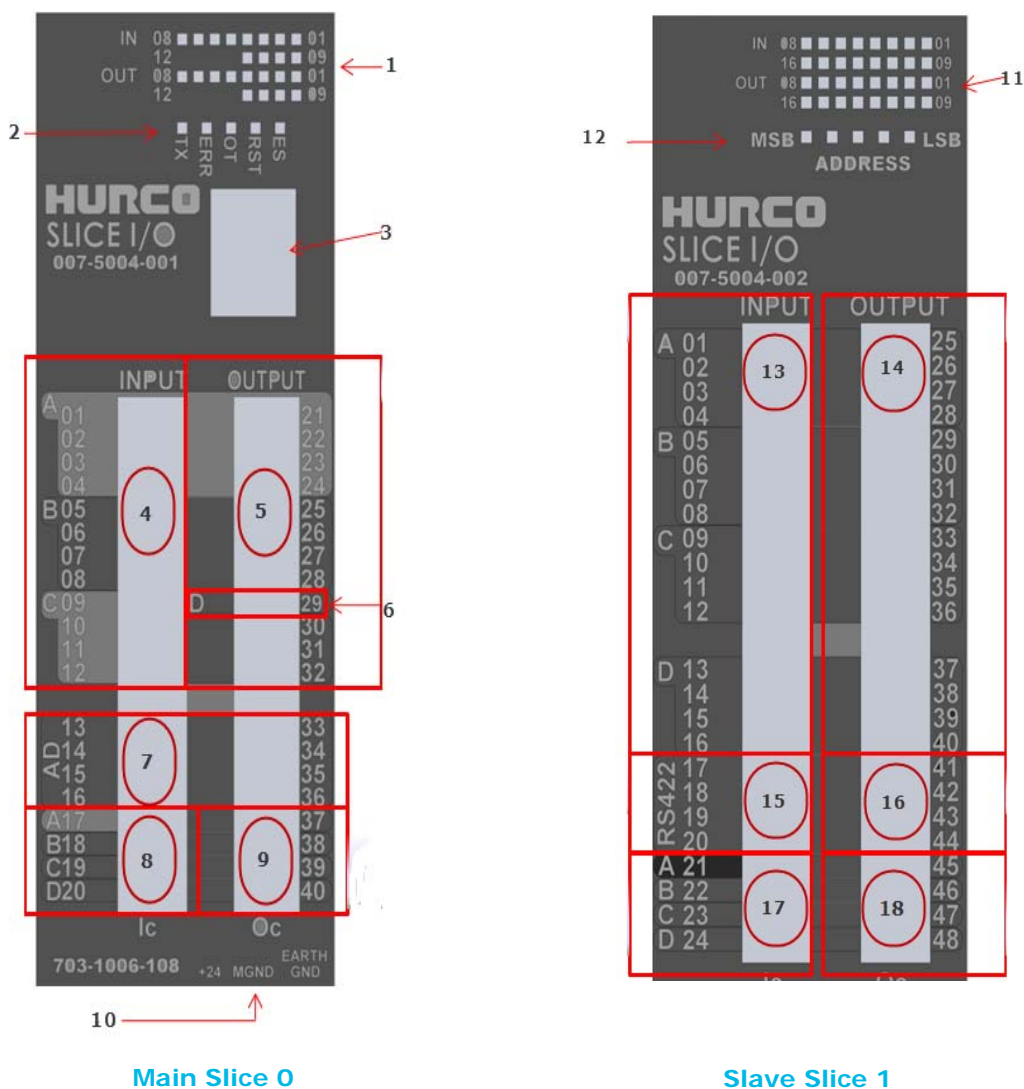
Contactors and Circuit Breakers

Contactors control power to the main electrical components such as Washdown, Conveyor, Automatic Tool Changer, or Turret and interrupt power when over-current occurs. Circuit breakers provide over-current circuit protection for the servo and spindle drive units.

Relays

Electro-mechanical operations on machines are controlled via relays mounted to a DIN rail. The coil relays are energized which activate normally-opened (NO) or normally-closed (NC) contacts.

The following figure identifies the components of the Main Slice and Slave Slice devices:



1 I/O Status LEDs	11 I/O Status LEDs
2 System Status LEDs	12 Slice Address (binary)
3 RJ45 CANBus Connector	13 16 Inputs
4 12 Inputs	14 16 Outputs
5 12 Outputs	15 (2) RS422 Inputs
6 OUT9 (Control On Relay)	16 (2) RS422 Outputs
7 4 A/D Inputs	17 Input Bank Commons
8 Input Bank Commons	18 Output Bank Commons
9 Output Bank Commons	
10 24V Power In	

Figure 2-3. Slice I/O

Control Systems

Circuit diagrams for coolant, pneumatic, and hydraulic systems are available in the *Mechanical and Electrical Manual* for your machine. These systems are described below.

Flood Coolant and Washdown System

The flood coolant system pumps coolant to the cutting tool, cleans swarf from the cut, and provides a cleaner work environment.

The washdown system uses a large flow of coolant to move chips to the front of the machine and onto the chip removal system. A washdown spray gun, if equipped, is externally mounted on the machine to spray chips found inside the enclosure.

The Coolant Washdown Flood system is self-contained. The operator can control the coolant system using console keys. See the Coolant and Chip Management section of the Specifications document for your machine for information about tank capacity..

Pneumatic System

The pneumatic system regulates the compressed air supplied to various machine systems and solenoid control valves. See the Service Requirements section of your machine's Specification Sheet for air supply requirements.

⇒ Do not tamper with the factory-set air pressure-detecting switch that monitors the air supply to the solenoid control valves.

The Filter, Regulator, and Lubricator (FRL) Unit is connected to the air manifold, and meters lubricant into the pneumatic system. The FRL prevents moisture from contaminating the compressed air supply, promotes trouble-free operation of air cylinders and valves, and extends the service life of metal components that come in contact with the compressed air stream.

Hydraulic System

Some models have a hydraulic system to control various machine systems, such as rotary or pallet components. Hydraulic systems consist of a hydraulic tank, 3 phase motor, pump, solenoid valves, and pressure gauges. The system's hydraulic pressure is set at the factory and should not be adjusted unless directed by Hurco.

Operator Control Console

Hurco machines are available with the single-screen Max5 console. A second graphics screen is available as an option. The screens are touchscreens for easy selection of data or fields. The number keypad is available for program entry. Console keys are devoted to mode and system control (Auto, Manual, Tool Change operations, and manual spindle or axis control). A Remote Jog Unit allows manual axis control and operator buttons for Start, Feed Hold, and Stop. The Remote Jog Unit is available in Basic, with LCD display, and with wireless LCD display. Two Universal Serial Bus (USB) ports are located on the right-hand side of the console. Also standard is the QWERTY keyboard and retractable drawer. Optional equipment include a shelf, an auxiliary screen, and tool holder. Pushbuttons activate these functions: Start Cycle, Power, Stop Cycle, Feed Hold or Motion Hold. There are override controls for spindle speed, axis feedrate, and rapid traverse.

The Operator Control Console is attached to the machine enclosure either by an L-tube or T-tube that allows the console to pivot towards the front enclosure door opening. Some Hurco machine models have the console mounted on a pendant arm that also pivots toward the front enclosure door opening. For dual-screen configurations, the right-hand screen displays graphic operations. Single-screen configurations require pressing a key to toggle the screen between text and graphic operations. Refer to the on-screen Help for operating and programming information.



Figure 2–4. Max 5 Control Console

Display

The monitor assembly contains a 19in LCD TFT module. In addition, a switching power supply and internal A/D board converts the incoming VGA signal to a digital signal compatible with the LCD module. The monitor is powered by DC voltage supplied from the Flat Panel Node. On screen display menu buttons on the touchscreen allow the operator to customize brightness, contrast, and color. Additionally the volume buttons control master volume for the audio.

Touchscreen and Touchscreen Controller

The touchscreen is a passive device consisting of a glass substrate and two layers of silver-ink screened polyester film separated by microscopic plastic spacers. The silver is thinly and precisely applied so that the silver ink has a consistent sheet resistance. When the operator applies pressure to the outer polyester film, the silver ink planes contact each other, momentarily completing a pair of voltage dividers. During that brief period the touchscreen controller applies a DC voltage between the top and bottom bus bars on the front silver ink plane. The touchscreen controller then reads the voltage level from the rear plane to determine vertical position.

During the second half of the scan cycle, the controller applies a differential voltage horizontally across the rear plane, then reads its voltage or horizontal positions from the front layer. This scan cycle occurs several hundred times per second and screen coordinates are digitally filtered before they are transmitted via USB to the host CPU and driver software.

The driver software has a built-in utility that the Service engineer uses to calibrate the touchscreen at machine installation. This procedure can be repeated by the operator as necessary.

Flat Panel Node

The Flat Panel Node (FPN) board communicates console I/O status to the host computer serially via CANbus. The following devices rely on the FPN to function:

- Program Entry Keyboard.
- Machine Function Keyboard.
- Console Keyboard LEDs.
- Control Panel—Pushbuttons, Lamps, Override dials, E-Stop Status.
- Remote Jog Unit (FPN provides a CANbus pass-through connection).

Jog Unit

A Remote Jog Unit interfaces to the host computer via CANbus. It is powered by 12VDC from the Flat Panel Node. Features include

- Emergency Stop button
- Store Position button
- Incremental Jog Handwheel
- x1, x10, and x100 Rapid Jog buttons
- Rapid +/- buttons
- Rapid Feedrate control knob
- Axis selector knob
- Hold to Run pushbutton
- On/Off button for rear-mounted LED lamp and work light
- Start, Feed Hold, and Stop buttons
- Rear-mounted magnetic supports
- Optional LCD digital read-out display for Machine and Part position and mode selection
- LED charging indicator light on optional Wireless model

QWERTY Keyboard

A QWERTY Keyboard is stored in a slide-out drawer on the lower half of the console. It is connected to the Flat Panel Node and provides data entry as well as cursor control with trackball-style pointing device.

USB Ports

Two USB (Universal Serial Bus) ports are located on the right-hand side of the console, connected to the main CPU via USB active extension cable in the Control Interface Harness.

Automatic Tool Changer

Machining centers are equipped with a multi-station swing-arm random pocket Automatic Tool Changer (ATC) for multiple cutting operations to be completed in succession with different tools, without requiring machine operator intervention to change tools. Basic ATC components are electric motor driven ATC arm and transmission, magazine with tool pots (tool pots move pneumatically), and an electric motor driven magazine. Some models may have a sliding mechanism for the ATC assembly or an ATC door to separate ATC components from the machining area.

All ATC operations require that the servo power is on, the machine is calibrated, and the ATC is at Home position. Diagnostics on the control allow for easy recovery of tool change issues.

The tool specifications for the ATC magazine are found in the Automatic Tool Changer section of the Model-specific Specifications document.

Spindle Chiller

The spindle chiller maintains spindle temperature by circulating liquid around the spindle cartridge. Chilling the spindle reduces thermal growth, which improves machining accuracy. If the chiller liquid level in the tank is not maintained at or above the low mark, the system pump could be damaged and spindle cooling impaired.

The Spindle Chiller must be located in a clean, well-ventilated area. The room temperature must be between 0° and 40°C (32° and 104°F). Ensure there are no obstructions to the air intake or exhaust components on the spindle chiller, leaving a clearance of 1 meter (3 feet) around the unit.

If there is a need to move the spindle chiller,

- Disconnect the power cord and drain the liquid from inside the cooler unit before moving.
- Keep the cooler unit in the upright position and avoid collision or shock during transport. Do not incline, lay on the side, or turn the unit upside down.
- Use a forklift or crane to move the unit.
- If using a crane, use lifting straps connected to the eye bolts.
- Keep the cooler unit balanced.

The spindle chiller has two operating modes: Differential and Fixed.

- In **Differential** mode, the chiller operates when the difference between the ambient air and liquid temperatures exceeds the setting on the temperature display.
- In **Fixed** mode, the chiller operates when the temperature of the liquid exceeds a fixed temperature as shown on the temperature display.

Turret

Turning centers are equipped with an indexable, multi-station turret for multiple cutting operations to be completed in succession without machine operator intervention to change tools. Turret rotation is controlled by hydraulics and valves. A turret assembly consists of a hydraulic turret, a tool station disk, hydraulic motor, and coolant nozzles.

Turning centers are equipped with either a standard turret or a VDI turret. The tooling specifications are found in the Turret section of the Model-specific Specifications document..

Chuck Types

The turning center spindle holds and turns the stock for cutting in either a three-jaw chuck or collet chuck clamped by a hydraulically actuated draw tube. Pressure is adjusted through a valve located behind an access panel at the front lower left side of the machine. Clamping by external, internal, or collet type workholding can be set through Manual mode. The chuck is opened or closed by pressing the foot pedal.

Rotary Axes

Machining centers can come equipped with rotary or rotary/tilt as added options, while certain machining center models come equipped with rotary, tilt, swivel, or combinations of these axes. In all cases,

- the A-axis rotates about the X-axis
- the B-axis rotates about the Y-axis
- the C-axis rotates about the Z-axis

Rotary axes typically rotate 360 degrees. Tilt axes are typically mounted with a rotary axis and rotate less than 360 degrees. Swivel axes typically have the spindle head mounted to the axis and also rotate less than 360 degrees.

For machines that come equipped with a rotary axis, see the Model-specific Specifications document for rotary axis details:

- A-, B-, or C-Axis Travel
- Table Working Surface
- Maximum Table Load Weight
- Rapid Traverse
- Accuracy and Repeatability

B-Axis

Machining centers with a motorized spindle and tilt mechanism capable of tilting 180° in the B-Axis provide a fifth axis for part programming. This type of spindle operates with hydraulics. The spindle's temperature is maintained through a spindle chiller system.

Dust Collector

The optional dust collector vacuums graphite dust particles from the cutting area.

The dust collector motor turns on when servo power is established in either Manual or Auto Mode. When servo power is disabled, the dust collector motor remains on for 60 seconds before shutting off. In Auto Mode, dust collector can be switched off, but will return to On when program starts again. Dust collector can also be operated in Manual Mode.

The dust collector uses cartridge-style filters and downward airflow to remove dust particles from the dust collector.

The dust collector monitors the differential pressure between the clean and dirty air chambers. If the air flow is low, in Manual Mode the spindle motor and dust collector motors turn off; when in Auto Mode, the machine is put in Interrupt Mode stopping the spindle and the dust collector motor.

OPERATION REQUIREMENTS

Machine Installation

The customer is responsible for proper site preparation before the machine is installed. A certified Hurco Field Service Engineer must install the machine in the prepared location. This location must not subject the machine to uncontrolled cabinet temperatures or unfavorable work environment conditions that could cause electronic component failure.

If the customer decides later to move the machine from its installed location, call Hurco for assistance.



Improper moving of the machine may result in personal injury or damage to the machine.

See the *Pre-Installation Manual for i-Series Machines* for detailed information about:

- Foundation Guidelines
- Electrical Service Requirements
- Compressed Air Requirements
- Lifting and Moving the Machine Guidelines
- Other materials and fluids to have available at installation Requirements

Initial Test and Examination

If it becomes necessary to move your machine, follow the instructions below for performing the initial test and examination of the machine and its guarding system.

Arrange for a Hurco-certified Service Engineer to perform the final machine setup. Complete these procedures prior to the arrival of the Service Engineer:

1. Provide utilities to the machine.
2. Check all machine lubrication levels.
3. Place the flood coolant tank, tubing, and coolant pump motor near the machine base. A Certified Electrician needs to provide power to the machine prior to the Service Engineer's arrival.

A Certified Electrician needs to provide power to the machine prior to the service engineer's arrival.

The Hurco-certified Service Engineer performs these tasks:

1. Installs the control console.
2. Measures voltages in the electrical cabinet and the control enclosure.
3. Installs the flood coolant tank and coolant pump motor.
4. Installs covers and enclosures.
5. Completes the machine level and makes required adjustments.
6. Checks fans and pumps for proper operation.
7. Checks all axes for calibration and correct limit switch operation.
8. Installs and tests all options.

Proper Operation and Maintenance

This section addresses the proper operation and maintenance of the machine. The information presented here is not a substitute for operator training, skill, and good judgment. Hurco does not accept any liability for operator error.

Training for Operators

Hurco or a Hurco-authorized distributor must train all machine operators. Hurco offers classes to demonstrate the programming capabilities of its CNC system. The training classes provide hands-on development of part programs.

Study this manual before attempting to operate the machine and become familiar with machine functions and safety features. Review all caution and warning messages, as well as all warning and instruction plates or decals on the machine.

Enclosure Doors and Guarding

Sliding enclosure doors are located on the front of each machine and provide access to the work area for work setup and part removal. Side enclosure doors are also provided for maintenance and cleanup but should remain closed during machine operation.



Enclosure doors should always be closed when the machine is operating in Auto Mode.

Enclosure doors are provided to minimize the risks of ejection of the workpiece, machine components, tools or parts of them, swarf, chips, or coolant and have been designed and constructed to withstand foreseeable impact energy based on EN 12417 standard for Machine Tools—Safety—Machining Centers and EN 12415 standard for Machine Tools—Safety—Small Numerically Controlled Turning Machines and Turning Centers” document.

If machining unbalanced workpieces, an ejection hazard is possible. Reduce this risk by counter balancing or machining at reduced speeds. Enclosure doors are intended to minimize the risks of ejection and not to eliminate them completely.

Enclosure doors are not designed to withstand dangers from noxious materials that can result in fire, explosion, or noxious dust.

Machine and Production Setup

During the arrangement of the tools and apparatus required for the performance of an operation, follow these precautions:

- Engage the Emergency Stop button when fixturing the workpiece. Never put your hands near a part being machined.
- Clamp the fixtures and workpiece securely before pressing the Start Cycle button to begin an automatic machine operation. Loose objects such as wrenches and chuck keys become flying projectiles if not removed before pressing the Start Cycle button to begin an automatic machine operation.
- Wear gloves or use a shop cloth when handling tooling.
- Inspect tools and tool holders frequently. Use tools that are properly sharpened and in good condition.
- Never start the machine when the cutter is in contact with the workpiece. Make sure the direction of spindle rotation is correct to prevent cutter breakage. Rotate the spindle clockwise for right-hand tools, and counterclockwise for left-hand tools.
- Keep the work area well-lighted. Adjust lamps so that light does not shine directly into the operator's eyes.
- Make certain all guards are in place before beginning operation.
- Know where all of the Emergency Stop pushbuttons are located.
- The operator should stay within reach of an Emergency Stop button when the machine is in motion.
- Be aware of all pinch points caused by the motion of the axes, table, head, and automatic tool changer or turret. Be aware of protruding machine parts.
- Keep the electrical cabinet doors closed while power is on. Before opening the electrical cabinet doors, verify that the main disconnect switch has been turned Off.



High voltages present in the machine electrical system can cause serious injury or death.

- Do not remove or bypass safety limit switches, interlocks, and other safeguards.
- Do not start the machine unless all systems contain the proper amount and type of lubricant.
- Make certain that all necessary guards and protective devices are in place before operating the machine.
- If unusual sounds, smoke, heat, or damaged parts occur, turn off the machine.
- Be sure that all Daily, Weekly, Monthly, Annually, etc. operation and maintenance checks have been completed prior to operating the machine.

Working Practices

Follow the correct service and repair procedures to ensure proper operation of the machine, and to reduce the likelihood of serious operator injury.

Observe these basic precautions when working near a machine:

Responsible Conduct

- Follow the instructions provided when performing a maintenance task..
- Keep all parts of your body away from moving parts.
- Be alert and keep safety in mind.
- Never attempt to operate or repair a machine if you have taken strong medication, used a prescription drug, or consumed an alcoholic beverage.
- Do not attempt to operate or repair a machine until you have read and understood all information that pertains to the machine, including all warning and instruction plates or decals mounted on the machine.
- Know how the machine functions, and understand its safety features.

Personal Care

- Avoid frequent or prolonged skin contact with fresh or used cutting fluids and oils.
- If machining chemicals come in contact with your skin, wash the area immediately.
- Wash your hands thoroughly before eating.
- Change clothing that has become contaminated with machining fluids and oils.
- For complete information about handling industrial chemicals used in machining, refer to the international Control of Substances Hazardous to Health (COSHH) materials from the chemical suppliers.

Wearing Apparel

- Wear eye protection and safety shoes while in the machining work area. Safety glasses with side shields are recommended. Safety shoes should be in good condition, with steel reinforced toes and oil-resistant soles.
- Remove clothing and jewelry that could get caught in machine moving parts. Do not wear loose-fitting clothing. Long shirt sleeves are not recommended.
- Keep long hair tied back so that vision is not obstructed and hair cannot become caught in moving parts.

Heavy Lifting

- Do not attempt to lift more than you can safely handle. When lifting, keep your back straight and use your legs.
- Use a hoist for heavy lifting, making sure that the load is evenly balanced and is raised slowly.
- Do not raise a large load over aisles and make certain that the landing area is clear and level.

Housekeeping

- Maintain a clean and orderly workspace around the machine. The floor must be free of spills and obstructions.
- Use only sturdy work platforms with anti-slip surfaces around the machine.
- Do not store tools, shop cloths, and miscellaneous parts on the machine.
- When removing chips or dust, make certain the spindle and cutter are completely stopped. Use a brush or chip scraper to remove chips—do not use compressed air to blow chips from the spindle, table, controls, cabinet or floor. Do not remove chips by hand, or while the spindle is turning. Dispose of chips and dust frequently.

Machine Safety

The Hurco machine's safety circuit is designed to provide safe and reliable operation. Tamper-resistant fasteners are used to hold combination door lock/switches in place and to prevent access to internal wiring.

If the owner or operator modifies the hardware or software by removing, altering, disabling, or tampering with any safety circuit, safety switch, or other safety operation and operates the machine with those modifications, such operation is extremely hazardous and is a *foreseeable misuse* of the machine, and voids the Hurco warranty. In addition, it is in violation of federal or local regulations, directives, codes, or ordinances. If such modifications are discovered, the machine must be immediately shut off and not used. Contact a Hurco-certified Service Engineer for assistance in restoring the machine to safe operation.

Following are basic rules governing operation.

- The spindle cannot operate unless all enclosure doors are closed, excluding doors that are fastened shut with bolts or screws.
- When the Limited Manual Operations are Enabled in the CE Diagnostics screen, with the enclosure door open on machining centers the spindle can run and the axes can be jogged at a limited RPM when the **Start Cycle** button is pressed and held down. Turning centers require both the **Start Cycle** button and the **Hold-to-Run** button be pressed and held down for this operation.
- Enclosure doors must be closed and locked during automatic operations such as run program, warm-up cycle, calibration cycle, automatic tool changes, probing, or turret diagnostics functions or tool setter operation.P
- In the event that an enclosure door is opened during automatic operation, an immediate command to stop all motion will be executed, changing modes from Auto to Interrupt.
- Redundancy is included in electrical design to detect single point failures (e.g., switch contact, relay coil).
- When the Emergency Stop button is pressed, power is removed from the spindle and axis drives, and the door locking mechanism is enabled.
- ATC electrical circuits will be isolated from source power when any door is open.

Operation Requirements for Enclosure Doors

Hurco machine tools are equipped with door interlocks to ensure the enclosure doors do not open during machining operations. Periodically check the safety circuits, especially after changing components. Operating restrictions for manual and Auto mode are listed below.



Pressing the **Emergency Stop** button will lock the enclosure doors when doors are in closed position.

In Manual mode with doors open, some operations will require the Hold-to-Run button to be pressed. A Hold-to-Run button is located on the side of the Remote Jog Unit or on the right-hand side of the Max console. In order to perform specific operations with the enclosure doors open, both the **Hold-to-Run** button and the **Start Cycle** button must be pressed. The Hold-to-Run button has three positions: fully up (off), middle (on), and fully down (off). The button must be held in the middle position to be enabled.

Manual Mode Operations, Enclosure Doors Open

The following list of operations cannot be completed in Manual Mode if the enclosure doors are open. This list may not be comprehensive of all restrictions or options installed on the machine.



Turning centers may also require that the spindle door also be closed.

- Cannot park the machine or home the axes.
- Cannot warm up the machine.
- Cannot begin machine calibration cycle.
- Cannot start chip auger or conveyor.
- Cannot perform coolant functions except for washdown gun.
- Cannot perform ATC Diagnostics or Turret Diagnostics.
- Cannot begin an automatic tool change cycle or index turret.
- Cannot run a part program in Auto mode.
- Cannot run spindle in Manual mode.
- Cannot perform Tool Probing (if equipped).
- Cannot jog any axis.
- Can run spindle at reduced speed if Limited Manual Operations is set.
- Can jog an axis at reduced feedrate if Limited Manual Operations is set.
- Can index Turret if Limited Manual Operations is set.
- Cannot turn Control Power On (turning centers only).
- Cannot retract the Part Catcher, if equipped, (turning centers only).
- Cannot run the Steady Rest Clamp/Unclamp, if equipped, (turning centers only).
- Can activate Chuck (turning centers only).

- Can activate Tailstock (turning centers only).
- Can activate Auto Door option (turning centers only).

Auto Mode Operations

- Doors must be closed to start a program and must remain closed while the program is running.
- Doors are unlocked when the program is complete.
- Doors may be open for Check for Errors or Estimated Run Time.
- Doors are unlocked at a Position Stop Block or M00/M01 command, but must be closed prior to pressing **Start Cycle** to resume the program.
- Doors are unlocked after the **Interrupt** console key is selected and after axis, spindle, and tool change operations are completed.
 - The doors must be closed prior to resuming the program.

Persons Trapped in Machine

Closing the enclosure door with control power Off locks the door; therefore, it is possible for a person to be locked inside the enclosure.



Do not close enclosure doors while performing maintenance inside the machine enclosure..

Never perform maintenance inside the machine enclosure without someone else present.

Releasing a Person Trapped Inside the Machine Enclosure

To release a person trapped inside the machine enclosure, where the machine is functionally sound (i.e., the machine functions as intended), follow these steps:

1. Release the **Emergency Stop** button.
2. Press the **Manual** console key.
3. Press the **Power On** button.
4. Press the **Start** button. The enclosure doors will automatically unlock.

Noise Levels

Noise level readings are taken in the vicinity of the console, 1.6 meters (60 in) from the floor, 1 meter (39 in) from the machine's enclosure. The maximum ambient noise level reading taken for machines is 60 dB. The maximum reading for any Hurco machine will not exceed 85 dB.



The maximum noise levels are for reference only, and are not necessarily safe working levels. While there is a correlation between the emission and exposure levels, this cannot be used to determine whether further precautions are required. Factors that influence the actual level of exposure of the workforce include characteristics of the workroom, other sources of noise, the number of machines and other adjacent processes. Also the permissible exposure level can vary from country to country. This information, however, will enable the user of the machine to make a better evaluation of the hazard and risk.

MACHINE MAINTENANCE

The maintenance schedule in this chapter is based on normal use (8 hours of operation per day). Your machine maintenance schedule may vary. Machines operated for longer periods each day or in warm or humid environments should be serviced more often..



Do not attempt to access the machine enclosure while machine power is on. Observe proper lock-out/tag-out procedures before performing any maintenance inside the machine enclosure.



Machine linear positioning accuracy was set at the factory, in an ambient temperature of 68° F (20° C). Continual operation at higher or lower temperatures may require that you re-compensate the linear positioning accuracy.

Safety Procedures for Electrical Service

Before removing or working on any cables, fuses, breakers, or other electrical components, make sure that the main disconnect switch on the electrical cabinet door is in the off position. Whenever work will be performed in an area away from the main disconnect switch, post a warning at the switch informing others that the machine is being serviced and the power must remain off.



High voltages inside the electrical cabinet can cause serious injury or death. Only qualified personnel may service the machine, and must follow all safety rules and precautions. The line-side of the main disconnect switch is hot, unless the AC source is disconnected.



Service procedures requiring electrical work while equipment is energized shall only be performed by qualified service personnel. Service personnel performing troubleshooting or adjustment procedures to electrical equipment in the control cabinet or other electrical enclosures with doors open or protective covers removed while machine power is energized, shall observe applicable safety practices, such as those outlined in NFPA 70E and Occupational Safety and Health Administration (OSHA) 29 CFR part 1910.331-335.

Daily Operational Checks

□ Daily: Perform operational checks.

The operator should check the following items each day:

- Clean the machine.
- Check that all shields, covers, and doors operate properly.
- Check the motorized spindle (if equipped) for leakage.
- Check the spindle chiller to be sure there is enough liquid in the tank or system.
- Check the working environment around the spindle chiller for appropriate ventilation and ambient temperature between 40° and 10° C (104° and 50° F).
- Check the chip removal system to ensure proper movement and equipment is free of extraneous items, such as tools or swarf.
- Jog each axis through its full travel, watching for smooth operation.
- Ensure that all axis limit switches are functioning correctly and are calibrated to their proper travel limits.
- Inspect the way covers for scratches or excessive wear.
- Inspect the enclosure windows for scratches, damage, cracks, or other deformities that could adversely affect the impact resistance. Please refer to *Enclosure Windows, on page 4 - 5*.
- Check that the way wipers are not damaged.
- Touch the guideways to check for proper lubrication. All axis guideways should have a thin film of lubricant.
- Check the oil level on the inside cover of the tool changer (if equipped), or on the right side of the swing arm unit, depending on your model.
- Check and clean the tool lock pins (if equipped).
- Check the hydraulic fluid level (if equipped) and verify pressure is set at 40 - 50 bar.
- Check the coolant level every day at the start of operation. If the machine is used more than 8 hours daily, check the coolant level every 8 hours.
- Turn power off and rotate the spindle by hand. It should rotate easily.
- Check that all console control buttons and keys light when pressed, and that all buttons and keys activate the intended functions.
- Clean the chip screens.
- Clean chips from way covers, enclosure, ATC, turret, and chip conveyor(s).
- Check the FRL unit or FR unit (depending on the type of machine) air pressure.
- Check the way lube level in pump.
- Clean the rotary table (if equipped) and check the rotary table oil level.

- Lubricate the spindle taper (if equipped), and clean it with a lint-free cloth dipped in clean, light oil.
- If the motorized spindle (if equipped) is disabled for more than 30 minutes, perform Spindle Pre-Lube and Warm-up cycles. Please refer to *Motorized Spindle Pre-lube and Warm-up*, on page 4 - 18.
- Run the spindle at various speeds, including the minimum and maximum RPM, while observing for proper start, stop, and spindle operation.



If the spindle is idle for more than thirty (30) days, please refer to the *Spindle Run-in or Cycle Procedure*, on page 4 - 22.

- Program a loop and tap at 800 RPM. The spindle rotation should not exhibit abnormal noise or vibration, and speed changes should be smooth.



If a machine has been idle for eight hours, it should be warmed up before cutting parts. Please refer to *Spindle Warm-up Cycles*, on page 4 - 18 for details about the warm-up procedure.

- For VM10HSi machines configured with the dust catcher option, monitor the dust catcher panel to view differential pressure setting. Replace filters if pressure is close to the Alarm setting. Alternatively, listen for the air blast from the nozzles. If they are firing continuously, the filters may need replacing.

Cleaning the Machine

Follow these recommendations when cleaning the machine:

- Machined and unpainted surfaces should be wiped clean with a lint-free cloth dipped in a clean, light machine oil.
- Exterior painted surfaces should be cleaned with a soft cloth dampened with water and a mild detergent.
- The control console exterior should be cleaned with a soft cloth moistened (not wet) with water and a mild detergent.
- The console screens should be wiped with a damp, soft, lint-free cloth.
- The machine enclosure should be thoroughly cleaned annually, or as needed.

Lubrication

☐ Daily: Check and maintain all lubricant levels.

Keep the machine in good operating condition. Lubrication points and recommended lubricants for machines appear in the respective sections. Lubricants that meet the same specifications as those listed may be substituted. Local suppliers should be able to cross-reference recommended lubricants. Viscosity ranges are based on ambient temperatures.

General Maintenance

T-Slots

Exceeding the T-slot torque on table specification listed below could result in deformation of the table or damage the T-slot.

T-Slot Size	T-Slot Torque on Table
10 mm	25 Nm
18 mm	89 Nm
22 mm	418 Nm

T-Slot Size	T-Slot Torque on Table
0.39 in	19 ft-lb
0.71 in	66 ft-lb
0.87 in	307 ft lb

Machine Warm-up

- ☐ Daily: Warm up a machine that has been idle for eight hours before cutting parts.

The warm-up cycle moves the axes at a set feedrate while running the spindle through increasing speed ranges to cause lubricants to work with all moving parts and to establish a stable temperature environment for critical moving components.

Control power must be on and the axes must be calibrated before a machine is warmed up. Hurco machines have an automatic cycle that runs the axes and spindle through warm up. See WinMax Help for instructions on how to start the automatic warm-up cycle. During warm up the spindle speed is incrementally increased and maintained for a specified time until the maximum RPM is reached. Software parameters control the duration at each speed increment as well as the spindle speed increments and the axial feedrate.

Check and Clean the Tools

- ☐ Daily or before operation: Check the condition of tools to ensure they are clean and free of damage.

Check the condition of the tools and clean them with a lint-free cloth dipped in clean light machine oil.

Enclosure Windows

- ☐ Daily: Inspect the enclosure windows for scratches, damage, cracks, or other deformities that could adversely affect the impact resistance.
- ☐ Every three years or less: Replace polycarbonate windows in enclosure doors.

Enclosure windows are made from polycarbonate that is impact resistant to ejected parts or materials during machining. The impact resistance of polycarbonate is reduced by as much as 10% each year due to exposure to metal working fluids, lubricants, and UV light. Replacement of the polycarbonate windows is recommended every three years or less, dependent upon machine usage and amount of fluids in contact with the window, in order to maintain the impact resistance.

Some polycarbonate panels may be labeled with manufacture date or installation date to provide basis for determining frequency of window replacement.

Chuck

- ☐ Daily: Grease the chuck.

The chuck is located inside the enclosure on the left side of the turning center. There are three lubrication points on the chuck for applying grease. Fill each of the 3 plug points with Moly Kote EP grease using a grease gun.

USB Port

- ☐ Daily: Check the USB port. Keep dirt, dust, coolant, and oils away from opening.

USB ports are located on the right-hand side of Max and dual-screen consoles. In addition, there are two USB ports on the electrical cabinet communications panel located on the rear of the machine. Each port should be checked for debris daily.

Check and Clean Tool Holders

- ☐ Weekly: Check each tool holder for damage.
 1. Clean tools and tool flanges with a lint-free cloth dipped in light machine oil.
 2. Check each tool holder for damage. Clean tool holders with a lightly oiled, lint-free cloth.
 3. Inspect tools and tool flanges for damage.
 4. Clean tools and tool flanges with a lint-free cloth dipped in light machine oil before replacing them in the magazine tool holders.

Tool Holder Balance

To ensure that the spindle operates correctly, the tool holder must be properly balanced. These specifications indicate the proper balance for two ranges of spindle RPM. Refer to the Spindle section of the Model-specific Specifications document for the type of tool holder for your machine.

Required Tool Holder Balance
<G6.3 @ ≤ 12000 RPM min ¹
<G2.5 @ >12000 RPM min ¹

Heat Exchanger

- Weekly: Clean the filter inside the heat exchanger.

The heat exchanger removes heat from the control cabinet. Follow these steps to remove dust:

1. Locate the heat exchanger either on top of the power cabinet or on the power cabinet door.
2. Lift the filter from the heat exchanger in order to remove the filter.
3. Rinse the filter with clean water and dry it.
4. Reinstall the filter inside the heat exchanger.

OR

1. Remove the filter from its mount on the outside of the electrical cabinet door (at the rear of the machine).
2. Rinse the filters with clean water and dry.
3. Reinstall the filter into its mount on the outside of the electrical cabinet door.

Grease Tool Holders

- Monthly: Apply grease to tool holders.

Using a brush, apply NGLI 1 grease to tool holders once a month.

Limit Switches and Dogs

- Monthly or 150-200 hours of operation: Inspect limit switches and dog fasteners for damage.

Limit switches and dogs are mounted on each axis and are used to determine end-of-travel and to establish reference points for initial machine zero settings.

Follow these steps to inspect the limit switches and dogs for cleanliness, loose connections, or damage. If necessary, use an Allen wrench to tighten the limit switches and dogs.

1. Refer to the *Mechanical and Electrical Manual* for your machine for limit switch and dog locations.
 - ⇒ Before removing any covers, clean excess coolant, chips, and debris from surfaces.
2. If necessary, remove covers to access limit switch and dog. Some limit switches may be in base casting and not accessible.
3. Check tightness of limit switch fasteners. Refer to the Machine-specific Specifications document for the Torque specification.
4. Check tightness of limit switch dog fasteners. Refer to the Machine-specific

Specifications document for the Torque specification.

Exterior Wiring

☐ Monthly: Inspect conduit, connectors, cabling, and wiring external to the machine for evidence of fraying, cracking, and looseness.

Machine Electrical Ground

☐ Every 3 Months: Measure the ground impedance (resistance to true earth).



Only a licensed electrician should perform this procedure.

The ground for the machine is located inside the control cabinet, near the disconnect switch.

Machine Level

☐ Every 6 Months or every 1000 hours: Verify the machine is sitting level.

After the service engineer has leveled the machine, it is the customer's responsibility to check and maintain this level (using the initial leveling specifications obtained at installation). Check machine level each month for the first six months after installation, and then once every six months.

Place a calibrated precision level (resolution 0.020 mm/m or 0.0005 in/ft.) parallel to X then Y on the work table surface. For turning centers, place the level on the leveling plate that bolts onto the turret.

1. Place the level at the center of the table, oriented in the X-Axis direction.
2. Move the table to nine positions equally spaced within the travel limits of the X and Y axes. There will be 3 X-axis positions and 3 Y-axis positions to be measured at each of the X-axis positions.
3. Record values at each position.
4. Place the level at the center of the table, oriented in the Y-axis direction.
5. Move the table to nine positions equally spaced within the travel limits of the X and Y axes. There will be 3 X-axis positions and 3 Y-axis positions to be measured at each of the X-axis positions.
6. Record values at each position.

For 3-axis machines, no value should exceed 0.020 mm (0.0005 in/ft). If this value is exceeded, contact Hurco Service.

Outriggers

☐ Every 6 Months or after 1000 hours of operation: Grease the outriggers.

Outriggers support the table at either end of its travel. Apply NLGI 2 grease into Zerk fittings located beneath the X-axis way covers.

To grease the outriggers:

1. Remove the right and left outrigger telescoping way covers on the front of the saddle (one on each side) to expose the way surface.
2. Apply the recommended grease into each of the Zerk fittings.
3. Run the Y-axis through its full travel, twice.

Run the table to the rear and inspect the outrigger way surface for signs of scratches or wear. The surface must be coated with a film of grease.

Autolube System

- Daily: Check and maintain autolube lubricant levels.

Hurco machines use one autolube system for lubricating the slideways, guideways, and ballscrews, another autolube system for lubricating the electro-spindle, motorized spindle, or steady rest (if equipped).

Slideways, Guideways, and Ballscrews Autolube System

The autolube system automatically lubricates the slideways, guideways, and ballscrews. The preset discharge rate is 3.0 cubic centimeters (cc) per pump cycle for most machines. The way lube pressure should be set at 2.9 bar or 42 psi.

Fill the Autolube reservoir between the high and low marks with ISO VG68 Way Oil.

The autolube system operates with a digital timer autolube system in one of two ways.

- When servos are On and adequate pressure is attained, the system cycles on for 30 seconds to send lube oil through the machine, then cycles off for 15 minutes.
- The factory-set Machine Parameters run the lube cycle every 9 minutes.

The autolube system is located on the back of the machine. If necessary, open the machine's rear access door to access the autolube system.



Excess Servo On time without table or head movement may cause oil to accumulate on the table and guideways. To eliminate excess lubrication, the Power Off Timer is set to automatically shut off power to a machine that has been idle for a specified time.



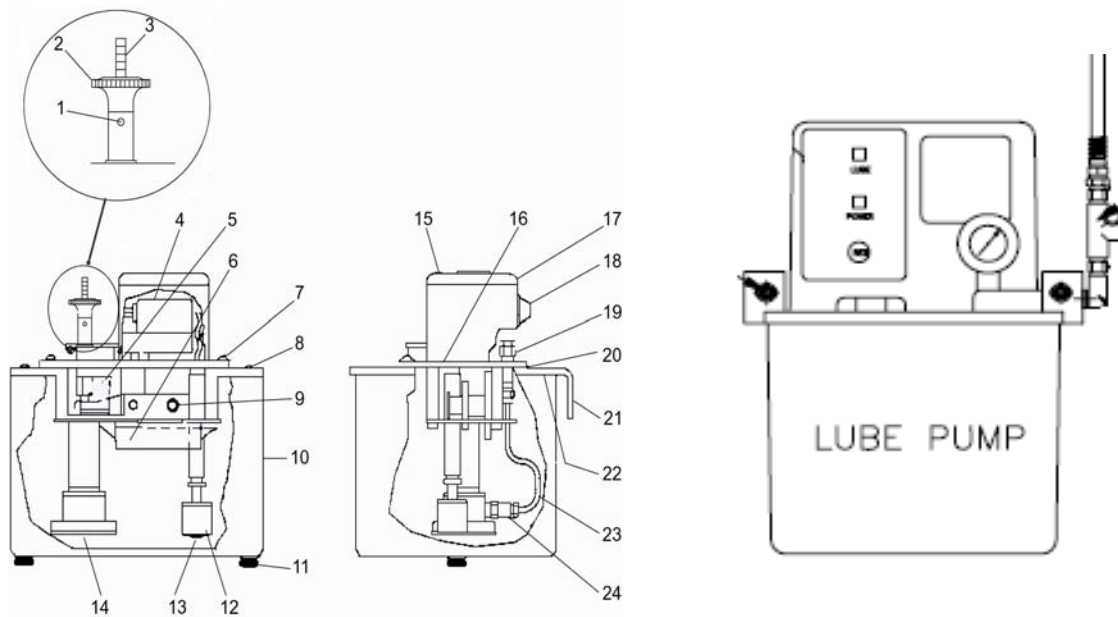
- Monthly: Add a rust preventative to the autolube system if the machine will be idle for 30 days or more.

Initiate a manual lube cycle and move all axes through full travel several times to allow delivery of the rust preventative throughout the system.



If the level of way lube becomes low, a message will appear on the screen.

Here are these two types of autolube systems:



Cycles on 15 seconds / off 30 minutes

Cycles every 9 minutes

1	Set screw	9	Retaining ring	17	Motor cover
2	Discharge plunger	10	Reservoir	18	Grommet
3	Indicator rod	11	Screw	19	"Thru" coupling
4	Electric motor	12	Float switch assembly	20	Reservoir gasket
5	Filter screen	13	O-ring	21	Mounting bracket, reservoir
6	Reservoir worm and gear lube	14	Suction filter group	22	Reservoir gasket
7	Screw, cover mounting	15	Screw, cover mounting	23	Outlet tube assembly
8	Screw, reservoir mounting	16	Gasket, motor cover	24	Outlet check valve assembly

Figure 4-1. Two types of Slideways, Guideways, and Ballscrews Autolube systems

Maintain Autolube Filler Filter Screen / Autolube Fluid Level

☐ Monthly: Maintain the autolube fluid level and check the filler filter screen.

The filter screen inside the oil filler section of the tank prevents contamination from entering the system. The filter screen must be checked and replaced if it becomes plugged. The autolube oil must be replaced monthly.

1. Lift the oil filler cap and check the filter screen. If the screen is dirty or clogged, clean and dry the screen before reinstalling it.
2. The oil level should be between the high and low marks (about 1/2 inch or 1.25 cm from top cover of tank). If needed, add oil to the tank.
3. Replace the oil filler cap.

Depending on the type of Autolube System equipped on your machine, follow the appropriate steps below:

1. Push the feed button on the Autolube System, then release it.
2. Repeat this action several times.

Or:

1. Press the F (Feed) key on the Autolube system. The RUN light will illuminate.
2. Press the F (Feed) key on the Autolube system until the ACT light is illuminated and blinking.
3. Press the F (Feed) key on the Autolube system a third time. The INT light will illuminate.
4. Press the F (Feed) key on the Autolube system a fourth time to initiate the lubrication cycle.

Activate Autolube System Manually

□ Monthly: Manually activate the autolube system if the machine has been idle for a long time before powering up, or if the oil has just been replaced.

Follow these steps for machining centers:

1. Pull upward on the discharge plunger then release it.
2. Stroke the plunger in this manner three to six times.

Follow these steps for turning centers:

1. Press the **Manual** console key to access the Manual screen.
2. Select the DIAGNOSTICS softkey.
3. Select the LUBE softkey. The Lube Diagnostics screen appears.
4. Select the MANUAL LUBE softkey to start the pump. At this point, you may step to the side of the machine and observe the site gauge on the Autolube Pump.

Adjust Autolube Discharge Rate

An indicator rod is located in the autolube system discharge chamber. The scale graduations on the flat surface of the rod indicate the discharge rate in cubic centimeters (cc) per pump cycle.

Depending on the type of Autolube System equipped on your machine, follow the appropriate steps below to adjust the Autolube system discharge rate:

1. Loosen (but do not remove) the set screw in the center of the discharge plunger body.
2. Turn the plunger body clockwise to increase, or counterclockwise to decrease, the pump discharge rate.
3. Once the required discharge rate is obtained, align the set screw with the flat surface on the rod.
4. Tighten the set screw to secure the rod position.

Or:

1. Press the F (Feed) key on the Autolube system two times until the ACT light illuminates and blinks.
2. Press the + or - on the Autolube system to increase or decrease the length of time that oil will flow to the machine.
3. Press the F (Feed) key on the Autolube system a third time. The INT light will illuminate.
4. Press the + or - key on the Autolube system to increase or decrease the dwell time between lubrication cycles.

Clean Autolube Tank and Suction Pump Filter

☐ Annually or at about every 2000 hours of use: Clean the autolube reservoir tank and suction filter.

The suction pump filter is 250 microns (60 mesh).

1. Shut off power to the machine.
2. Loosen and remove the two thumbscrews that secure the reservoir to its mounting bracket.
3. Lower the reservoir downward from the threaded spacers.
4. Remove the suction filter group by first carefully prying out the retaining ring.
5. Noting the order of assembly, remove the suction filter discs and screws.
6. Insert the new coarse screen (filter disc support), fine screen (filter disc, screen disc), filter clamp ring, and retaining ring.
7. Clean any contaminates from the inside of the tank. Dry the inside of the tank with a clean, lint-free cloth.
8. Check the filter screen in the oil filler. It should be clean and undamaged.
9. Make certain the gasket is installed and in good condition.
10. Place the tank on its mounting bracket, guiding it over the threaded spacers.
11. Carefully tighten the two thumb screws that secure the tank to its mounting bracket.



Over-tightening these thumbscrews can damage the tank.

12. Make certain the filter screen is installed in the oil filler.
13. Fill the reservoir with the recommended oil.
14. Manually activate the system.

Electro-spindle Autolube System

☐ Daily: Check and maintain electro-spindle air-oil lubricant levels.

The air-oil lubrication system lubricates the 18000 RPM electro-spindle. The micro-lubrication system lubricates bearings that rotate at a high speed. A distributor injects a small quantity of lubricant in the air flow that is broken into micro parts upon contact with the bearings. Fill the Air/Oil Unit with ISO VG68 oil (CLP) with EP-additives.

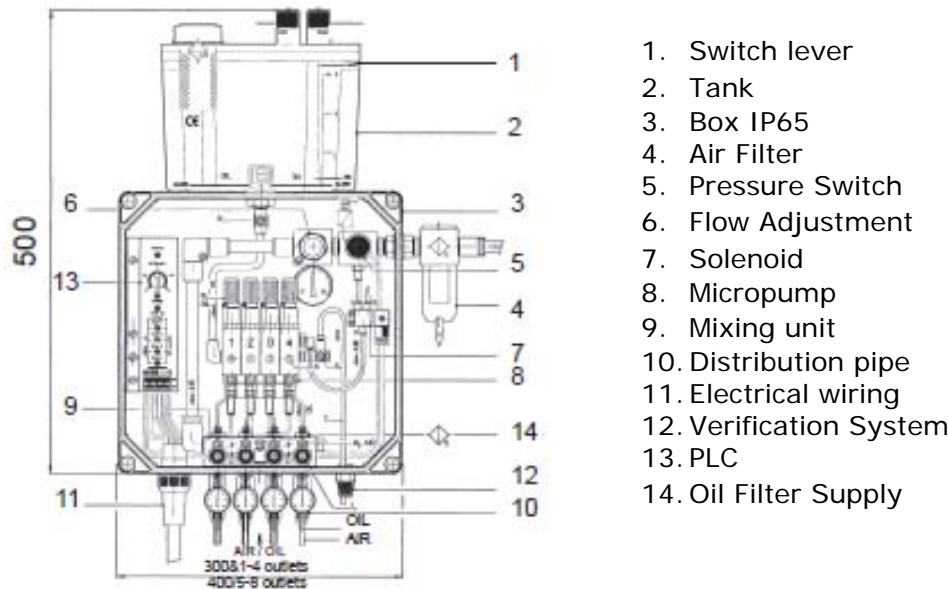


Figure 4-2. Electro-spindle Air-Oil Lubrication Tank Assembly

The electro-spindle air-oil lubricator has these specifications:

- Pump flow rate: variable from 3 to 24 mm³
- Air filter: automatic discharge and 5 micron filtration
- Maximum flow: 0.77 liters/min
- Pressure gauge: electrical signal calibrated at 5 bar on inlet
- Minimum pressure gauge: adjustable from 0.3 to 5 bar
- Oil filter: 5 micron filtration
- Oil type: ISO VG68 (CLP) with EP-additives.



Never, under any circumstances, use the following:

- MoS2 additives
- oil mixtures
- way lubricating oil

Motorized Spindle Autolube System

- Daily: Check and maintain motorized spindle air-oil lubricant levels.

The air-oil lubrication system lubricates the motorized spindle.

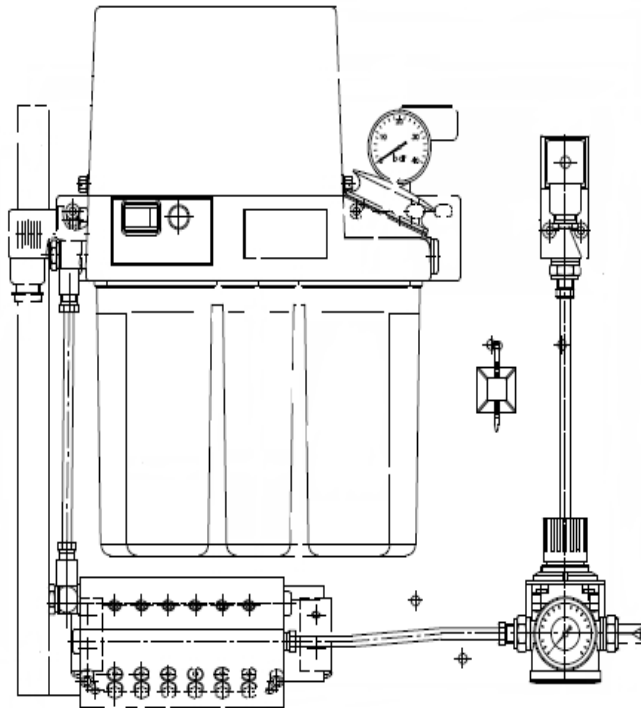


Figure 4-3. Motorized Spindle Air-Oil Lubrication Tank Assembly

The motorized spindle air-oil lubricator air pressure is adjusted to 3 bar, and the output flow rate is 0.24 liter/min.

Oil purity on bearings is according to ISO 4406, Code 13/10. Code designations are

- 13: between 40-80 particles \geq 4 microns/ml of fluid.
- 10: between 5-10 particles \geq 6 microns/ml of fluid.

Recommended oil lubricant type is Hydraulic Oil - ISO VG68 (CLP) with EP-additives.



Never, under any circumstances, use the following:

- MoS2 additives
- oil mixtures
- way lubricating oil

Spindle



Do not use compressed air to clean the spindle. Dirt blown into the spindle will irreparably damage the motorized spindle bearings.

☐ Daily: Lubricate the non-motorized spindle taper, and wipe it clean with a lint-free cloth dipped in clean, light oil. If the machine will be idle, wrap the spindle taper in a cloth soaked with clean Autolube oil.

☐ Daily: check the spindle for leakage.

☐ Weekly: check and fill oil level of unclamp cylinder cup. Use ISO VG32 oil and maintain at 1/3 full, not to exceed 1/2 full.

☐ Weekly: check the Tool Clamping System pull force with a pull measurement system.

☐ Weekly: check the Tool Clamping System collet chuck for damage, dirt, and adequate lubrication. Replace O-rings if damaged.

☐ Monthly: check the Tool Clamping System alignment dimension in release position with the clamping unit under pressure in the unclamp position.

☐ Monthly: check the Tool Clamping System operating sequence by performing a clamping and releasing operation with a tool.

☐ Every 3 Months: replace the Tool Clamping System O-ring.



Failure to meet spindle warm-up, spindle run-in, or tool holder balance requirements may affect machine warranty, and may cause premature spindle failure, excessive spindle vibration, surface finish irregularities, and other performance problems.

Spindle Warm-up Cycles

The tables below show the recommended spindle speed and machine run time intervals necessary for spindle warm-up.

6000 Max RPM		6500 and 8000 Max RPM		10000 Max RPM		15000 Max RPM	
Speed (RPM)	Run Time	Speed (RPM)	Run Time	Speed (RPM)	Run Time	Speed (RPM)	Run Time
1. 1500	2 min	1. 1000	2 min	1. 1000	2 min	1. 1000	2 min
2. 3000	2 min	2. 3000	2 min	2. 3000	2 min	2. 3000	2 min
3. 4500	2 min	3. 5000	2 min	3. 5000	2 min	3. 5000	2 min
4. 6000	2 min	4. 7000	2 min	4. 6000	2 min	4. 7000	2 min
		5. 8000	2 min	5. 7000	2 min	5. 9000	2 min
				6. 9000	2 min	6. 11000	2 min
				7. 10000	2 min	7. 13000	2 min
						8. 15000	2 min

12000 Max RPM		18000 Max RPM		20000 Max RPM		30000 Max RPM	
Speed (RPM)	Run Time	Speed (RPM)	Run Time	Speed (RPM)	Run Time	Speed (RPM)	Run Time
1. 1000	2 min	1. 1000	2 min	1. 5000	5 min	1. 5000	5 min
2. 3000	2 min	2. 3000	2 min	2. 10000	5 min	2. 10000	5 min
3. 5000	2 min	3. 5000	2 min	3. 15000	5 min	3. 15000	5 min
4. 6000	2 min	4. 7000	2 min	4. 20000	5 min	4. 20000	5 min
5. 7000	2 min	5. 9000	2 min			5. 25000	5 min
6. 9000	2 min	6. 11000	2 min			6. 30000	5 min
7. 11000	2 min	7. 13000	2 min				
8. 12000	2 min	8. 15000	2 min				
		9. 18000	2 min				

Motorized Spindle Pre-lube and Warm-up

□ Daily: Perform Pre-lube and Warm-up Spindle cycles for the High Speed (18000 RPM) Motorized Spindle or the High Speed (18000 RPM) Electro-spindle.

Please refer to the Model-specific Specifications document for information about the spindle.

When the spindle is stopped (0 RPM), the spindle pump and air continue to cycle for an additional 30 minutes. If the spindle is turned on and off during this 30 minutes, the timer does not reset unless the spindle is off for 20 seconds. The pre-lube cycle requirement begins following this 30 minutes..

Adding the 30 minute cycle that occurs after the spindle is off, a pre-lube cycle is needed for a motorized spindle if the spindle is off for 30 additional minutes or more; an electro-spindle requires a pre-lube cycle if the spindle is off for an additional hour or more. Both spindle types require a warm-up cycle if the spindle is off for an additional 30 minutes or more.

From the operator's perspective, the spindle pre-lube and warm-up cycle is required after the motorized spindle is off for 60 minutes and after 90 minutes for the electro-spindle. The type of spindle pre-lube and spindle warm-up cycle required changes as the amount

of time the spindle is off (spindle-off time) increases.

These tables describe the different cycles based on spindle-off time:

- *High Speed 6000, 10000, or 18000 RPM Motorized Spindle , on page 4 - 20.*
- *High Speed 18000 RPM Electro-spindle, on page 4 - 21.*

The spindle needs to be run for more than 20 seconds to reset the timer for the pre-lube and warm-up cycles. If spindle pre-lube and spindle warm-up cycles are required, the following limitations are in place:

- Spindle cannot be enabled in manual mode.
- The Machine Warm-up cycle cannot be started.
- Cannot run a program in Auto mode.
- Cannot select Auto mode from an Interrupt mode condition if the Spindle has been off for more than 30 minutes.

A message appears on the screen when a pre-lube or warm-up cycle is required.

Motorized Spindle Pre-Lube and Spindle Warm-up Cycles

To initiate a Spindle Pre-Lube and Spindle Warm-up cycle:

1. Turn On Control Power.
 2. Select the **Manual** mode console key.
 3. Insert a tool in the spindle (the Tool in Spindle must not be 0).
 4. Select the **Diagnostics** softkey.
 5. Select the **Machine Diagnostics** softkey.
 6. Select the **Pre-Lube & Warm-Up Cycle** softkey. The **Start Cycle** button flashes.
 7. Press the **Start Cycle** button.
 - An in-process message appears on the screen until both cycles are done.
 - When both cycles have been completed, the message is cleared and the limitations listed above are removed.
- ⇒ All CE requirements for enclosure doors must be satisfied to begin the cycles and until the cycles are completed.
- ⇒ If either cycle is interrupted, then both cycles will need to be restarted.

High Speed 6000, 10000, or 18000 RPM Motorized Spindle

The following table lists the total time required to complete the Motorized Spindle Pre-Lube and Spindle Warm-up cycles in which the spindle limitations are in effect..

Spindle Off Time	Spindle Pre-lube	Spindle Warm-up	Total Time (min:sec)
0 to 60 min	Not required	Not required	0:00
60 min to 48 hours	Duration of cycle = 1 min: <ul style="list-style-type: none"> Pump on for 10 sec Pump off for 10 sec 	Spindle on at 500 RPM for 30 sec Spindle on at 1500 RPM for 30 sec Spindle on at 3000 RPM for 30 sec Spindle on at 50% for 1 min Spindle off for 1 min Spindle on at 75% for 1 min	5:30
2 days to 7 days	Duration of cycle = 1 min: <ul style="list-style-type: none"> Pump on for 10 sec Pump off for 10 sec 	Spindle on at 500 RPM for 30 sec Spindle on at 1500 RPM for 30 sec Spindle on at 3000 RPM for 30 sec Repeat 5 times: <ul style="list-style-type: none"> Spindle on at 25% for 1 min Spindle off for 1 min Repeat 5 times: <ul style="list-style-type: none"> Spindle on at 50% for 1 min Spindle off for 1 min Repeat 5 times: <ul style="list-style-type: none"> Spindle on at 75% for 1 min Spindle off for 1 min 	32:30
More than 7 days	Duration of cycle = 5 min: <ul style="list-style-type: none"> Pump on for 10 sec Pump off for 50 sec 	Spindle on at 500 RPM for 30 sec Spindle on at 1500 RPM for 30 sec Spindle on at 3000 RPM for 30 sec Repeat 5 times: <ul style="list-style-type: none"> Spindle on at 25% for 30 sec Spindle off for 2 min Repeat 5 times: <ul style="list-style-type: none"> Spindle on at 50% for 30 sec Spindle off for 2 min Repeat 5 times: <ul style="list-style-type: none"> Spindle on at 75% for 30 sec Spindle off for 2 min Repeat 5 times: <ul style="list-style-type: none"> Spindle on at 100% for 30 sec Spindle off for 2 min 	56:30

High Speed 18000 RPM Electro-spindle

The following table lists the total time required to complete the VMX42HSRTi 18000 RPM Electro-spindle Pre-Lube and Spindle Warm-up cycles in which the spindle limitations are in effect.

Spindle Off Time	Spindle Pre-lube	Spindle Warm-up	Total Time (min:sec)
0 to 30 min	Not required	Not required	0:00
30 min to 90 min	Not required	Spindle on at 7200 RPM (40% Max Spindle Speed) for 1 min Spindle on at 12600 RPM (70% Max Spindle Speed) for 1 min Spindle on at 18000 RPM (100% Max Spindle Speed) for 1 min	3:00
1 hour to 16 hours	Pump on for 5 min	Spindle on at 3600 RPM (20% Max Spindle Speed) for 1 min Spindle on at 5400 RPM (30% Max Spindle Speed) for 1 min Spindle on at 7200 RPM (40% Max Spindle Speed) for 1 min Spindle on at 12600 RPM (70% Max Spindle Speed) for 1 min Spindle on at 18000 RPM (100% Max Spindle Speed) for 1 min	10:00
More than 16 hours	Pump on for 5 min	Spindle on at 900 RPM (5% Max Spindle Speed) for 1 min Spindle on at 2700 RPM (15% Max Spindle Speed) for 1 min Spindle on at 5400 RPM (30% Max Spindle Speed) for 1 min Spindle on at 7200 RPM (40% Max Spindle Speed) for 1 min Spindle on at 9000 RPM (50% Max Spindle Speed) for 1 min Spindle on at 12600 RPM (70% Max Spindle Speed) for 1 min Spindle on at 18000 RPM (100% Max Spindle Speed) for 1 min	12:00

Spindle Run-in or Cycle Procedure

□ Monthly: Perform a spindle run-in before operating the machine if the spindle has been idle for more than 30 days or if the spindle has never been used.

1. Referring to the appropriate Max RPM Spindle table that follows, run the spindle for the indicated time, at the recommended speeds, depending on your maximum spindle speed. Proceed in the order listed in the table.
2. Monitor the temperature at either the front or upper bearing and either the rear or lower bearing (depending on the type of machine), both of which should not exceed 55°C (130°F) once the maximum RPM is achieved.



SRI, SWi, and SRTi electro-spindles that have been idle for 3 months or more should not exceed 50°C (122°F).

Please refer to *SR, SW, or SRT i-Series Electro-spindle Run-in Cycle*, on page 4 - 26 for details.

3. If spindle flange temperature does not exceed 55°C (130°F) at any time during the spindle run-in procedure, then the warm-up procedure is complete.
4. If spindle flange temperature exceeds 55°C (130°F) at any time during the spindle warm-up, then stop the spindle immediately. Allow the spindle to cool to room temperature.
5. Restart the warm-up procedure at the last speed used prior to the temperature spike.
6. Repeat steps 1-3 above until the spindle runs at each specified RPM for the time specified, below 55°C (130°F).

Spindle Speed	Spindle Run Time
1600 RPM	
1. 200 RPM	2 min
2. 400 RPM	2 min
3. 600 RPM	2 min
4. 800 RPM	2 min
5. 900 RPM	5 min
6. 1000 RPM	10 min
7. 1100 RPM	16 min
8. 1200 RPM	20 min
9. 1400 RPM	30 min
10. 1600 RPM	60 min

Spindle Speed	Spindle Run Time
2800 RPM	
1. 300 RPM	4 min
2. 500 RPM	5 min
3. 1000 RPM	10 min
4. 1500 RPM	16 min
5. 2000 RPM	20 min
6. 2500 RPM	30 min
7. 2800 RPM	60 min

Spindle Speed	Spindle Run Time
3000 RPM	
1. 300 RPM	8 min
2. 500 RPM	5 min
3. 1000 RPM	10 min
4. 1500 RPM	16 min
5. 2000 RPM	20 min
6. 2500 RPM	30 min
7. 3000 RPM	60 min

Spindle Speed	Spindle Run Time
3500 RPM	
1. 300 RPM	8 min
2. 500 RPM	5 min
3. 1000 RPM	10 min
4. 1500 RPM	16 min
5. 2000 RPM	20 min
6. 2500 RPM	20 min
7. 3000 RPM	30 min
8. 3500 RPM	60 min

Spindle Speed	Spindle Run Time
4500 RPM	
1. 600 RPM	4 min
2. 1200 RPM	2 min
3. 1800 RPM	2 min
4. 2000 RPM	5 min
5. 2400 RPM	10 min
6. 3000 RPM	16 min
7. 3600 RPM	20 min
8. 4200 RPM	30 min
9. 4500 RPM	60 min

Spindle Speed	Spindle Run Time
4800 RPM	
1. 600 RPM	4 min
2. 1200 RPM	2 min
3. 1800 RPM	2 min
4. 2000 RPM	5 min
5. 2400 RPM	10 min
6. 3000 RPM	16 min
7. 3600 RPM	20 min
8. 4200 RPM	30 min
9. 4800 RPM	60 min

Spindle Speed	Spindle Run Time
6000 RPM	
1. 600 RPM	2 min
2. 1200 RPM	2 min
3. 1800 RPM	2 min
4. 2400 RPM	2 min
5. 3000 RPM	5 min
6. 3600 RPM	10 min
7. 4200 RPM	16 min
8. 4800 RPM	20 min
9. 5400 RPM	30 min
10. 6000 RPM	60 min

6000 Max RPM Motorized Spindle Run-in or Cycle		6500 Max RPM Belt Driven, High Torque, 50 Taper Spin- dleRun-in or Cycle		8000 Max RPM Belt Driven, 50 Taper Spindle Run-in or Cycle		10000 Max RPM Motorized Spindle Run-in or Cycle	
Speed (RPM)	Run Time	Speed (RPM)	Run Time	Speed (RPM)	Run Time	Speed (RPM)	Run Time
1. 1500	5 min	1. 1500	15 min	1. 1500	15 min	1. 1500	15 min
2. 0	5 min	2. 3000	15 min	2. 3000	15 min	2. 3000	15 min
3. 3000	5 min	3. 4500	30 min	3. 4500	15 min	3. 4500	15 min
4. 6000	15 min	4. 6500	60 min	4. 6000	15 min	4. 6000	15 min
				5. 7500	30 min	5. 7500	15 min
				6. 8000	60 min	6. 9000	30 min
						7. 10000	60 min

12000 Max RPM Motorized Spindle Run-in or Cycle		SRI, SWi, or SRTi Machines 12000 Max RPM Electro Spindle Idle for 3 Months or More		15000 Max RPM Motorized Spindle Run-in or Cycle	
Speed (RPM)	Run Time	Speed (RPM)	Run Time	Speed (RPM)	Run Time
1. 1500	15 min	1. 500	10 min	1. 1500	15 min
2. 3000	15 min	2. 1000	10 min	2. 3000	15 min
3. 4500	15 min	3. 2000	10 min	3. 4500	15 min
4. 6000	15 min	4. 4000	10 min	4. 6000	15 min
5. 7500	15 min	5. 6000	5 min	5. 7500	15 min
6. 9000	15 min	6. 8000	5 min	6. 9000	15 min
7. 10000	15 min	7. 10000	5 min	7. 10500	15 min
8. 11000	30 min	8. 12000	5 min	8. 12000	15 min
9. 12000	60 min			9. 13500	30 min
				10. 15000	60 min

18000 Max RPM Motorized Spindle Run-in or Cycle		20000 Max RPM Motorized Spindle Run-in or Cycle		30000 Max RPM Motorized Spindle Run-in or Cycle	
Speed (RPM)	Run Time	Speed (RPM)	Run Time	Speed (RPM)	Run Time
1. 4500	5 min	1. 5000	12 min	1. 5000	12 min
2. 0	5 min	2. 10000	12 min	2. 10000	12 min
3. 9000	5 min	3. 15000	12 min	3. 15000	12 min
4. 0	5 min	4. 20000	12 min	4. 20000	12 min
5. 18000	15 min			5. 25000	12 min
				6. 30000	12 min

SR, SW, or SRT i-Series Electro-spindle Run-in Cycle

Run the electro-spindle at the specified RPM for the specified amount of time (refer to *SRI, SWi, or SRTi Machines 12000 Max RPM Electro Spindle Idle for 3 Months or More, on page 4 - 25*), while measuring the temperature inside the electro-spindle cone with a temperature measuring device in the location shown below.

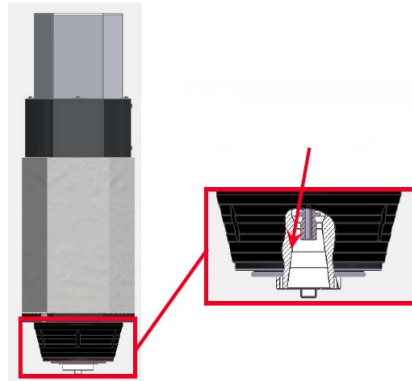


Figure 4-4. Electro-spindle Temperature Measurement Location

Monitor the electro-spindle temperature until the temperature becomes stable for five minutes at the specified RPM and does not exceed 50°C (122°F).



If the electro-spindle temperature exceeds 50°C (122°F), stop running the electro-spindle, allow it to cool to 20-25°C (68°-77°F), then restart the procedure from the beginning (500 RPM for 10 minutes).

Repeat at each RPM increment for the specified amount of time until the electro-spindle run-in procedure is completed.

Pneumatic System

The pneumatic system includes a Filter, Regulator, and Lubricator (FRL) Unit. The filter cleans incoming compressed air, and expels accumulated moisture through a drain. The lubricator meters oil into the air stream to lubricate cylinders and valves. The rate at which lubricant is released into the pneumatic system (i.e., the drip rate) is adjustable.

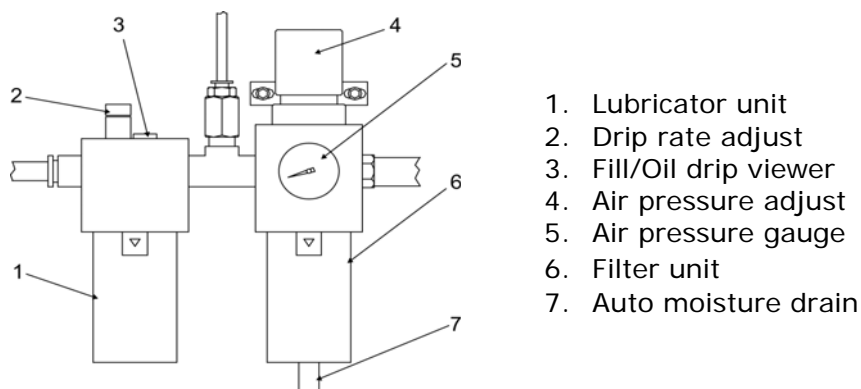


Figure 4-5. Filter, Regulator, and Lubricator Unit

For TM i-Series models the pneumatic system includes a Filter and Regulator Unit with no lubrication unit. Other turning centers pneumatic systems include the FRL system. The parts catcher and auto door options operate using the pneumatic system.

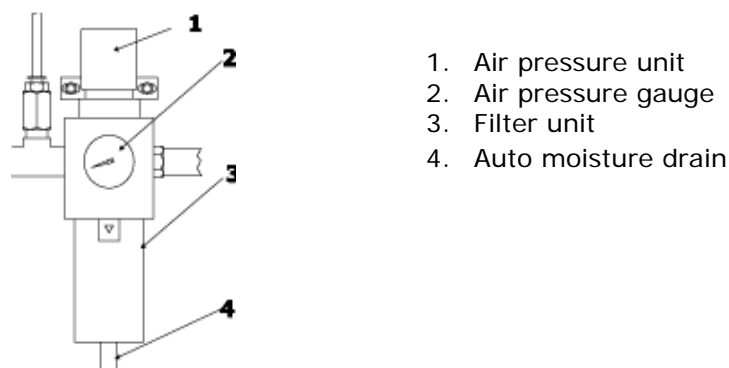


Figure 4-6. Filter and Regulator Unit (for TM i-Series)

Set Air Pressure

- Daily: Check the FRL or FR unit air pressure.

If the air pressure reading on the gauge does not meet the required specification, adjust the knob on top of the filter unit to set the correct system pressure. To adjust the knob, pull it up and turn. To lock the knob, push it back down.

Maintain Lubricator Oil Level

Maintain the lubricator oil level between the low and high marks on the lubricator unit. If oil must be added, do not overfill. Use oil type ISO VG32.



Shut off the compressed air supply before adding lubricant or removing one of the housings. Use only recommended oils or equivalents.

Adjust Drip Rate Screwe

The oil drip rate was factory-set and should not need adjustment. However, if the oil drip is not visible at the top of the lubricator unit, turn the drip rate adjustment screw to obtain one drop of lubricant for every 8 tool changes.

Check and Replace Air Filter Element

- Every 3 Months or every 500 hours: Check the FRL air filter element regularly and replace it.

If the filter becomes clogged, the air pressure may still measure as acceptable, but air flow to the pneumatic system will be restricted.



First remove the metal bowl guard, then remove the bowl to access the filter element, clean the bowl using a soft, lint-free cloth dabbed with the recommended lubricant. Do not use any type of cleaning fluid.

Before reconnecting the air supply, reinstall the metal bowl guard.

Check Auto Moisture Drain

- ☐ Daily: Check the auto moisture drain on FRL.
- ☐ Weekly: Check the auto moisture drain on the Filter and Regulator Unit for TM i-Series models.
- ☐ Every 3 Months: Drain moisture from the lines of the Filter and Regulator Unit or the FRL.

Make sure the auto moisture drain is not stuck open and leaking air. If the drain is stuck open, follow these steps:

1. Disconnect the compressed air supply to the machine.
2. Turn the auto drain nut at the filter unit bottom counter-clockwise one turn.
3. Using a crescent wrench, turn the auto drain nut at the bottom of the filter unit counterclockwise one turn.
4. Tighten the nut clockwise.

Hydraulic System

Some Hurco machines use hydraulics to run certain components. The hydraulic pressure is set at the factory and should not be adjusted.

HMX Hydraulic Pressure Settings

The HMX i-Series machines have a hydraulic system for operating the table clamp, B-axis clamp, spindle clamp, APC Up/Down (Automatic Pallet Changer), and APC Right/Left.

Machine Model	Table Clamp/Unclamp	B-Axis Clamp	Spindle Clamp/Unclamp	APC Hydraulics	
				Left/Right	Up/Down
HMX400	35KG	35KG	50KG	30KG	35KG
HMX630	50KG	35KG	85KG	30KG	50KG

Hydraulic System	Pressure Setting
B-Axis (Tilting Head)	30-40 Bar
C-Axis (Rotary Table)	30-40 Bar
Unclamp Cylinder	40-50 Bar

Trunnion Hydraulic Pressure Setting

☐ Daily or every 8 hours: Check the hydraulic pressure of the trunnion table clamping system (if equipped) to ensure it is between 30 and 40 Bar.

The trunnion table clamping system uses hydraulic pressure to regulate flow of oil to the system. The rotary axis (C-axis) and tilt-axis (A-axis) each have separate oil systems to ensure adequate lubrication.



Some models have a pneumatic clamping system.



Operating the clamping system above 40 Bar may cause buckling of the clamping system and damage to the tilt and rotary axes of the trunnion table. The system's hydraulic pressure is set at 35 Bar during factory installation. Hurco recommends maintaining the hydraulic pressure for the clamping system at 35 Bar.



Disassembling the trunnion table or any component of the table may cause irreparable damage and void your Hurco warranty. Contact a Hurco-certified Service Engineer to service the trunnion table.



VMX30Ui and VMX42Ui machining centers use a pneumatic clamping system. Refer to *Pneumatic System*, on page 4 - 27 for details.

Follow these steps to check the pressure:

1. Locate the T-valve on the back of the tilt-axis (i.e., A-axis) table below the pressure switch.

2. Attach a pressure gauge to the T-valve to read the hydraulic pressure.
3. Make sure the air pressure at the booster cylinders (accessible through the side enclosure panel) is between 3 and 3.2 Bar. If necessary, adjust the air pressure at the booster cylinders.


Follow these steps to adjust the hydraulic pressure of the clamping system:

1. Open the access door for the ATC on the left side of the machine.
2. Use the pressure regulator knob to adjust the hydraulic pressure.
 - Turn the pressure regulator knob clockwise to increase pressure.
 - Turn the pressure regulatory knob counter clockwise to decrease pressure.
3. Close the ATC access door.

Turning Centers Hydraulic Pressure Settings

Turning centers hydraulic systems operate the chuck, turret, and optional tailstock assembly. The hydraulic pump provides power for the chuck, turret, and tailstock assembly. The following table contains hydraulic pump pressure settings for the turning centers.

Machine	Hydraulic Pressure Setting	
	bar	psi
TM6i	32.0 bar	455 psi
TM8i	32.0 bar	455 psi
TM10i	40.0 bar	580 psi
TM12i	53.9 bar	782 psi
TM18i	39.2 bar	569 psi
TM18Li	39.2 bar	569 psi
TMM8i	54.0 bar	782 psi
TMM10i	71.6 bar	1038 psi
TMX8i	54.0 bar	782 psi
TMX8MYi	68.6 bar	995 psi
TMX8MYSi	68.6 bar	995 psi
TMX10i	54.0 bar	782 psi
TMX10MYi	68.6 bar	995 psi
TMX10MYSi	68.6 bar	995 psi

- **Hydraulic Pump Low Pressure Cut-off**— Δ 15.0 kg/cm² (Δ 213 psi).
 -  The hydraulic pressure falling below the low pressure cut-off results in an error on the control.
- **TMM Series C-Axis Assist Brake Hydraulic Pressure Setting**—2.8 - 3.2 kg/cm² (40-45 psi).
- **TMM Series Turret Pressure**—is adjustable and should be set to 50 +/- 2 kg/cm² (711 +/- 29 psi).
- **TMX Series Turret Pressure**—is adjustable and should be set to 50 bar

+2.5/-10 bar (725 + 35/-145 psi).

Chuck Hydraulic Pressure Setting

The chuck hydraulic pressure gauge is located on the front, left side of the enclosure. If there are two gauges, the chuck gauge is on the left; the tailstock gauge is on the right.

The amount of hydraulic pressure affects the pressure the jaws apply to the stock. The maximum hydraulic pressure setting for the chuck is 40.8 kg/cm² (580 psi) for all turning center models.

To adjust the hydraulic pressure for the chuck,

1. Open the door beneath the gauge.
2. If there are two knobs, use the one on the left to adjust the hydraulic pressure for the chuck. Turn the knob locking ring under the pressure adjustment to unlock the knob.
3. Turn the knob clockwise to turn up the pressure for harder stock; turn the knob counterclockwise to turn down the pressure for softer stock.
4. Turn the locking ring clockwise to lock the knob in place.

Tailstock Hydraulic Pressure Gauge Setting

The tailstock hydraulic pressure gauge is located on the front, left side of the enclosure. If there are two gauges, the chuck gauge is on the left; the tailstock gauge is on the right.

The amount of hydraulic pressure affects the speed at which the tailstock quill advances or retracts and the force applied by the tailstock.

To adjust the hydraulic pressure for the tailstock,

1. Open the door beneath the gauge.
2. If there are two knobs, use the one on the right to adjust the hydraulic pressure for the tailstock. Turn the knob locking ring on the pressure adjustment to unlock the knob.
3. Turn the knob clockwise to turn up the pressure for harder stock; turn the knob counterclockwise to turn down the pressure for softer stock.



When the quill is advanced, the pressure can only be adjusted higher because of the check valve. To lower the pressure when the quill is advanced,

1. Retract the quill.
2. Turn the knob counterclockwise to lower the pressure setting.
3. Advance the tailstock.
4. Turn the knob clockwise to the desired pressure.



Adjust the tailstock movement with the flow control valve located behind the left door housing. Open the door to access the valve. With this setting, the pressure remains unchanged, but the speed of the tailstock movement is increased or decreased.

4. Turn the locking ring clockwise to lock the knob in place.

Maintain the Oil Level

- Every 3 Months or 500 hours of operation: Check the hydraulic system oil level.
 - Hydraulic Tank—Maintain the oil level at 180.0 liters with either Teresso Oil 32 (Esso), DTE Oil Light (Mobil), or Tellus Oil 32 (Shell).
 - HMX i-Series Rotary Table (B-axis) Gearbox—Maintain the oil level so the sight glass is half full with 0.5 liter of ISO VG100~150 oil.
 - SR/SRT/SW i-Series models (C-axis)—Maintain the oil level so the sight glass on the remote hydraulic tank is half full with ISO VG46 hydraulic oil.
 - TM i-Series Hydraulic Tank—Maintain the oil level so the sight glass at rear of machine is half full with ISO VG32 oil.
 - TM6i tank capacity is 40.0 liters/10.6 gal..
 - TM18Li tank capacity is 90 liters/23.8 gal.
 - TM8i, TM10i, TM12i, TM18i, TMM8i, TMM10i, TMX8i, TMX8MYi, TMX8MYSi, TMX10i, TMX10MYi, TMX10MYSi tank capacity is 70.0 liters/18.5 gal.

Follow these steps to maintain the oil level:

1. Check the tank sight gauge.
2. If the level is low, add the recommended oil type.

Replace Hydraulic Oil

☐ Annually or every 2000 hours of operation: Replace the hydraulic oil and filter.

The intake filter or strainer used on the Hydraulic tank is 150 microns (100 mesh).

Follow these steps to replace the hydraulic oil:

1. Drain the oil using the plug at the bottom of the tank.
2. Flush the system. Use a non-volatile flushing agent that is suitable for use in a mineral-type hydraulic system.
3. Check the filter and replace it, if necessary.
4. Replace the drain plug.
5. Add the recommended oil type to the tank, checking the sight gauge on the tank to determine when the tank is full.

Flood Coolant and Washdown System

The flood coolant system pumps coolant to the tool in the turret or spindle. The washdown system uses a large flow of coolant to move chips to the front of the machine and onto the chip conveyor. A washdown spray gun is externally mounted on the machine to spray chips found inside the enclosure.

Chips that are flushed out of the machining center collect in the chip conveyor tank. Used coolant is cleaned of chips and oil and recirculated into the coolant tank. Filters remove contaminants from the coolant. When the chip conveyor tank becomes full with coolant, the coolant over flows into the coolant tank.

Selecting Coolant

Use a non-synthetic or semi-synthetic water soluble coolant to prevent damage to the machine oil, guideways, precision ballscrews, and painted surfaces. Coolant should have these qualities:

- Must be suitable for the workpiece material and machining operation.
- Must be soluble in water.
- Must contain mineral content of at least 35%. When synthetic coolants and coolants that contain too little mineral oil come in contact with guideway lube oil, they can clog the guideways.
- Must provide adequate rust protection.
- Must be innocuous (not harmful) to paint.
- Must contain anti-foam, anti-bacterial, and anti-fungal agents.
- Must be non-irritating to skin.
- Must allow penetrating lubrication oil (way oil) to float on the surface of the coolant (instead of dissolving in the coolant).
- Must not contain aggressive additives. However, suitable additives can increase cutting capacity.



Failure of devices or performance problems related to coolant are not a defect in Hurco's material or workmanship, and will not be covered by Hurco's warranty. Some Coolants in certain circumstances may affect machine's paint or labeling of control keyboard. Damages of this kind are not a defect in Hurco's material or workmanship, and will not be covered by Hurco's warranty.

Preparing Coolant

Follow these guidelines when preparing coolant:

- Mix the coolant according to coolant manufacturer's instructions. Use deionized (preferred) or softened water for the coolant mixture. To prevent zinc contamination, do not store coolant in a galvanized container.
- Check coolant concentration regularly with a refractometer or by titration.
- Screen off any residue floating in the coolant.
- Use coolant additives such as bactericides, fungicides, and anti-foam corrosion agents only if recommended by the coolant manufacturer.
- Do not allow foreign matter to mix with the coolant. Contaminated coolant can damage machine parts.

Check and Maintain the Coolant

☐ Daily or every 8 hours: Check the coolant level every day at the start of operation.

To maintain the coolant level, proceed as follows:

1. Find the level indicator on the coolant tank. If the flood coolant pump is off, then fill the coolant to the H (High) mark. Note that the machine should be off for at least 5 minutes before filling the tank with coolant.
2. If the flood coolant pump is delivering coolant to the machine, then fill to the MAX mark.



If the coolant level drops below the L (Low) level mark on the coolant tank, the coolant system may not operate properly.

Replacing Coolant

- ❑ Weekly or after 40-50 hours of operation: Clean the coolant filters.
- ❑ Every 3 Months or every 500 hours: Replace coolant and coolant filters.
 1. Using a suitable brush, remove chips and other debris from the enclosure (and chip conveyor, if installed).
 2. Drain used coolant from the system and tanks.
 3. Clean or change pump filters and pick-up tubes.
 4. Fill the coolant tank with a neutral aqueous (water-based) cleaning agent and flush thoroughly.
 5. Drain the cleaning agent.
 6. Rinse the system thoroughly with a 1% coolant solution. If bacteria or fungi contaminate the system, use a cleaning agent recommended by the coolant manufacturer.
 7. Drain the rinsing solution.
 8. Add new coolant.
 9. Dispose of used coolant and cleaning solution in compliance with applicable pollution control regulations.

Cleaning the Coolant Tank

To clean the tank:

1. Drain coolant from chip conveyor and coolant tank using vacuum or pump.
2. Disconnect hoses from the tank and pull the tank out toward the side.
3. Remove any remaining chips from the tank with a soft brush.
4. Remove the two chip screens from the coolant tank.
5. Rinse and dry the screens before replacing them.
6. Reposition the coolant tank in same location as original. Weir from chip conveyor should align with screen on top of coolant tank.
7. Re-attach all hoses previously disconnected.

Chip Conveyor

The chip conveyor is intended to collect chips or swarf that are washed into the conveyor from the machine enclosure and then remove chips or swarf from the conveyor using conveyor paddles or belt to the exit chute into a collection receptacle. However, some chips or swarf may remain in the conveyor and the chip conveyor may require periodic cleaning to remove the chips that cannot be removed via the paddles or belt system.



Activate E-Stop prior to attempting to access any part of the chip removal system and prior to removal of the chip conveyor from the normal operating position beneath the machine tool enclosure.



Do not reach into the chip removal system. Disconnect the chip removal power connector prior to service or accessing the chip conveyor.

Check and Maintain Chip Conveyor

☐ Daily: Clean the chip conveyor chip screens (if equipped).

Chip conveyor may require multiple cleanings per day when chips or swarf are small and have tendency to float on top of chip conveyor (i.e. small chips or swarf of copper, aluminum, plastics).

☐ Every 3 Months or after 500 hours of operation: Clean the chip conveyor (if equipped) whenever the coolant is replaced.

Removing Chip Conveyor from Machine

Be sure the chip conveyor is not in motion before moving it from beneath the machine.



The Manual and Auto screens show the status of the conveyor as Off, Forward, or Reverse. The alarm lamp also illuminates a yellow signal when the conveyor is in forward or reverse condition. For machines equipped with CE or ANSI door safety switches, the front enclosure doors will also be locked when the chip conveyor is in forward or reverse.

It is also recommended that the console E-stop be engaged.

If the chip removal system must be moved, follow these steps:

1. Disconnect the chip conveyor power plug, typically located at the side of the enclosure.
2. Unscrew the four (4) bolts located under each corner of the conveyor.

⇒ The Hurco Service Engineer screws the bolts into place during installation, and the conveyor cannot be moved. These bolts are in place to keep the conveyor from moving, and to keep the conveyor at a slight angle, allowing coolant to drain out of the conveyor to the coolant tank.

3. Remove chip chutes that may be protruding from the interior of the enclosure into the chip conveyor. The chip chutes will prevent moving the chip conveyor from beneath the machine.
4. Remove front splash guard, if equipped.
5. Empty coolant out of the chip conveyor into a proper receptacle using a vacuum or pump.
6. Pull the conveyor out from the machine, toward the side.

To replace conveyor beneath machine, reverse these steps. When re-seating the leveling bolts, be sure that all leveling bolts raise the chip conveyor rollers off of the floor and that there is a slight angle towards the weir for proper coolant drainage from the chip conveyor into the coolant tank.

Chip Conveyor Paddle Screws and Chains

☐ Every 6 Months: Inspect the chip conveyor chains and paddle screws (if equipped) for tightness.

There are two types of chip conveyors: drag flight and belt.

Drag Flight

The drag flight operates with paddles that pull the chips toward the conveyor for disposal. There are 3 button-head screws on each end of the drag flight paddles. These screws need to be checked for tightness. If any screws are loose, tighten the screws.

The drag flight paddles move with sprockets and chains located on the inside of each side of the chip conveyor. Check the chains for looseness and tighten if necessary.

Belt

The belt type operates by collecting the chips on top of a belt moving to the conveyor for disposal. The belt runs on guides with sprockets and chains located on the inside of each side of the chip conveyor. Check the chains for looseness and tighten if necessary.

Automatic Tool Changer

The lubrication required depends upon the type of ATC. Please refer to the Automatic Tool Changer section of the Model-specific Specification document for information about your machine's ATC taper size and number of tool pockets.

Tool changers have an enclosed oil lubrication system. The tool changer housing holds the oil, some of which is displaced into a small oil reservoir during the tool change cycle.



Some cam parts are grease-packed, and do not require routine maintenance.

Clean the Tool Lock Pins and Tool Gripper Fingers

- Daily: Clean the tool lock pins and tool gripper fingers located on the tool changer arm.
- Every 6 months: Add NGLI 1 grease to the Zerk fittings on the tool changer arm.

There are 2 tool lock pins on top of the tool changer arm, located near the center. When the tool changer arm is in the Up position, the tool lock pins plunge down into the tool changer arm, flush with the top of the arm. They must be free of chips and debris for proper operation.

Tool gripper fingers are located on each end of the tool changer arm. These fingers mechanically grip the tool and move the tool to the spindle or tool magazine. They must be free of chips and debris for proper operation.

Maintain the ATC Arm and Transmission Oil Level

- Every 3 Months or after 500 hours of operation: Check the ATC oil level.

Observe the oil level in the reservoir cup, located on the front of the tool changer or on right-hand side of swing arm. The oil level should always be in the middle of the round sight glass. If the oil level is low, add a maximum of 5.8 quarts of ISO VG150 ~220 oil.

Grease the ATC Magazine Chain

- Every 6 Months or every 1000 hours: Grease the ATC magazine chain assembly.

Use a brush to apply a light coating of NGLI 1 grease over the chain assembly. Avoid grease build-up. Also use a grease gun to apply 5 cc of NGLI 2 grease into the Zerk fitting.

Grease the ATC Magazine Drum

- Every 6 Months or every 1000 hours: Grease the ATC magazine drum (if equipped).

The ATC magazine of HMX i-Series machines is housed in a drum. Follow these steps:

1. Use a grease gun or soft-bristled brush to apply NGLI 1 oil between each tool pocket on the drum.
2. Avoid grease build-up.

Replace the Tool Changer Oil

□ Annually or after 2000 hours: Replace the ATC oil.



The oil should be changed more often than annually if it appears to be darkening.

1. Open the drain plug located near the bottom of the swing arm transmission casting, or the cup inside the cover of the tool changer. Drain the oil.
2. Flush the system. Use a non-volatile flushing agent that is suitable for a mineral-type lubricating system.
3. Replace the drain plug.
4. Add the new oil.

Spindle Chiller

Maintain the Spindle Chiller System

☐ Daily or before operation: Maintain the spindle chiller system (if equipped).

Follow these steps:

1. Check the chiller solution level and add solution, if necessary.
2. Inspect chiller tubing for bends, tears, or constrictions that may impair flow to the spindle. Replace any damaged tubing.
3. Check the chiller tubing for leaks. Repair or replace if necessary..
4. Check the spindle chiller solution for presence of contaminants; sediment in the solution could block tubing.
5. Replace contaminated solution by flushing and cleaning the tank before refilling.

Repair Leaks in the Spindle Chiller

☐ Daily: Inspect for leaks in spindle chiller.

Leaky pipes are repaired using tube clips or by replacing the pipes. If welding is required to repair a leaky pipe,

1. Choose a well-ventilated area.
2. Extract all water from the cooler unit.
3. Disconnect all pipes between the machine tool and the cooler unit..
4. Extract liquid from the cooler unit according to the relevant regulations of environmental protection.

Maintain Spindle Chiller Solution

□ Weekly: Inspect the chiller solution level (if equipped), and if necessary, add solution to the unit.

Follow these steps:

1. Check the solution level through the sight gauge on the chiller tank.
2. If the level is low, add the recommended chiller solution to the tank. Do not overfill the tank. See the table below for the appropriate quantity and lubrication type.



Use a fully synthetic water miscible corrosion-protection concentrate for spindle cooling systems to protect against corrosion. The additive should not contain any glycols, which are harmful to galvanized parts.

Quantity	Lubrication Type
250 BTU / 13 liters	12.35 liters (3.3 gal.) drinking water
250 BTU / 3.5 gal.	0.65 liters (1.4 pt.) Motorex Coolant-F
400 BTU / 35 liters	33.25 liters (8.8 gal.) drinking water
400 BTU / 9.3 gal.	1.75 liters (3.7 pt.) Motorex Coolant-F
750 BTU / 45 liters	41.80 liters (11.1 gal.) drinking water
750 BTU / 11.9 gal.	2.20 liters (4.7 pt.) Motorex Coolant-F
1000 BTU / 45 liters	41.80 liters (11.1 gal.) drinking water
1000 BTU / 11.9 gal.	2.20 liters (4.7 pt.) Motorex Coolant-F

For motorized spindles, fill the chiller unit with clean water and anti-corrosive additive XTREMECOOL (mixing ratio 10%).

Maintain the Spindle Chiller Tank Air Filter and Water Filter

□ Weekly or after 40 hours of operation: Inspect the spindle chiller tank air filter and water filter (if equipped) for dirt and damage.

To maintain the spindle chiller air filter screen, follow these steps:

1. Shut off the machine power.
2. Pull the air filter out of the spindle chiller using the black tab located above the control panel. The air filter is positioned horizontally.
3. Inspect the spindle chiller tank air filter.
4. Clean the air filter using a vacuum cleaner, compressed air, or brush and water if the air filter is dirty.
5. Replace the air filter if it is damaged.
6. Inspect the water filter located in the rear of the spindle chiller tank, near the water lines exiting the tank.
7. Replace the water filter cartridge if it is dirty or damaged.

Remove Air from Spindle Chiller Circulating System

□ Weekly: Remove air from spindle chiller circulating system.

If air penetrates the circulating system, the flow rate will decrease and there will be noise in the system. To remove air from the circulating system,

1. Turn on the main machine power. This starts the chiller unit, and the pump will start operating.
2. Loosen the pipe slightly at the outlet of the cooler unit to push the air out of the system.
3. Tighten the pipe.
4. Switch off the main machine power.

Flush, Clean Tank, and Refill Chiller Solution

□ Annually or every 2000 hours, or every 1000 hours if in a hard water area: Flush, clean, and refill the spindle chiller tank (if equipped) once each year and any time the spindle chiller solution shows signs of contamination or overheating.

Follow these steps:

1. Gradually add the flushing agent solution per the flushing agent supplier's recommendations. Recommended flushing agent for motorized spindles is TST Cleaner LUBRIZOL CONTRAM CB-1 (mixing ratio 3%).
2. Continue to use the spindle/chiller system normally for the next 48 hours. It is important that the chiller system is left running to flush the complete system through.
3. Empty the solution.
 - a. Shut off machine power.
 - b. Locate the drain on the bottom front of the chiller tank.
 - c. Remove the drain plug.
 - d. Use a funnel to drain fluid into a container. Discard the chiller solution per applicable laws.
 - e. Replace the drain plug.
4. Fill the chiller system with clean chiller solution per the Maintain Spindle Chiller Solution section. Do not overfill tank.

Operation Checklist

Before operating the spindle chiller,

- ❑ Daily: Check the spindle chiller (if equipped) to be sure the working environment has appropriate ventilation and the ambient temperature is between 10° and 40°C (50° and 104°F).
- ❑ Weekly: Check the spindle chiller (if equipped) to be sure there is a sufficient amount of liquid in the tank or in the system.



Insufficient liquid within the system will cause damage to the pump.



Restarting the spindle chiller frequently will cause damage to the unit. Do not restart the cooler unit within 3 minutes after turning it off.

Follow these safety precautions:

- Keep the spindle chiller in a safe area, free of dampness or moisture.
- Do not stack anything on top of the spindle chiller.

Follow these steps to keep the exterior of the spindle chiller clean:

1. Turn off machine power.
2. Clean the surface of the spindle chiller with cool water, mild detergent, and a lint-free cloth.
3. Wipe electrical components with a dry cloth.

If repairs or replacement parts are required, please follow these safety precautions:

- Turn the machine's main power switch Off before proceeding.
- Avoid flame near any oil (in the form of liquid or gas).
- Choose a well-ventilated location if releasing refrigerant.

Spindle Chiller Control Panel for Model HWK

Refer to the supplier's manual for details about the Spindle Chiller Control Panel.

Spindle Chiller Temperature Requirement

The spindle chiller should be set for Differential Temperature Control, except for SR, SW, and SRT i-Series models which should be set for Fixed Temperature Control.

Hurco recommends the Differential Temperature on the spindle chiller be set to 2°C cooler than the ambient temperature to maintain the appropriate liquid temperature.

Hurco recommends setting the Fixed Temperature on the spindle chiller to 24°C.

Differential Temperature Mode

When the Spindle Chiller is in Differential Temperature Mode, setting the Liquid Temperature to -2°C programs the spindle chiller to constantly maintain the liquid temperature 2° cooler than the ambient temperature. If the ambient temperature changes, the liquid temperature is adjusted to keep it 2° cooler than the ambient temperature. Refer to the supplier's manual for instructions.

With machine power on, the cooler unit starts the cooling process when the temperature difference between the liquid and the ambient air is greater than the Differential Temperature setting.

The cooling process stops when the temperature differential between the liquid and the ambient air is equal to or less than the Differential Temperature setting.

Fixed Temperature Mode

For SR, SW, and SRT i-Series machines, Hurco recommends the spindle chiller be set to Fixed Temperature mode. With machine power on, the cooler unit starts the cooling process when the liquid temperature rises above the Fixed Temperature setting. If the temperature of the liquid reaches the Fixed Temperature setting or lower, the cooling process stops.

If the ambient temperature reaches 31°C or greater, increase the Fixed Temperature setting to be 5°C cooler than the ambient air temperature to reduce condensation in the spindle head.

During the course of a day, the ambient temperature can change. When that occurs, the Fixed Temperature needs to be adjusted.

Coolant thru Spindle (CTS)

The optional Coolant Thru Spindle (CTS) pump assembly has an internal filter to clean coolant used by the CTS system. The CTS pump assembly is located at the rear of the coolant tank.

Coolant Filter for CTS

- ☐ Weekly: Check the CTS coolant filter (if equipped) and clean when necessary.
- ☐ Every 3 Months or 500 hours: Replace the CTS coolant filter (if equipped).

To access the CTS coolant filter:

1. Remove the filter housing unit from the CTS pump assembly.
2. Remove the CTS coolant filter from the housing unit.
3. Rinse the filter with clean, soapy water and dry. If the filter is damaged, replace it.

Trunnion Table

The trunnion table clamping system uses hydraulic pressure to regulate flow of oil to the system. The rotary axis (C-Axis) and tilt-axis (A-Axis) each have separate oil systems to ensure adequate lubrication.

Inspect the Trunnion Clamping System Pneumatic Lines

☐ Daily or every 8 hours of operation: Check the trunnion table (if equipped) clamping system's incoming pneumatic lines for leaking, cracking, or kinks.

If the incoming pneumatic lines are exposed to the working environment, ensure the lines are free of damage from chips and are not twisted or bent.

Clean the Trunnion Table

☐ Daily, after every shift, or every 8 hours of trunnion operation: Clean the trunnion table.

Use flood coolant and a clean brush to remove chips from the trunnion table. Use gentle pressure while cleaning the table to retain table alignment.



Do not use compressed air to remove chips or dirt from the trunnion table. Air-blown water and chips come lodged underneath and cause damage to the trunnion table.

Maintain the Trunnion Clamping System's Oil Level

☐ Weekly or every 40 hours of operation: Check the oil level for the trunnion clamping system.

1. Open the access door on the right side of the machine.
2. Check the level of the oil in the sight gauge located on the side of the booster cylinder. The oil sight gauge level should be half-filled with oil.
3. If the oil level is low, add oil to the reservoir bowl until the oil sight gauge level is half-filled with oil.
4. Close the ATC access door.

Check Oil Drip Rate for Trunnion C-Axis Clamp/Unclamp

The trunnion table C-axis clamping system is factory set at 1 drop per 8-10 clamp/unclamp cycles. The drip rate adjustment knob is located on the right hand side of the C-axis.



Some machine models have a cover for the clamping system. For those machines, remove the cover to access the drip rate adjustment knob.

If the drip rate needs to be adjusted, turn the drip rate adjustment knob so the indicator lines up with one of the numbers 8, 9, or 10 at the base of the knob.

Trunnion Rotary C-Axis

The rotary-axis (i.e., C-axis) on the trunnion table is positioned 360° and becomes the machining center's fourth axis for part programming. The rotary axis has a separate oil system to ensure adequate lubrication.

Use a maximum of 2.0 liters of ISO VG150 oil.

Maintain the Trunnion Rotary C-Axis Oil Level

☐ Daily or after 8 hours of operation: Check the trunnion rotary-axis oil level.

Follow these steps:

1. Move the rotary-axis to 0° (the horizontal table position).
2. Check the oil level through the oil level sight gauge located on the front side of the trunnion table. The oil sight gauge should be half-filled with oil.

If the oil level is low, open the oil fill plug located on the top of the trunnion table and add clean oil until the level of oil in the sight gauge is half-filled (the level of oil will cover the red dot in the sight gauge).

Replace the Trunnion Rotary C-Axis Oil

- Annually or after 2000 hours of operation: Replace the trunnion rotary-axis oil.



The rotary-axis oil should be changed more often than annually if the oil appears to be darkening.

Follow these steps: :

1. Move the rotary-axis to approximately 60° , until the oil fill plug on the top of the trunnion table faces the bottom of the machining center.
2. Place a suitable container underneath the trunnion table to collect the used oil.
3. Open the drain plug on the top of the trunnion table and drain the used oil into the container.
4. Close the oil drain plug.
5. Tilt the rotary axis to approximately 30° , until the oil fill plug on the top of the trunnion table faces towards the back of the machining center.
6. Open the oil fill plug located on the back side of the trunnion table and add approximately 2. 0 liters of clean oil.
7. Close the oil fill plug.

Trunnion Tilt A-Axis Maintenance

The tilt-axis (i.e., A-axis) on the trunnion table is tilted between -30° and $+110^{\circ}$ to become the fifth axis during part programming. A separate oil system is used to keep the tilt-axis lubricated.

Use a maximum of 2.0 liters of ISO VG150 oil.

Maintain the Trunnion Tilt A-Axis Oil LevelMantenere la Trunnion Tilt A-Axis del livello dell'olio

☐ Daily or after 8 hours of operation: Check the trunnion tilt-axis oil (if equipped).

Follow these steps:

1. Remove the machine's inspection plate on the right side of the machining center.
2. Check the oil level through the oil level sight gauge. The oil sight gauge should be half-filled with oil (i.e., the level of oil should cover the red dot in the sight gauge).
3. If the oil level is low, open the oil fill plug located above the oil level sight gauge and add clean oil until the level of oil in the sight gauge is half-filled.
4. Replace the machine's inspection plate.

Replace the Trunnion Tilt A-Axis Oil

☐ Annually or after 2000 hours of operation: Replace the trunnion tilt-axis oil (if equipped).



The tilt-axis oil should be changed more often than annually if the oil appears to be darkening.

Follow these steps:

1. Place a suitable container underneath the tilt-axis to collect the used oil.
2. Open the oil drain plug located on the bottom of the tilt-axis.
3. Drain the used oil into the container.
4. Close the oil drain plug.
5. Remove the machine's inspection plate on the right side of the machining center.
6. Open the oil fill plug located above the oil level sight gauge and add approximately 2.0 liters (one gallon) of clean oil.
7. Close the oil fill plug.
8. Replace the machine's inspection plate.

B-Axis

Maintain the Oil for the B-Axis Tilt

□ Weekly or after 40 hours of operation: Check the oil level for the B-Axis tilt mechanism.

Use a maximum 0.75 liter (25.4 ounces) of ISO VG150 synthetic oil.

Follow these steps to maintain the oil for the tilt spindle:

1. View the oil level through the sight gauge located on the tilt mechanism gear box. If the oil level looks adequate when viewed through the sight gauge, but a low oil error message appears when attempting to run a part program.
2. If the oil level is low, open the oil fill plug on the top of the tilt mechanism gear box.
3. Add oil until the level of oil is half-full in the sight gauge.
4. Close the oil fill plug on the gear box.

Replace the Oil for the B-Axis Tilt Mechanism

□ Annually: Replace the oil for the B-Axis tilt mechanism.

Follow these steps to replace the oil for the tilt spindle:

1. Run the B-axis for at least 15 minutes.
2. Open the oil drain plug located at the bottom of the tilt mechanism gear box.
3. Drain the used oil into a suitable container.
4. Replace the oil drain plug.
5. Open the oil fill plug located at the top of the tilt mechanism gear box and add approximately 0.75 liters (25.4 ounces) of new oil.

C-Axis Rotary Table

Check the oil through the oil level indicator. The oil level of the rotating axis must be checked with the table in horizontal position at 0° with both axes clamped. Fill with a maximum of 1.65 liters (55.8 ounces) of ISO VG150 synthetic oil so the sight glass is half full.

Clean the C-Axis Rotary Table

☐ Daily after every shift or 8 hours of operation: Clean the C-Axis rotary table (if equipped) to remove debris that may cause damage.

Follow these steps to clean the rotary table:

1. Use a lint-free cloth to wipe any chips away from the rotary table.
2. Use a clean, lint-free cloth dipped in clean mineral oil to gently wipe the rotary table clean. Use gentle pressure when cleaning the rotary table to retain table alignment.

Maintain the Oil Level for the C-Axis Rotary Table

☐ Weekly: Check the oil level for the C-Axis rotary table, and if necessary add oil.

Use a maximum 1.65 liters (55.8 ounces) of ISO VG150 Synthetic Oil.

Follow these steps to maintain the oil level for the rotary table.

1. Check the oil level through the oil sight gauge on the rotary table. The oil sight gauge should be half-filled.
2. If the oil level is low, open the oil fill plug located directly above the oil sight gauge and add clean oil until the level of oil in the sight gauge is half-filled.
3. Push the adjuster knob down to lock it in this position.
4. Jog the C-axis 360° and listen for the whistling sound. Adjust the flow control valve for the C-axis rotary table until the noise is minimal.



Do not completely close the flow control valve.

Adjust Air Pressure and Flow Control for Rotary Table

The integrated C-axis rotary table uses pneumatic pressure to keep coolant and debris out of the rotary table unit. The air pressure also relieves excess pressure on the table seals, preventing premature wear of the seals, but may result in a slight whistling or squealing sound. This noise has no effect on the table operation.

To set the pneumatic pressure,

1. Locate the regulator for the TRBTH610 C-axis rotary table. This unit is positioned on the rear left-hand side of the machine, when facing the front of the machine. There are 2 air lines on the output side of the regulator. One air line, usually located on the top, connects to the spindle; the other air line, usually located on the bottom, connects to the C-axis rotary table.
2. Fully open the flow control valve that connects the C-axis rotary table.
3. Unlock the regulator by pulling up the adjuster knob.
4. Turn the adjuster knob until the reading is between 0.4 and 0.6 Bar. Counter-clockwise lowers the pressure; clockwise increases the pressure.



Regulators need to bleed off when lowering the pressure. Always bleed below the desired pressure then bring the pressure back up to the desired amount of pressure.

5. Push the adjuster knob down to lock it in this position.
6. Jog the C-axis 360 degrees and listen for the whistling sound. Adjust the flow control valve for the C-axis rotary table until the noise is minimal.



Do not completely close the flow control valve.

Dust Collector

Filter conditions may appear on the display of the dust collector unit. An alarm and a message appears on the control when the filters need to be replaced.

Remove, inspect, or change the filter cartridges from outside the unit by removing the filter access cover and sliding the filter out.

Turret

- Monthly: Check the turret oil level.

Fill with ISO VG100-150 oil so sight glass on the front of the turret is half full.

The turret is located inside the enclosure on the right side of the turning center. Check the oil level in the sight glass on the front of the turret oil tank. The tank should be at least 1/2 full. Use the inlet plug located in the front to fill the tank. Refer to *Lubrication*, on page 4 - 4 for information about turret lubrication.

The live-tooling turret is available on TMM8, TMM10, TMX MY, and TMX MYS i-Series turning centers for inserting live-tooling tool holders.

TMM10i MDT20 Gear Box

- Every 6 Months or 1000 hours of operation: Check the grease in the live-tooling turret gear box.

Use 200 grams of Klubersynth UH1 14-1600 (Cod. 0897155) grease.

Remove the plug at the top of the MDT housing and check the amount of grease in the gear box.

1. Remove the plug at the top of the MDT housing shown in the figure below.

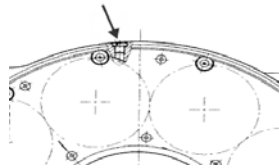


Figure 4-7. Live-tooling Turret Gear Box

2. Insert a small-diameter screw driver and touch the gear below the plug hole.
3. Remove and inspect the screw driver tip:
 - If no grease is present on the screw driver tip, add grease (maximum 40 cm³ or 2.5 in³). Use 200 grams of Klubersynth UH1 14-1600 (Cod. 0897155).
 - If dark grease is present on the screw driver tip, do not add grease.
 - If there is a grease and metallic dust mixture, grease and coolant mixture, or grease and oil mixture on the screw driver tip, contact a Hurco service representative for assistance.
4. Replace the plug at the top of the MDT housing.

Turret Disk

- Every 6 Months or 1000 hours of operation: Clean the back of the live-tooling turret disk and the gasket.

The turret disk is sealed with a gasket. The gasket is a green ring that is visible behind the turret disk.

1. Remove the turret disk assembly by removing the 8 M8 SHCS and Dia. 10 alignment pins, if present.
2. Inspect the turret disk and clean if necessary.
3. Remove and clean the green seal and seal cavity.
 - a. Remove the 13 M4x8 SHCS (1) and 13 springs (2).
 - b. Inspect and replace the seal if damaged.
 - c. Install the 13 M4x8 SHCS (1) and 13 springs (2).

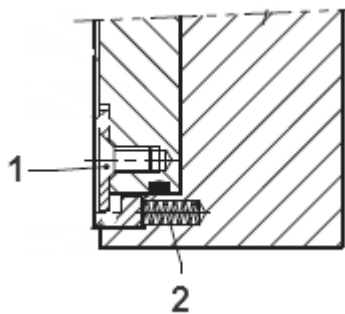


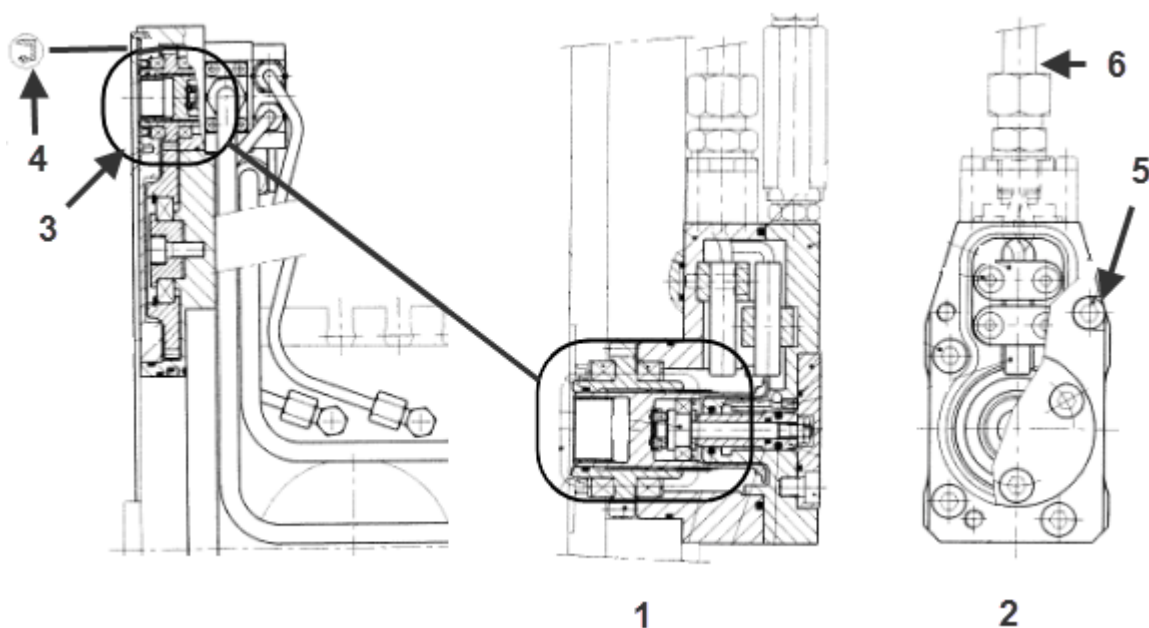
Figure 4-8. Turret Disk side view M4x8 SHCS and spring

4. Install the turret disk assembly and tighten the 8 M8 SHCS and Dia. 10 alignment pins, if present, and torque to 34 Nm on the front of the turret disk.
5. Realign the turret disk upon installation.
 - a. Attach a coaxial indicator to the chuck.
 - b. Sweep the outside of the tool holder with the end of the coaxial indicator until the dial indicates the center (0,0).

Turret Power Intake Rotary Seal

□ Every 6 Months or 1000 hours of operation: Check the live-tooling turret power intake rotary seal.

1. Remove the power intake engagement group on the rear of the turret by removing the 4 M6x18SHCS.
2. Loosen the 2 hydraulic lines.
3. Remove the tool disk, screw, and washer..
4. Inspect the rotary seal gasket and replace if necessary.
5. Replace the screw and washer.
6. Install the power intake engagement group.



1	Power Intake—Side View
2	Power Intake—Rear View
3	Screw and Washer
4	Gasket (Rotary Seal)
5	Socket Head Cap Screw
6	Hydraulic Lines

Figure 4–9. Power Intake assembly and Rotary seal

Turning Center Coolant Collector Filter

☐ Daily: Clean the coolant collector filter.

A coolant collector is located at the rear of the spindle, inside the enclosure. This device collects coolant that runs through the spindle as the spindle turns and returns the coolant through a hose into the coolant tank.

In addition to returning the coolant, the collector uses a filter to keep the tank free of chips. This filter needs to be cleaned frequently to avoid having the coolant overflow from the collector.

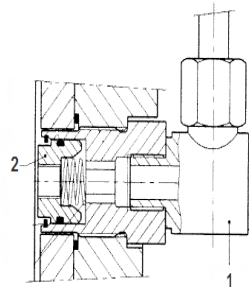
To access the coolant collector and filter, open the enclosure door on the left side of the machine, where the Communications Panel is located.

TMM i-Series Coolant Valve

□ Every 3 Months or 500 hours of operation: Inspect and clean the TMM i-Series coolant valve located inside the turret.

TMM8i MDT16 Turret

The coolant valve assembly is located inside the turret. Access the coolant valve assembly from the back of the turret.



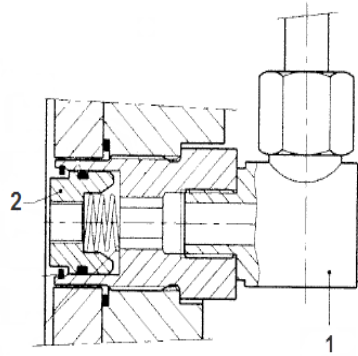
1	Screw
2	Coolant PlugPlug refrigerante
3	Spring
4	Coolant Valve

Figure 4–10. Live-tooling TMM8i MDT16 Turret Coolant Valve assembly

1. Remove the turret covers.
2. Remove the screw (1) at the top of the Coolant Valve assembly.
3. Remove the coolant plug (2) by inserting an M5 bolt and pulling the plug out.
4. Remove the coolant valve spring (3).
5. Remove the coolant valve (4) by inserting an M6 bolt and pulling the valve out.
6. Check the condition of the coolant valve O-ring seal.
 - a. Thoroughly clean the coolant valve.
 - b. Thoroughly clean the valve cavity inside the turret.
7. Replace the coolant valve if necessary.
8. Install the coolant valve.
9. Install the coolant plug.
10. Tighten the screw.
11. Install the turret covers.

TMM10i MDT20 Turret

The coolant valve is located at the end of the coolant valve assembly. The coolant valve assembly is located inside the turret. Access the coolant valve assembly from the back of the turret by removing the coolant fitting.



1	Banjo Fitting
2	Coolant Valve

Figure 4–11. Live-tooling TMM10i MDT20 Turret Coolant Valve assembly

1. Remove the turret covers.
2. Remove the banjo fitting (1).
3. Remove the coolant valve assembly (2).
4. Check the condition of the coolant valve O-ring seal.
 - a. Thoroughly clean the coolant valve.
 - b. Thoroughly clean the valve cavity inside the turret.
5. Replace the coolant valve if necessary.
6. Install the banjo fitting.
7. Install the turret covers.

TMX i-Series Turret Coolant Valve

□ Every 3 Months or 500 hours of operation: Inspect and clean the TMX i-Series coolant valve located on the turret.

TMX i-Series machines are equipped with a turret that has a coolant valve. The coolant valve needs to be cleaned periodically.

Follow these steps to remove the coolant valve plug and clean the valve and spring:

1. Remove the set screw with a 3.0 mm hex key.
2. Thread a 5.0 mm SHCS into the plug.
3. Remove and clean the plug, removing any chips.
4. Thread a 4.0 mm SHCS into the cap and spring assembly.
5. Remove and clean the spring and cap, removing any chips.
6. Replace the P9 O-ring if damaged.
7. Remove the nozzle plug with an M8 bolt. Check the condition of the P9 O-ring and the nylon plug surface.
8. Reinstall the coolant plug, using the 8.0 mm bolt.
9. Replace the spring and cap, using the 4.0 mm SHCS threaded into the assembly.
10. Replace the set screw using a 3.0 mm hex key.

Parts Catcher

Adjust Parts Catcher Speed

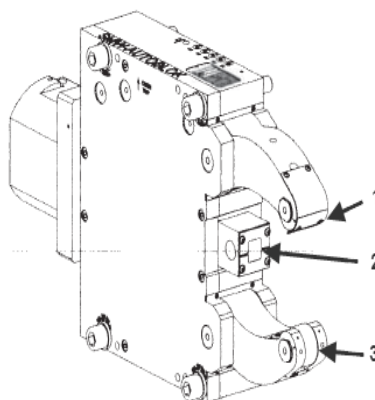
You can adjust the speed that the turning center optional parts catcher moves up and down.

1. Remove the access door on the front of the turning center. The screws are on the inside of the machine.
2. Locate the two brass knobs. Each knob is connected to its own air line feeding pressure to it.
 - The knob on the top controls the speed for the upward movement.
 - The knob on the bottom controls the speed for the downward movement.
3. Turn the knob (top or bottom) clockwise to lower the speed and counterclockwise to increase the speed.
4. Observe the parts catcher in operation and make adjustments to the knob settings before reattaching the access door.

Steady Rest

Some i-Series machines may be equipped with an optional Steady Rest device. The device supports long thin stock at its mid-point.

- ❑ Daily: Check Steady Rest lubrication points (on the 2 rollers and the center arm). Lubricant must be present at these points.
- ❑ Monthly: If compressed air is used, remove the drain plug and open the Steady Rest drain. (The location is located on the Steady Rest label.) Ensure that air can pass through. Replace the plug to close the drain.
- ❑ Annually: Disassemble and clean the Steady Rest.
- ❑ Annually: Check the Steady Rest safety valve.



1	Roller (lubrication point 1)
2	Roller (lubrication point 2)
3	Roller (lubrication point 3)

Figure 4–12. Steady Rest Clamping mechanism

Steady Rest Autolube System

The Steady Rest lubrication system lubricates the optional Steady Rest mechanism for turning centers.

Fill the reservoir with a maximum 2 liters of HLP 46 - 68 DIN 51502 oil, filling between the high and low marks on the reservoir. The reservoir has a float switch.

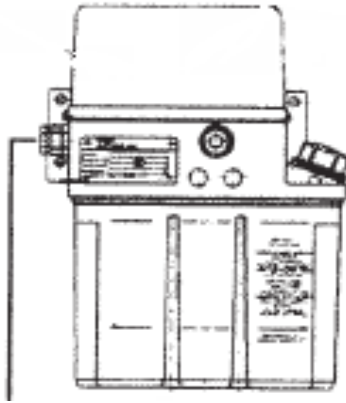


Figure 4–13. Steady Rest Autolube system

The Steady Rest Oil Lubricator air pressure is adjusted from 0.5 to 3 bar.

The Steady Rest Oil Lubricator cycles as follows:

- Once an hour when the Steady Rest is installed.
- Every 4 minutes when the Steady Rest is clamped and the spindle is running.
- Every 10 minutes when the Steady Rest is clamped and the spindle is not running.

TROUBLESHOOTING

Failure conditions are evident during power up and operation. Failure detection and prevention descriptions follow.



Before testing live circuits or attempting any repairs to electrical connections, make sure that the power switch on the electrical cabinet is in the Off position. Follow all established safety practices. Remember that the power line from the source to the machine is live even though the machine tool is not receiving power.

Power-Up Troubleshooting

If a problem occurs during power up, look for one of the following symptoms:



- No messages appear on the console screen. The system may beep, but does not start up.
- Error messages appear during the initialization process before the Input screen appears.
- Error messages appear on the Input screen.

No Response on the Console

If no messages appear on the text screen after switching the power on, make sure of the following:



- Power supply cord inside the electrical cabinet is properly connected to the power source.
- Main fuses supplying power to the machine have not failed.

Initialization Error Messages

After power has been switched on, initialization messages appear on the text screen.

Other possible messages during initialization may indicate missing or corrupted files. The usual solution for such problems is to restore or delete files. For help solving these problems, contact your local Hurco service representative.



Before calling a Hurco service representative for assistance, always switch off the control at the power button, wait a few minutes, and then power on again..

If an error message appears, write down the entire message before calling a Hurco service representative for assistance.

Error Messages

If errors occur after power up, take careful note of any error messages on the screen. Note if the red beacon is on or flashing when the error occurs. Also, note if the control responds to any key, button, or touchscreen selection after the error occurs.

Corrective Measures

One or more of the following corrective measures may be necessary:

Check Wiring

Perform these checks:

- Trace the wiring as far as possible.
- Wiggle connectors and ensure they are properly seated.
- Test the connections with an ohmmeter.

Perform a Reset

Technical assistance personnel may ask you to reset the machine. Switch the main power off and then back on. If possible, complete proper shutdown procedures.

Emergency Stop Condition

Pressing the Emergency Stop button removes all servo power and power to the way lubrication pumps. A message on the screen indicates the Emergency Stop condition, and the red beacon lights up.

To restore machine power after an Emergency Stop condition:

1. Twist and lift the **Emergency Stop Button**.
 - ⇒ There may be more than one Emergency Stop Button on your machine. Know the location of each one and release each.
2. Press these console keys in this order:
 - a. Press the **Manual** console key.
 - b. Press the **Power On** button. The Start Cycle button flashes.
 - ⇒ The system begins processing information about the servos as soon as the button begins flashing. When this processing is complete, a prompt message appears on the screen for you to press the Start Cycle button.
 - c. Press the **Start Cycle** button to enable the servos.

Machine Diagnostics

The control detects the status of various machine components, such as the automatic tool changer or turret, and presents this information on Diagnostics screens. Refer to the WinMax Help for information about machine diagnostics.

Common Problems

Common operator problems are listed below, with potential causes and solutions. These problems are usually noticeable without the help of error messages, although error messages may occur. More than one problem can result from a single cause.

Machine operation failures are a programming or a hardware problem. Hardware includes electronic components, wiring, and electro-mechanical devices.

Power-on Self Test

When you turn on the machine, the control performs a self test. If an error in the control circuitry is detected, a pattern of beeps may sound instead of the normal start-up beep. A screen error message may appear—follow any on-screen instructions.

Machine Voltages

Missing or faulty connections can cause a combination of problems, as listed below.

Connections	Description
Missings	<ul style="list-style-type: none"> • Open grounds • Open neutrals • Open phase connections • Missing neutral-to-ground strap at main source
Improper	<ul style="list-style-type: none"> • Phase and neutral reversed • Phase and ground reversed • Ground and neutral reversed • Ground and neutral shorted at panel
Loose	<ul style="list-style-type: none"> • At main panels • At equipment • At other equipment in system • At service entrance

Table 5–1. Troubleshooting: Missing or Faulty Connections

Fluctuating voltages to the machine may occur when power usage in your region is high (typically on a very hot or cold day). See the following table.

Causes	Problems	SolutionsSoluzioni
Power sag	Fuse blows	<ul style="list-style-type: none"> Repair faulty in-plant wiring. Move any other machines on the circuit to separate circuits.
	Power is lost	
	Motor(s) overheat	
Power spike	Microprocessor and/or control PC boards fail	<ul style="list-style-type: none"> Move any nearby high current switching devices (arc welders, inductive motors) away from the machine.. Properly ground equipment. Install surge protection to insulate against lightning strikes.
	Machine stops and/or data is lost.	

Table 5-2. Troubleshooting: Power Fluctuation

If a machine malfunction occurs, then consider the following issues:

- Is another machine that uses high current connected to the AC distribution power supply line?
- Is the ground impedance of the AC distribution power supply line sufficient?
- Are there fluctuations in the input voltage to the machine?
- Is there a source of “noise” nearby (crane, welder, etc.)?
- If other CNC or NC machines are connected to the same group of circuits, do any of those machines demonstrate similar problems?
- Was another machine operating at the same time the problem occurred?
- Does the problem occur mainly at a certain time of day?



Power surges can occur when large loads are suddenly placed on, or removed from, an electrical system.

Coolant System

Refer to the tables below if a problem occurs with the coolant system.

Problem	Cause	Solutionsoluzione
Coolant flows slowly or stops.	<ul style="list-style-type: none"> • Clogging due to dirty coolant. • Pump is not working properly. 	<ul style="list-style-type: none"> • Flush lines, clean filters, drain and refill the system with fresh coolant. • Check and service the pump. For mist system, check shop air pressure.
No liquid (only air) comes from nozzle.	<ul style="list-style-type: none"> • Coolant tank is empty. Serbatoio liquido di raffreddamento è vuoto. • Manual valve is off. 	<ul style="list-style-type: none"> • Fill coolant tank with fresh coolant. • Close off valve, then slowly open again to get desired flow.
Coolant fails to start.	<ul style="list-style-type: none"> • Coolant valve is not turned On. • Coolant is not programmed to be On. • Coolant pump not working. 	<ul style="list-style-type: none"> • Turn on the valve (via the control). • Check the operating mode (auto or manual) or programming. • Check connector.
Coolant fails to stop when head is up to Z retract level.	<ul style="list-style-type: none"> • Incorrect program parameters. 	<ul style="list-style-type: none"> • Check parameters and correct the setting.

Table 5–3. Troubleshooting: Coolant System

Washdown Coolant System, Machining Centers

Refer to the table below if a problem occurs with the washdown coolant system.

Problem	Cause	Solution
Washdown coolant flows intermittently in machine enclosure.	Pulsating or Delay Washdown Enable is set to 1 and Alt Washdown Dwell is greater than 0.	Do not set Pulsating or Delay Washdown Enable to 1. Set Pulsating or Washdown Enable to 0 for continuous washdown flow on right and left sides of machine enclosure. <ul style="list-style-type: none"> Set Pulsating or Washdown Enable to 2 and use Washdown Delay On/Off Timers to cycle washdown pump and pause coolant flow.
Washdown coolant flow does not pause for time in Alt Washdown Off Time.	Pulsating or Delay Enable is set to 1 and Alt Washdown Off Time is greater than 0.	Do not set Pulsating or Delay Washdown Enable to 1. Set Pulsating or Washdown Enable to 2 and use Washdown Delay On/Off Timers to cycle washdown pump and pause coolant flow.
Washdown coolant flow does not alternate as programmed.	Pulsating or Delay Washdown Enable is set to 0.	Do not set Pulsating or Delay Washdown Enable to 0. Set Pulsating or Washdown Enable to 1 and define alternate washdown coolant flow using Alt Washdown Dwell, Alt Dwell Lt Side, and Alt Washdown Off Time.
Washdown coolant does not flow.	Washdown On Delay Timer is set to 0.	Set Washdown On Delay Timer to define the time, in seconds, for washdown coolant to pump to the machining center.
Washdown coolant pump won't turn off.	Washdown Off Delay Timer is set to 0.	Set Washdown Off Delay Timer to define the time, in seconds, for washdown coolant to stop pumping to the machining center.

Table 5–4. Troubleshooting: Washdown Coolant System

Motion and Spindle Rotation

Refer to the appropriate table below if a problem occurs with the spindle unit.

Belt-Driven Spindle	
Cause	Solution
Override pot is at 0.	Move spindle override pot above 0%.
Program might not have proper RPM setting.	Check the RPM setting in the program. If this setting is wrong, check and correct the entire program.
Spindle drive breaker is tripped.	Power down the machine, reset the breaker on the spindle amp, and turn on power.
Spindle will not rotate and error message displays.	Contact Hurco service representative for information.
Machining Centers Only	
Cause	Solution
For SK tool holders, tool is not released.	<ul style="list-style-type: none"> The tool cone/cone is not greased/clean.
For HSK tool holders, coolant in the tool holder.	<ul style="list-style-type: none"> The O-ring seal in the clamping taper of the collet chuck is damaged or broken. Replace the O-ring seal; check tool for burring and ensure correct fitting.

Motorized Spindle	
Cause	SolutionUrsache/Lösung
Motorized spindle does not start.	Motor phases may not be fully connected; verify that electrical connections are complete.
Motorized spindle overheats.	Chiller solution flow may not be sufficient; change the direction of the pump by swapping two of the three phase wires.
	Chiller solution temperature too high. <ul style="list-style-type: none"> Verify the safety system in the spindle chiller cabinet. Make sure spindle chiller thermostat is set at 30°C. Check coolant level of spindle chiller and add freon, if necessary.
	Bearings may overheat because lubricant level is too low. <ul style="list-style-type: none"> Make sure air and oil levels of spindle chiller are correct. Inspect chiller tubing and repair/replace damaged tubes.
	The machining center overloaded with work. Verify that the material removal efficiency (milling width x depth of cut x feed rate) for every kW of spindle power is lower than the following: <ul style="list-style-type: none"> aluminum: 60 cm³/min steel: 20 cm³/min
	Inspect bearings and replace any worn bearings.
Motorized spindle barely moves or stops.	<ul style="list-style-type: none"> Check to make sure the tool post is properly inserted into the taper. Check the condition of the flexible tubing and repair or replace damaged tubing.
Coolant leaks from the rotary transmission unit inside the motorized spindle.	<ul style="list-style-type: none"> Check the seal on the unit. If worn, replace the rotary transmission unit.
Oil level is half-filled on tilt mechanism gear box, but low oil error message appears when attempting to run a part program.	Reactivate the oil level switch check the oil level again. <ol style="list-style-type: none"> Rotate the B-axis +90 degrees five times, then -90 degrees five times. Remove the B-axis oil plug and add a small amount of oil. Refer to <i>Lubrication, on page 4 - 4</i> for oil type and amount. If error message continues, repeat steps 1 and 2.
Tool post on motorized spindle does not release tool from ATC.	Check the system pressure to make sure incoming tool change plunger pressure is lower than system pressure.

Table 5-5. Troubleshooting: Spindle Unit

Cause	Solution
Chip buildup causes a Motion Error.	Look under chip covers for excessive chip buildup. Clean and maintain to avoid reoccurrence.
The X, Y and Z axes ballscrews are not well lubricated.	Check the lube oil level, lubrication to the way ballscrews, and lube pump operation. Correct as needed.
Servo cable connections are not making good contact.	Check each connector (by hand, visual check is not enough). Clean, press together and wiggle. Replace the connection if it is intermittent during wiggling.
Check servo for amplifier error LED On error message.	Note the location of lighted LED(s) and message text. Contact your Hurco distributor for technical assistance.
Parts not made to correct size. Servo encoder not working properly.	Verify axis machine motion matches the motion displayed on screen. Jog the axes while watching position numbers on the screen.
Actual collision or binding occurs between machine parts and product fixtures.	Examine the path, parts, and fixtures for evidence of collision or rubbing.

Table 5–6. Troubleshooting: Power Off Motion Error

Refer to the table below if the machine chatters while machining or cutting.

Cause	Solution
Machine feeds too fast.	Preview the program settings for Feed and Speed – reprogram if they are wrong. Make sure that the actual speed matches the programmed speed.
Incorrect tool, tool is damaged, or tool is dull.	Make sure the right tool is being used for the application. Make sure the tool shaft is clean and not bent. Sharpen the tool or replace it.
Fixture is not rigid enough.	Inspect the fixture. Tighten or reinforce it if needed.
Work material is not held perfectly straight.	Inspect the spindle taper, chuck, or collet for foreign material. Clean if necessary. Inspect the tool holder to see that the tool is inserted straight. Reinsert the tool if needed. Check tool retention force on the draw bar.

Table 5–7. Troubleshooting: Machine Chatter

Refer to the table below if small errors in dimensions show up occasionally.

Cause	Solution
Temperature fluctuates as the part is machined.	Stabilize the temperature of the blank by providing enough coolant while machining.

Table 5–8. Troubleshooting: Errors in Dimensions

Environmental Conditions

Temperature and other environmental variables can cause problems that might otherwise be attributed to the machine.

When the electrical cabinet overheats, control power is disabled and a message appears on the screen until the cabinet temperature sensor registers a temperature drop to an acceptable level. If this error condition occurs, make certain the cabinet is not subject to an additional heat source, such as a space heater or bright sunlight from a nearby window.

Problems	Causes	Solutions
Relatively small dimensional problems occur in the product.	Metal blanks stored in temperatures much higher or lower than the temperature of the machining area can expand or contract during and after machining.	Before machining, move the blanks to the machine area and allow the blanks time to reach ambient temperature.
Dust, debris, rust or discoloration accumulates on work surfaces.	Extreme temperatures are typically the problem, and/or the environment is too humid or too dusty.	Improve the machine environment. For example, close the machining area to outside dust and install air conditioning to lower room temperature and humidity levels.

Table 5–9. Troubleshooting: Environmental Factors

ORDERING REPLACEMENT PARTS

Hurco maintains a large inventory of service parts. You may order parts from Hurco by telephone, fax, mail, or from your local Hurco Distributor. Contact information is provided during the installation. In addition, Hurco subsidiary contact information are found on the Hurco Web site: **www.hurco.com**.

Information Required for Parts Orders

For Hurco to process your order and supply you with the correct part(s), you must provide the detailed information described below:

- **Serial Number** index of the Hurco machine. The machine serial number is located on the identification/data plate, which is attached to the electrical cabinet door.
- Your company purchase order number.
- The part number, part name (description) and quantity desired. State where you found the part number. If you found it in a manual, include the manual part number, revision or date, and page the part was found on.
- Your company name and complete address.
- Name and telephone number of person ordering the parts.
- Indicate the condition of the machine (e.g., inoperable or functional).
- Provide the billing address to which invoices are to be mailed.
- Provide the shipping address, as well as any special shipping instructions, including mode of shipment, the department and person to ship to, and the delivery date requested.

Returning Parts

You must contact Hurco to receive a Return Materials Authorization (RMA) number before returning a part. The RMA number must be written on the outside of the container used to ship the returned part.

⇒ Hurco will not accept parts shipped without an RMA number clearly displayed on the outside of the shipping container.

All parts are subject to inspection before credit is issued.

All defective parts replaced under warranty agreement must be returned within 30 days.

RELEASE NOTES

Maintenance and Safety Manual for i-Series Machines

v453EN August 2016

Revised by: K. Gross, H. Arle

Approved by: D. Skrzypczak

Updates to Machine Maintenance chapter (enclosure windows per SI 3956, chip conveyor per SI 3871, spindle chiller per SI 4186), Machine Components chapter (operator control console per CQ 35769), and Operation Requirements chapter (machine and production setup per CQ 33501).

Maintenance and Safety Manual for i-Series Machines

v388EN March, 2015

Revised by: K. Gross

Approved by: D. Skrzypczak

Maintenance and safety information for all i-Series machines.
(Added turning centers to v382.)

Maintenance and Safety Manual for i-Series Machining Centers

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Revised by: K. Gross

Approved by: D. Skrzypczak

Maintenance and safety information for all i-Series machining centers

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