HURCO®

MAINTENANCE AND SAFETY MANUAL

for Lathes

Preliminary Manual

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USING THIS MANUAL

Printing

To print part or all of this manual from the CD, select **File / Print** to print this document. Be sure to review the **Print Range** selections and make the appropriate choice for pages. Select **Properties / Paper / Quality** and adjust the **Tray Selection / Paper Source** if necessary.

Understanding Hurco Icons

This manual may contain the following icons:

Caution/Warning

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

Hints and Tricks

Useful suggestions that show creative uses of the features.

Important

Ensures proper operation of the machine and control.

Troubleshooting

?

Steps that can be taken to solve potential problems.

Where can we go from here?

Lists several possible options the operator can take.

Table of Contents

To assist with onscreen viewing, this icon is located on the cover page. Click the icon to access the Table of Contents.

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MAINTENANCE CHECKLIST

Daily (Every 8-10 Hours)

Weekly (Every 40-50 Hours)

Monthly (Every 150-200 Hours)

Every 3 Months (Every 500 Hours)

Every 6 Months (Every 1000 Hours)

Annually (Every 2000 Hours)

Notes

MACHINE COMPONENTS

Overview

Hurco machining centers use microprocessor-based computer numerical control (CNC) digital control systems. Part programs are entered in either Conversational or Conventional NC (G-Code) format.

All machining centers described in this manual have a horizontalspindle with programmable spindle speeds, and a multi-tool Automatic Tool Changer (ATC) and 2 axes. Options are available to accommodate various machining applications. Check with your full service distributor or Hurco about available options.

Closed loop servo drive systems and motors with rotary encoders power the mechanical drives that position the axes. The rotary encoders and linear scales 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.

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

Refer to the *Parts Listings and Wiring Diagrams Manual* for mechanical and electrical component drawings for your machine.

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

Machine Model

The TM6, TM8, and TM10 machines are described in this manual.

Frame

The major structural assemblies (base, column, head, and table) of each Hurco machine are constructed of thick-walled, fine-grain cast iron. This construction provides strength and excellent dampening characteristics, keeping deflection and resistance at a minimum during machining.

The machine base (including leveling bolts) is the substructure for the column 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.”

Head

The cast iron head assembly is designed to produce superior cutting accuracy.

Guideways

The X and Z axes guideways are oversized, precision linear rails.

Switches and Sensors

Limit switches, proximity switches, and electrical sensors monitor machine functions. These devices report their state to the control. If a malfunction is detected, a stop condition will shut off power to the servo systems and spindle.

Enclosure

Full chip enclosures are standard in Hurco machining centers.

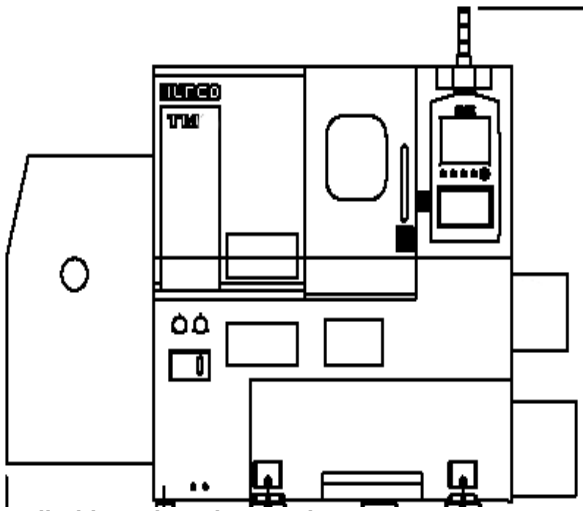


Figure 1–1. Full Chip and Coolant Enclosure—TM

Standard features include a flood coolant system with chip pan. An optional chip conveyor may be installed.

Spindle and Drive System

The spindle and drive subsystem consists of a spindle, motor with encoder, pulley arrangement and drive unit. Different size spindles, motors and pulleys gives each machine its unique cutting power specification.

TM6

Spindle Specifications	Units	
Max RPM		6000 rpm
Base Speed RPM		1090 rpm
Motor HP - Continuous	7.5 kW	10 hp
Motor HP - Peak (1 min. rating)	11 kW	15 hp
Spindle Torque - Continuous	65 Nm @ 1090	48 ft-lb @1090
Spindle Torque - Peak (1 min. rating)	98 Nm @ 1090	72 ft-lb. @ 1090 rpm

Table 1–1. TM6 Spindle Specifications

TM8

Spindle Specifications	Units	
Max RPM		4800 rpm
Base Speed RPM		870 rpm
Motor HP - Continuous	11 kW	15 hp
Motor HP - Peak (1 min. rating)	14 kW	19 hp
Spindle Torque - Continuous	123 Nm @ 870	91 ft-lb @ 870
Spindle Torque - Peak (1 min. rating)	154.6 Nm	114 ft-lb. @ 873 rpm

Table 1–2. TM8 Spindle Specifications

TM10

Spindle Specifications	Units	
Max RPM		3000 rpm
Base Speed RPM		TBD rpm
Motor HP - Continuous	TBD kW	TBD hp
Motor HP - Peak (1 min. rating)	19 kW	25 hp
Spindle Torque - Continuous	49.1 Nm	36.2 ft-lb
Spindle Torque - Peak (1 min. rating)	311.8 Nm	230 ft-lb. @ 572 rpm

Table 1–3. TM10 Spindle Specifications

Spindle

TM lathes have a cartridge type spindle. This spindle is precision balanced, and made of high-grade alloy steel. The spindle shaft (inside the cartridge) is supported by ABEC-7 class angular contact bearings.

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.

AC Spindle Drive Unit

The spindle drive unit contains closed-loop control and controls the spindle motor using an encoder. A microprocessor governs the closed-loop control, including monitoring.

The following messages are output at terminals via relay contacts:

- Ready/Fault
- Main Spindle Messages
- Heat Sink Temperature Monitoring
- Motor Over-temperature

Electronic Spindle Orientation

The standard spindle on VMX machines uses electronic spindle orientation. The spindle is stopped at a fixed position through signals sent from an electronic encoder assembly attached to the spindle motor shaft.

Proximity Sensor Spindle Orientation

VMX machines with the Coolant-thru Spindle (CTS) option use proximity sensor spindle orientation. This method of orientation uses a proximity switch mounted on the spindle and a screw on the collar of the spindle shaft, or a slot on the spindle shaft, as its target.

Spindle Motor

The spindle motor and spindle are coupled using a no-slippage gear belt. The motor is fully enclosed, uses forced-air cooling, and has no brushes to inspect or replace.

Machine	Spindle Drive/Belt Ratio
TM6	1.00 :1
TM8	1.00 :1
TM10	1.00 :1

Table 1–4. Spindle Drive Belt Ratio

To allow the machining of a variety of parts, the spindle RPM is specified in the part program. A manual spindle speed override on the control console permits fine-tuning of the spindle RPM for a specific machining cycle, without changing the part program.

Axes Motion System

AC servo drive systems power the X, Y and Z axes in Hurco machining Approximate positioning specifications appear below.

TM6

X Axis Specifications	Units	
Motor Torque—Continuous	5.4 N m	48 lb-in.
Motor Torque—Peak	10.8 N m	122 lb-in.
Axis Thrust—Continuous	2.9 kN	650 lbs.
Axis Thrust—Peak	1655 kN	7.4 lbs.
Rapid Feed Rate	19 m/min.	750 ipm

Z Axis Specifications	Units	
Motor Torque—Continuous	5.4 N m	48 lb-in.
Motor Torque—Peak	10.8 N m	122 lb-in.
Axis Thrust—Continuous	2.9 kN	650 lbs.
Axis Thrust—Peak	7.4 kN	1655 lbs.
Rapid Feed Rate	24 m/min.	945 ipm

Table 1–5. TM6 Axes Motion Specifications

TM8

X Axis Specifications	Units	
Motor Torque—Continuous	5.4 N m	48 lb-in.
Motor Torque—Peak	10.8 N m	122 lb-in.
Axis Thrust—Continuous	2.9 kN	650 lbs.
Axis Thrust—Peak	7.4 kN	1655 lbs.
Rapid Feed Rate	19 m/min.	750 ipm

Z Axis Specifications	Units	
Motor Torque—Continuous	5.4 N m	48 lb-in.
Motor Torque—Peak	10.8 N m	122 lb-in.
Axis Thrust—Continuous	2.9 kN	650 lbs.
Axis Thrust—Peak	7.4 kN	1655 lbs.
Rapid Feed Rate	24 m/min.	945 ipm

Table 1–6. TM8 Axes Motion Specifications

TM10

X Axis Specifications	Units	
Motor Torque—Continuous	TBD N m	TBD lb-in.
Motor Torque—Peak	TBD N m	TBD lb-in.
Axis Thrust—Continuous	TBD kN	TBD lbs.
Axis Thrust—Peak	TBD kN	TBD lbs.
Rapid Feed Rate	19 m/min.	750 ipm

Z Axis Specifications	Units	
Motor Torque—Continuous	TBD N m	TBD lb-in.
Motor Torque—Peak	TBD N m	TBD lb-in.
Axis Thrust—Continuous	TBD kN	TBD lbs.
Axis Thrust—Peak	TBD kN	TBD lbs.
Rapid Feed Rate	24 m/min.	945 ipm

Table 1–7. TM10 Axes Motion Specifications

Servo Motors

Ultimax controls axes velocity and travel direction using AC servomotors. These motors are enclosed, transistor-driven, and self-cooled. Because they are designed without brushes, the motors are free from flashover and commutation loss.

Ballscrews and Bearings

The precision ballscrews are the double ballnut type. 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 class bearings.

Feedback Systems

Each drive has circuitry to detect conditions in the servo’s closed-loop system.

Each axis motor is equipped with a rotary encoder that provides velocity and position feedback signals for each closed-loop system. These signals are required for motor control and accurate positioning.

Limit switches mounted on each axis are used to establish reference points for initial machine zeros and for determining end-of-travel.

Machine Electrical Cabinet

The machine's electrical control cabinet contains CNC-related electronics and power-related circuitry.

Safety Procedures for Electrical Service

Before removing or working on any printed circuit board (PCB), cables, fuses, breakers, or other machine 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 of 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.

Handling Printed Circuit Boards

The following procedures should be taken to prevent damage when removing printed circuit boards (PCB), or when checking the boards for proper and secure connections.

⇨ Avoid flexing PCBs. Rough handling can result in hairline cracks in the printed circuit etching. Problems caused by cracks in PC boards can be hard to isolate. Avoid touching the components on a PCB because they can be damaged by static electricity.

- Always put on a static safe handling wrist strap before touching PCB assemblies inside the cabinets, and before removing replacement boards from their static protective packaging.
- Visually inspect the wrist strap every time you put it on, making sure that the snap fasteners are properly connected.
- Be sure the strap fits snug to the wrist. Taking off the wrist strap should be the last thing you do when finished inside the cabinet.
- After the replacement PCB is properly mounted in the cabinet, place the defective PCB assembly into the static shielding and return to Hurco.

Electrical Cabinet Components

The electrical cabinet contains power circuitry and CNC electronics. The cabinet is attached to the machine column 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).

Electrical Cabinet Operating Temperature

The electronics inside of the electrical cabinet are designed to tolerate reasonably high ambient temperatures. Fans on some of the electronic assemblies and a heat exchanger on the cabinet door circulate warm air away from components.

The cabinet contains a temperature sensor, mounted on the CANbus control board in the ISA control board rack. This sensor is preset to a high temperature limit. If the temperature exceeds the limit, the machine will enter an emergency stop condition.

Hurco Machining Centers that are not equipped with the air conditioning option may be operated in ambient temperatures up to 95º F (35º C), and in relative humidity (non-condensing) up to 95%.

Electrical Cabinet Layout

Electrical cabinet layouts may vary from machine to machine. See the Parts Listings and Wiring Diagrams Manual for your machine model.

Power Supply

The DC switching power supply mounted on the ISA control card rack converts the 115 VAC input power to the regulated DC voltages distributed by the DC distribution board. The DC distribution board supplies regulated DC voltages to all printed circuit board assemblies in the card cage, Ultimax console and control relays.

CNC Electronics

The primary CNC-related PC boards that are located in the machine's electrical cabinet are described below.

Ultimax ISA Control Card Rack

The Ultimax ISA Control Card Rack contains the following microprocessor control printed circuit boards:

- Main CPU (Single Board CPU and Passive Backplane)
- Peripheral Interface
- Dual VGA Board
- Motion Controller
- CANbus Controller
- CANbus DC I/O Backplane
- I/O Interface

Main CPU Board

The main CPU board is a single board computer with a microprocessor CPU.

The CPU board uses a passive backplane that provides both ISA and PCI buses, and is jumper-configurable to permit system performance enhancements. Since the board's memory requirements are based upon the application requirements, memory is upgradeable.

Peripheral Interface

The Ultimax control supports standard AT compatible peripherals including:

- Hard disk
- Serial interface—COM1 and COM2
- Floppy disk

The interface for the hard disk is an integrated disk electronics (IDE) interface. It is considered integrated because the hard disk controller resides on the drive itself and the interface reside on the motherboard. The connector for this interface is typically a dual row, 40-pin header.

The main CPU board supports a standard, 34-pin, PC/AT style, floppy disk interface. The base level system has at least one 1.44 MB drive.

VGA Board

The VGA board enables the CPU board to display text and graphics on the monitor. The Dual VGA boards connect to the CPU board via the PCI bus.

Motion Control Board

The motion control subsystem uses a Digital Signal Processor (DSP) motion controlboard to control the servo amplifiers for the axes and the spindle pack.

A standard Matrix 4 board has the capability of controlling four servo axes or three servo axes and a spindle drive. The four identical servo channels on the board are updated and coordinated using two DSP integrated circuit microchips.

An optional Octavia DSP board may be installed on your machine. The Octavia DSP board has the capability of controlling eight servo axes.

CANbus Controller Board

The CANbus is a multi-master serial bus developed for the controller area network (CAN). This bus is the input/output (I/O) center of the Ultimax ISA platform.

The CANbus controller board and the DC I/O interface board handle the I/O control functions within the CNC controller. The external node used by the machining center is the console interface.

The CANbus controller board is an intelligent AT bus board for executing logic control programs, controlling CANbus I/O, controlling local 24-volt I/O, and monitoring the on-board A/D converter.

CANbus DC I/O Backplane

The CANbus DC I/O backplane distributes power and CANbus signals to the I/O interface board. The basic voltage levels are +5VDC, +/-12VDC, +24VDC. There are three isolated grounds: digital GND, machine GND, and analog GND. The backplane slot determines the node address of the board.

I/O Interface Board

The CANbus I/O interface board forms the interface between the motion subsystem and the CANbus controller I/O. The I/O signals on this board are buffered and then routed within the enclosure over a ribbon cable to the motion or CANbus subsystems. The board uses Honda connectors.

CANbus DC I/O Node

The CANbus DC I/O Node board mounts on the CANbus DC I/O backplane in the extension enclosure to the ISA card rack. This board communicates with the machine through 32 input and 32 output connections, and transfers information through the backplane to the CANbus controller.

The 24 volt solid state outputs are current limited to 150mA. Outputs are disabled at power up and when the E-Stop button is depressed.

Multiple boards may be used to provide additional I/O. The extension enclosure accepts two of these boards in addition to the I/O interface board; all are connected to the CANbus DC I/O backplane. Expansion for other boards is possible. The following table shows machine-specific I/O signals.

Description	Signal Type
ATC	I/O
Spindle Amp	I/O
Drawbar Air Pressure	O
Drawbar Switch Limits (clamp/unclamp)	I
Spindle Unclamp PB	I
Spindle Unclamp Control	O
X, Y, Z Amp Alarm	I
X, Y, Z Amp Reset Servo Enable Signals	O
Washdown	O
Spindle Bearing Coolant Buildup Purge	O

Table 1–8. CANbus DC I/O Node Board Inputs and Outputs

Communication Ports

All communication ports are located on the Comm Port/Hour Meter/Light Switch panel assembly on machine control cabinet. The following connectors are available:

Port	Connector Type	Use
PORTS 1 and 2	9-pin	RS-232 C Serial Communications
Indexer	8-pin military	Indexer
10-base T	RJ45	Network (Ethernet)
Coax In/Out	BNC	Network (Ethernet)

Table 1–9. Communication Ports

The communication ports are typically arranged as follows:

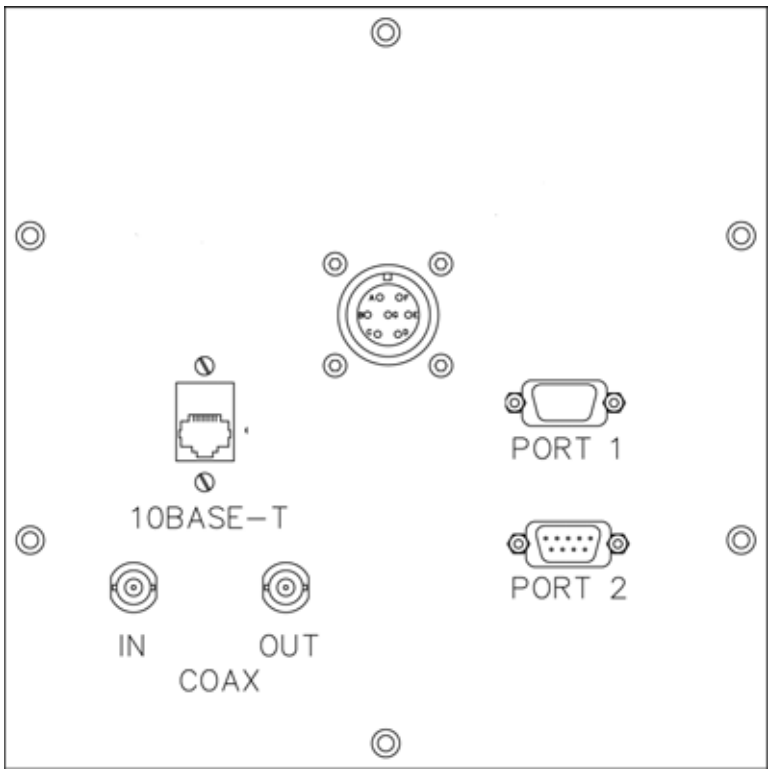


Figure 1–2. Communication Port Assembly

RS-232-C Serial Ports

The two RS-232-C serial ports (Port 1 and Port 2 in previous figure) can be used to connect peripherals to the machine. These ports may be addressed separately. The standard baud rates are software-selectable. Either port can be used as an output or input, depending upon the software.

The connector pin designated for each signal (RS-232-C) is shown below:

Figure 1–3. Male 9-Pin D-Type Connector

While the signals present at the serial ports conform to the RS-232-C standard, not all standard RS-232-C signals are available. Some peripheral devices may provide RS-232-C control signals that are not available at the ports described here. However, such devices can usually be adapted to these ports. In some cases, it may be necessary to add jumpers to the connector. Signals available at the serial ports are:

COM 1 / COM 2	Signal Name	Signal on this Pin
1	Data Carrier Detect (DCD)	Not used by the control.
2	Receive Data (RXD)	Data received (by machine) in serial format from peripheral device.
3	Transmit Data (TXD)	Data transmitted (by machine) to peripheral device in serial format.
4	Data Terminal Ready (DTR)	Not used by the control.
5	Signal Ground (SG)	Line establishing the common ground reference potential for all interface lines
6	Data Set Ready (DSR)	Signal to notify printer that transmitter is ready for transmission.
7	Request to Send (RTS)	Line used by control to instruct peripheral device to get ready to receive data. Data can be transmitted after the Clear-To-Send signal is received from connected peripheral device.
8	Clear to Send (CTS)	Control line used by peripheral device to indicate that it is ready to receive data from machine.
9	Ring Indicator (RI)	Signal indicates modem has received the ring of an incoming call.

Table 1–10. RS-232-C Signals Available at Serial Ports

To connect a peripheral to the machine, fabricate an adapter cable. If a properly shielded low capacitance cable is used, cable lengths of up to 100 feet are permissible.

Be certain that you use the correct cabling before connecting the device to the machine. Consult the peripheral manual to determine whether the peripheral is a Data Terminal Equipment (DTE) or Data Communication Equipment (DCE) device. The Hurco machine is a DTE device, and in most cases, so is a personal computer. A printer may be either a DTE or DCE device.

Indexer Port

Indexing signals are always present at the Indexer port, so there is no need to turn it on. It is the customer's responsibility to provide a harness from the Indexer to the Indexer port. Before making this harness, see the machine's *Parts Listings and Wiring Diagrams Manual* for the correct pin-outs.

Network Ports

The 10baseT (RJ45) and the two BNC connectors are used with the Ultinet option. This option requires an ethernet card, cabling from the ethernet card to the communications panel, V2.10 software or greater and an optikey diskette to enable the option.

Operator Control Console

Hurco Lathes come with a Lathe Max Control console. Contact your full service distributor or Hurco for more information about features.

For operating and programming information, refer to the *Getting Started Manual, Conversational Part Programming Manual* and the *NC Part Programming Manual* shipped with the machining center.

A Max for Lathe console is pictured below:

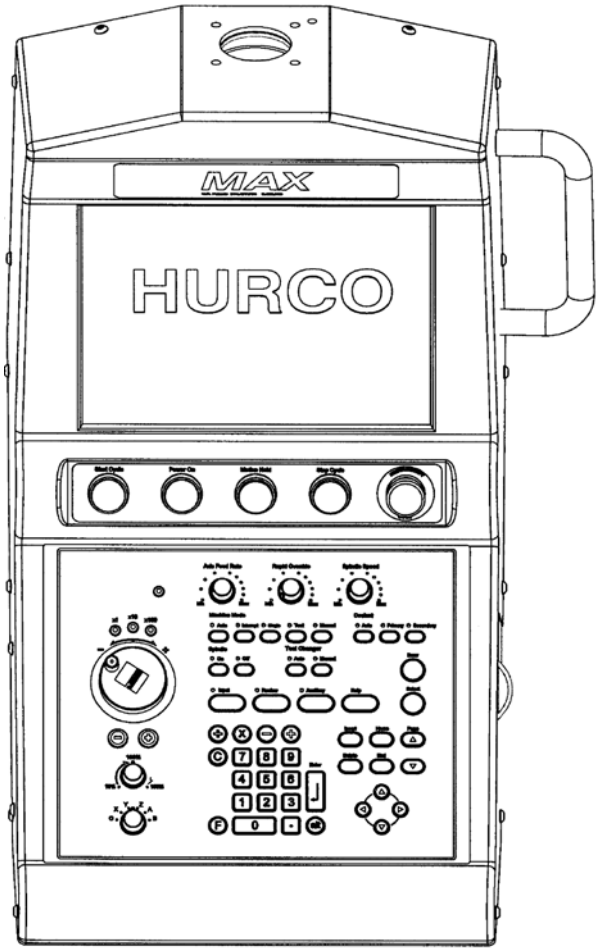


Figure 1–4. Max for Lathe Control Console

Flat Panel Node PCB

The CANbus Flat Panel Node PCB is an intelligent slave that processes the operator interface I/O functions related to the console. This printed circuit board is located in the Ultimax control console and has the following features:

- An 8 x 8 keyboard matrix for scanning, decoding and debouncing of keys
- Outputs to control 16 discrete LEDs and three 24-volt status lamps
- Emergency stop hardware contacts and software input
- Green “Run” LED and red system fail “Sysfail” LED

For operating and programming information, refer to the *Lathe Max Control Getting Started, Conversational Part Programming and NC Part Programming* manuals shipped with the machine.

Coolant System

A flood coolant system is standard on each machining center. A washdown hose and nozzle to clean chips from inside the enclosure are also included.

TM6, TM8, TM10

Tank Capacity	Flood Pump Rating	Flood Pump Size
62 L	60 L/Min.	0.19 kW
16.3 Gal.	15.8 Gal./min.	0.25 hp

Table 1–11. TM6, TM8, TM10 Coolant Capacity and Pump Rating

The flood coolant system cleans swarf from the cut and protects the part and tool. The system is self-contained. The operator can control the coolant system using console pushbuttons.

Pneumatic System

The pneumatic system regulates the air valves that supply compressed air to machine systems, such as spindle blow out. Compressed air is used in the tool release and in ATC motion.

⇨ A factory-set air pressure detecting switch monitors the air supply to the solenoid control valves. Do not tamper with this switch.

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 air stream.

Incoming air pressure can be adjusted using the knob on top of the filter assembly. For information about maintaining the FRL Unit, refer to *Lubrication, 3 - 3* in the Machine Maintenance chapter of this manual.

Turret

The Lathe uses hydraulics, pneumatics and switches to exchange OD (outer diameter) and ID (inner diameter) tools between the slotted disc turret and the spindle. The table below lists tooling specifications:

TM6

Specifications	Units	
Tool Stations		12
Adjacent Turret Rotation		.5 sec.
Farthest Turret Rotation		1.5 sec.
Turret Positioning Accuracy		+/- 0.0002 in.
Turret Repeatability Accuracy		+/- 0.0002 in.
Tool Shank Diameter	19.05 mm	.75 in.
Boring Bar Diameter	31.75 mm	1.25 in.

Table 1–12. TM6 Tooling Specifications

TM8

Specifications	Units	
Tool Stations		10
Adjacent Turret Rotation		.5 sec.
Farthest Turret Rotation		1.5 sec.
Turret Positioning Accuracy		+/- 0.0002 in.
Turret Repeatability Accuracy		+/- 0.0002 in.
Tool Shank Diameter	25.4 mm	1.0 in.
Boring Bar Diameter	38.1 mm	1.5 in.

Table 1–13. TM8 Tooling Specifications

TM10

Specifications	Units	
Tool Stations		10
Adjacent Turret Rotation		.5 sec.
Farthest Turret Rotation		1.5 sec.
Turret Positioning Accuracy		+/- 0.0002 in.
Turret Repeatability Accuracy		+/- 0.0002 in.
Tool Shank Diameter	25.4 mm	1.0 in.
Boring Bar Diameter	38.1 - 50.8 mm	1.5 - 2.0 in.

Table 1–14. TM10 Tooling Specifications

The basic sequence of operation, assuming that the magazine is positioned to the next tool required, is as follows:

1. Start the tool change process with the turret at Home position and the spindle oriented.
2. The turret rotates from the Up position to the Down position.
3. The tool indexer rotates CCW direction
4. The spindle clamps the tool in the spindle.
5. The tool indexer rotates back to the 0 degree position.
6. The turret rotates back to the Up position.

Keep tool clearances in mind during tool setup to avoid tools coming in contact with the chuck or the rear of the tool indexer.

MACHINE STANDARDS

European Community Machine Safety Standards

The information in this section complies with documentation requirements of the European Community's machine safety standards.

Directives

These directives apply to all machining centers sold in Europe:

- European Machinery Directive 98/37/EC
- Electromagnetic Compatibility Directive 89/336/EEC (amended by 91/263/EEC and 92/31/EEC)
- European Low Voltage Directive 73/23/EEC (amended by 93/68/EEC)

Harmonized Standards

These standards apply to all machining centers sold in Europe:

Safety

- EN 292-1
- EN 292-2
- EN 294
- EN 349
- EN 418
- EN 953
- EN 954-1
- EN 60204-1

EMC (Electromagnetic Compatibility)

- EN 50081-2
- EN 50082-2

Other Standards

- BS 5378 Parts 1 and 3

Safe Installation of Guarding System and Machine

Inspect the machining center to ensure that all parts are included and intact.

The owner is responsible for proper site preparation before the machine is installed. A 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 owner decides later to move the machining center from its installed location, it is recommended that the owner call Hurco for assistance.

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

Guarding System

Each machining center has a self-contained guarding system. Inspect the machine to ensure the guarding system is intact.

- The chip doors on the front of the machine lock during Automatic Run Mode to prevent access to the moving parts of the machine.
- The guards on each side of the machine are either movable or fixed. The movable guards can be opened to access the inside of the machine. A special key is required to open a fixed guard.

Machine

Check these items before the machine is installed:

Foundation Conditions

The foundation must be able to support the weight of the machining center, and should be constructed of continuous concrete (reinforced concrete is best). The thickness and consistency of the concrete must be compatible with industry standards for supporting the machine's weight. Actual requirements will depend upon the physical properties of underlying soil. Friction pads or machine anchors may be required to assure optimal machine performance.

Electrical Service Requirements

Follow all requirements below to help ensure personnel safety and to prevent equipment damage.

⚠ Always disconnect machine power before working with electrical connections.

Connecting Electrical Service

Observe the following guidelines when connecting electrical service:

- On-site wiring must comply with all established directives and standards.
- Dedicated, grounded 3-phase AC power is required to prevent high and/or low voltages, spikes, surges, and high frequency noise caused by inductive loads.
- The AC power source must match the voltage specifications listed on the machine's data plate.
- Wiring to the machine must be capable of supplying continuous specified amperage.
- Failure to provide the required power parameters may affect machine safety, performance and warranty.
- A Hurco Certified Service Engineer must supervise final electrical connections to the machining center.

Recommended Isolation Transformer Configuration

If a transformer other than the one provided with the machine is used, it must meet Hurco's machine operating voltage requirements. Use one of the configurations shown in the figure below. Hurco recommends the Wye system.

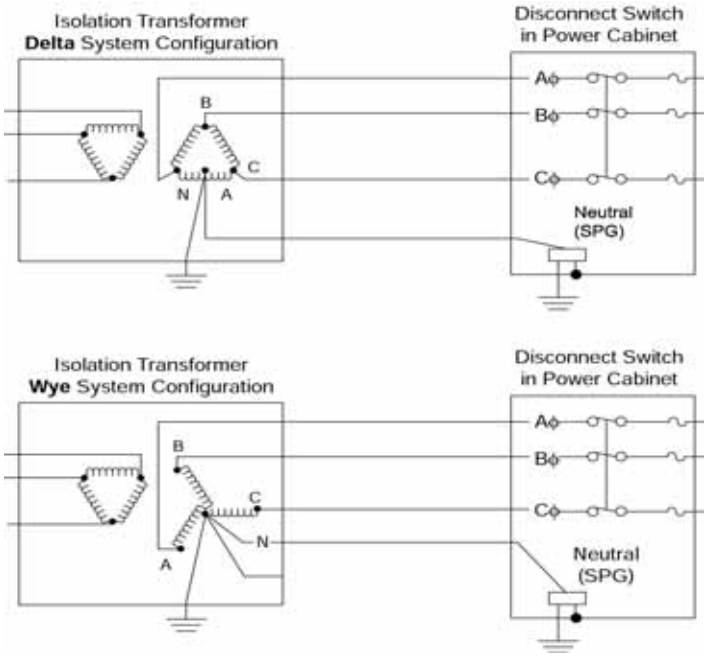


Figure 2–1. Delta and Wye Transformer Configurations

Grounding Equipment

The machine's electrical and electronic control systems are interconnected, terminating at the Protective Earth (PE) or ground point.

- The ground point must be properly connected to the ground circuit of the AC power source. The ground point is located inside the machine's power cabinet.
- The ground point provides only one conducting path between the machine and external ground, preventing an unwanted ground loop (ground differential voltage).

Compressed Air Requirements

A continuous supply of clean and dry air is essential for proper machine operation, and must be connected to the machine as described here.

Compressed Air Specification

Compressed air must conform to the specification: 5 CFM at 80-100 psi or 0.14 m^3/min at 5.5 to 7.0 bar.

Connecting Compressed Air

The air supply line must meet these requirements:

- An NPT pipefitting must connect the air supply line to the machine.
- A regulator valve must be installed to control the air pressure into the machine.
- A factory-set pressure switch must be installed to shut off control voltages if the air pressure falls below the pre-set level.
- A minimum 1.27 cm diameter (1/2 inch, trade size) pipe, or an equivalent 1.99 cm (7/8 inch) diameter air hose supply line is required to provide adequate air volume.
- A drip leg should be installed in the line ahead of the filter/regulator assembly. The drip leg will help remove moisture accumulation in the supply, making the filter last longer.
- Quick coupler type fittings should not be used at the connection to the air filter/regulator, or within the supply line to the machine.

Anti-Vibration Mountings

Anti-vibration mountings, consisting of a spring-mounted ball bearing, are attached to each machine. Loose springs and balls are signs of excessive vibration.

Check the mountings before uncrating the machine to ensure that the machine has been handled properly prior to its arrival. Continue to inspect the mountings on a regular basis.

Initial Test and Examination

Follow the instructions below for performing the initial test and examinationof the machine and its guarding system.

Contact your Hurco Distributor to arrange for a Hurco Service Engineer to perform the final machine setup. Complete these procedures prior to the Service Engineer's arrival:

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.

The Hurco Service Engineer performs these tasks:

1. Inspects the machine level and makes required adjustments.
2. Checks and connects electrical service to the machine.
3. Installs the control console.
4. Measures voltages in the electrical cabinet and control enclosure and makes adjustments, if needed.
5. Installs the flood coolant tank, tubing, and coolant pump motor.

   Hurco is not responsible for failures of the motor encoder and cable assemblies resulting from abuse and direct spray of coolant.

6. Installs covers and enclosures.
7. Checks fans and pumps for proper operation.
8. Checks all axes for calibration and correct limit switch operation.
9. Tests the disk drive.

Safety Circuits

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 machining center with those modifications, such operation is extremely hazardous and is a *foreseeable misuse* of the machine, and voids the Hurco warranty. If such modifications are discovered, the machining center must be immediately shut off and not used. A Hurco service representative must be contacted for assistance in restoring the machine to safe operation.

Guidelines

The machining center safety circuit is designed to provide safe and reliable operation of Hurco products. The basic rules governing operation are as follows:

- The spindle cannot operate unless all enclosure doors are closed, not including doors that are fastened shut with bolts or screws.
- Enclosure doors must be closed and locked, or during automatic execution, warm-up cycle, calibration cycle, automatic tool changes, probing, or when running the spindle (excepting orient).
- In the event that the enclosure door is opened during automatic operation, or any time the doors are locked, an immediate command to stop all motion will be executed and control power will be removed.
- Redundancy is included in electrical design to detect single point failures.
- When the Emergency Stop button is pressed, power is cut off to the spindle, after allowing for deceleration (approximately 7 to 10 seconds).
- ATC electrical circuits will be isolated from source power when any door is open.

Tamper-resistant fasteners are used to hold combination door lock/switches in place and to prevent access to internal wiring.

CE Safety Circuits Commissioning Checklist

Periodically check the safety circuits, especially after changing component parts. Checklists are provided below for Manual Setup, Automatic Preparation, and Automatic Production Modes:

Mode: Manual Setup

- Door(s) Status— Open
- Access code — Enabled (Limited operation)
  A four-digit code is required for enabling limited safe operation such as jogging axes with the chip doors open. The code is entered in the CE Status & Diagnostics screen.

	Safety Requirement	Verification	Pass	Fail
1	Control shall not allow “Spindle On” to be selected.	<Error message> displayed when Spindle On key depressed.		
2	Calibration cycle shall not be initiated.	<Error message> displayed when softkey is touched.		
3	Control shall not allow tool change to be initiated.	<Error message> displayed when tool change cycle initiated.		
4	Axes may be jogged at maximum feedrates of 2 M/min.	Initiate jog cycle at maximum allowable feedrate.		
5	Chip auger shall not run.	<Error message> displayed when auger softkey touched.		
6	Part program execution shall not be initiated.	<Error message> displayed when automatic mode enabled.		

Table 2–1. CE Safety Circuits—Manual Mode Setup

Mode: Automatic Preparation

- Door(s) Status— Closed
- Mode— Manual

	Safety Requirement	Verification	Pass	Fail
1	The axes may be jogged at maximum allowable feedrate without restriction.	<Error message> displayed when doors opened with jog key depressed; all motion ceases upon opening.		
2	All tool change cycles shall be permitted.	Verify all doors lock when tool change key selected. • Front enclosure • Side enclosure • ATC loading (CAT50)		
3	Chip auger functions shall be permitted when function is selected.	Verify all doors lock when softkey function is touched. • Front enclosure • Side enclosure • ATC loading (CAT50)		

Table 2–1. CE Safety Circuits—Automatic Mode Preparation Setup

Mode: Automatic Production

- Door(s) Status— Closed.

	Safety Requirement	Verification	Pass	Fail
1	Doors shall remain locked throughout part program execution.	Verify all doors lock in auto mode when Start Cycle pushbutton is engaged. • Front enclosure • Side enclosure • ATC loading		
2	Doors shall unlock in auto mode only after all motion ceases.	Verify doors unlock after axis and spindle stop with program abort engaged (Stop Cycle pushbutton or Interrupt Key)		
3	Doors shall remain locked during an Emergency Stop condition.	Verify all doors remain locked when Emergency Stop is engaged during part program execution. • Front enclosure • Side enclosure • ATC loading		
4	Doors shall unlock only after the fault condition has been reset.	Verify all doors unlock only after control power is restored (reset and Control On).		

Table 2–1. CE Safety Circuits—Automatic Mode Production Setup

Safe Operation

This section addresses the safe operation of the machining center. 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 machining center 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 machining center 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 machining center.

Setup

Follow these precautions during machine and production setup:

- Perform all setup work with the Emergency Stop engaged. Never put your hands near a part being machined.
- Clamp the work piece and fixtures securely before starting the machine. Loose objects such as wrenches and chuck keys can become flying projectiles if not removed before starting the machine.
- 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 work piece. 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.

Operation and Maintenance

- Know where the Emergency Stoppushbuttons are located.
- Do not leave the machine unattended, but stand away while it is running. Never lean on the machine.
- Be aware of all pinch points caused by the motion of the table, head and automatic tool changer. 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's electrical system can cause serious injury or even 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.

Safe Working Practices

Follow the correct service and repair procedures to ensure safe operation of the machining center, and to reduce the likelihood of serious operator injury.

Observe these basic safety 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 center work area. Safety glasses with side shields are recommended. Safety shoes should be in good condition, with steel toes and oil-resistant soles.
- Remove clothing and jewelry that could get caught in the machine's moving parts. Do not wear loose-fitting clothing. Roll long shirt sleeves above the elbow.
- 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, make certain the cutter is 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 frequently.

Control Systems

Circuit diagrams for electrical, hydraulic, and pneumatic systems are available in the machining center's *Parts Listings and Wiring Diagram Manual*.

Noise Levels

The following noise level readings were taken in the vicinity of the Ultimax CNC, 1.6 meters from the floor, 1 meter from the machine's enclosure. The maximum ambient noise level reading taken for each machine at the time was 60 dB.

Measurements were made with background noise present using a dB meter set on A-rated scale. The sensor head was placed vertical to the floor.

Readings Measured From CNC

Machine	dB Reading
TM6	max 82 dB
TM8	max 82 dB
TM10	max 82 dB

Table 2–2. Noise Levels

⇨ The noise emission levels in the previous table 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.

Persons Trapped in Machine

If all safety circuits are intact, it is not possible to run a machining center while in direct contact with any axis, the tool changer, chip conveyor, or chip auger.

To release a person trapped in the machine, press the Emergency Stop button

- With machine power off, the relief valves will depressurize, allowing manual movement of machine components (e.g., ATC arm).
- With machine power on, counter motions can be activated using the Ultimax control. In addition, power-piloted valves can be activated by pressing corresponding pushbuttons.

Pressing the Emergency Stop button will lock enclosure doors.

Enclosure doors should not be closed while performing maintenance inside the machine enclosure.

Personnel should not perform maintenance inside the machine enclosure without someone else present.

To release locked enclosure doors, you must power On the machine:

1. Press the Machine Mode Manual console key.
2. Turn the machine power On.
3. The enclosure doors automatically unlock.

MACHINE MAINTENANCE

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

Daily Operational Checks

The operator should perform the following each day:

- Check that all shields, covers and doors operate properly.
- Jog each axis through its full travel, watching for smooth operation.
- Ensure that all axis limit switches are functioning correctly and are adjusted to their proper travel limits.
- Inspect the guideways for scratches or excessive wear.
- 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.
- Run the spindle at various speeds, including the minimum and maximum RPM, while observing for proper start, stop and spindle operation.
- 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 activate the intended functions.
- Clean chips from way covers, enclosure, turret, and chip conveyor.
- Wipe spindle taper with a lint-free cloth dipped in clean, light oil.

Cleaning the Machine

Follow these recommendations when cleaning the machining center:

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

Floppy Disk Drive and Diskettes

Follow the recommendations below for diskettes and the disk drive:

- Keep dirt, dust, coolant and oils away from the floppy drive.
- Keep the drive door closed when not inserting or removing a diskette.
- Keep diskettes away from heat, extreme cold and electromagnetic fields. Do not touch the diskette surface. Store diskettes in closed containers to protect them from dust and dirt.

Heat Exchanger

The heat exchanger removes heat from the control cabinet. Filters inside the heat exchanger become dirty with dust, and must be cleaned weekly.

Exterior Wiring

Inspect conduit, connectors, cabling and wiring external to the machine every month for evidence of fraying, cracking and looseness.

Lubrication

Periodically check and maintain all lubricant levels to keep the machine in good operating condition. Lubrication points and recommended lubricants appear in the table below. This list is not exhaustive. Lubricants that meet the same specifications as those listed below may be substituted. Local suppliers should be able to cross reference recommended lubricants.

TM

Lube Point	Fill Level or Condition	Lubricant Type[a]	Lubricant Manufacturer
Turret Oil		I.S.O. VG 32	
FRL Oil	Between low and high marks on the lubricator unit.	I.S.O. VG 32	Same Manufacturers as ATC Cam Oil
Tool Release Cylinder Oil	Maintain at 1/3 full, not to exceed 1/2 full.	I.S.O. VG 32	Same Manufacturers as ATC Cam Oil
Way Lube Oil	Between high and low marks on reservoir. Refer to *Autolube System, 3 - 4* for more details.	I.S.O. VG 68	Febis K68 (Esso), Vactra No. 2 (Mobil), Tonna Oil T68 (Shell)
Way Lube Volume	2 liter		
Way Lube Pump, voltage		115 VAC, 1 ph	
Way Lube Pump, cycle	3cc/cycle 4 cycles/hour		

a Viscosity ranges are based on ambient temperatures.

Table 3–1. Lubrication for Lathes

Autolube System

The Autolube system automatically lubricates the slideways, guideways, and ballscrews. The pump cycles once every 15 minutes to send lube oil through the system when servos are On. The preset discharge rate is 3.0 cubic centimeters (cc) per pump cycle, and is adjustable.

Refer to *Figure 3–1. Autolube Pump and Tank Assembly , 3 - 6* for a diagram of the autolube system.

If the machine will be idle for 30 days or more, add a rust preventative to the system lubrication. Initiate a manual lube cycle and move all axes for full travel several times to allow delivery throughout the 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 can be set to automatically shut off power to a machine that has been idle for a specified time.

The oil filter strainer prevents contamination from entering the system. The strainer must be checked periodically, and replaced if it becomes plugged.

Check Filler Screen and Fluid Level

Maintain the fluid level and check the filler screen:

1. Lift the oil filler cap and check that the screen is clean. Clean and dry the screen before reinstalling it.
2. If needed, add oil to the tank. The level should be between the high and low marks (about 1/2 inch or 1.27 cm from top cover of tank). Replace the fill cap.

Activate System Manually

If the machine has been idle for a long time before powering up, or if the oil has just been replaced, follow these steps to manually activate the Autolube system:

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

Adjust Autolube Discharge Rate

An indicator rod is located in the Autolube system's discharge chamber. The scale graduations on the flat surface of the rod indicate the discharge rate in cubic centimeters (cc) per pump cycle. To adjust the discharge rate of the Autolube system, follow these steps:

1. Loosen (but do not remove) the setscrew 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 setscrew with the flat surface on the rod. Tighten the setscrew to secure the rod position.

Replace Oil and Suction Filter

To drain the reservoir and replace the oil and suction filter, follow these steps:

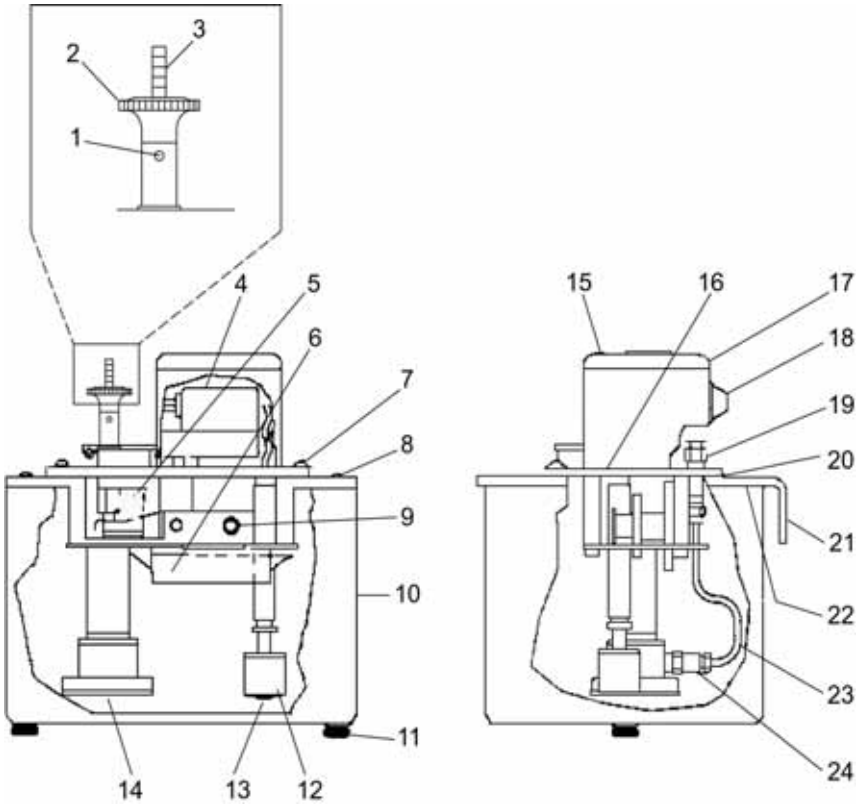
1. Shut off power to the machine.
2. Loosen and remove the two thumbscrews that secure the reservoir to its mounting bracket.
3. Lower the reservoir downward from the threaded spacers.
4. Remove the suction filter group by first carefully prying out the retaining ring.
5. Remove the filter discs and screws. Note their order of assembly.
6. Insert the new coarse screen (filter disc support), fine screen (screen disc, filter disc), filter clamp ring and retaining ring.
7. Clean any contaminates from inside of the tank. Dry the inside with a clean, lint-free cloth.
8. Check that the strainer in the filler opening is clean and not damaged.
9. Make certain that the gasket is installed and is 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. Check that the screen is installed in the filler opening.
13. Fill the reservoir with the recommended oil.
14. Manually activate the system.

Here is a diagram of an Autolube system:



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	Strainer, oil filter	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 3–1. Autolube Pump and Tank Assembly

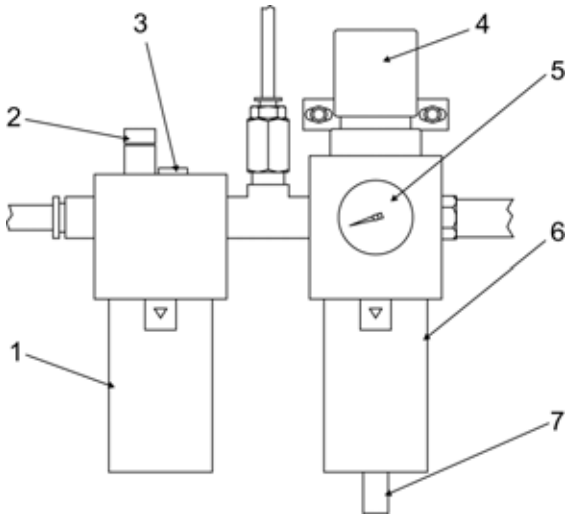
Turret

Refer to the Lubrication, *3 - 3* table for information about turret lubrication.

Pneumatic System FRL Unit

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., drip rate) is adjustable.

⇨ The air supply requirement for the machine is a continuous 5 CFM of clean, dry compressed air at 80-100 psi (0.14 M3/min at 5.5 to 7.0 bar).



1	Lubricator unit	5	Air pressure gauge
2	Fill/Oil drip viewer	6	Filter unit
3	Drip rate adjust	7	Auto moisture drain
4	Air pressure adjust		

Figure 3–2. Filter, Regulator, and Lubricator

Set 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.

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

Adjust Drip Rate Screw

The oil drip rate was factory-set and should not require 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 second tool change.

Check and Replace Air Filter Element

Check the air filter element regularly, and replace it when necessary. If the filter becomes clogged, the air pressure may still measure as acceptable, but air flow to the pneumatic system will be restricted.

When you remove the bowl to access the filter element, clean the bowl using a soft, lint-free cloth dabbed with the recommended FRL Unit lubricant. Do not use any type of cleaning fluid.

Before connecting the air supply, install the metal bowl guard.

Check Auto Moisture Drain

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

1. Shut off the compressed air supply to the machine.
2. Using a crescent wrench, turn the auto drain nut at the filter unit bottom counter-clockwise one turn.
3. Press upward on the nut to release any foreign material that may be lodged, and to reseat the drain valve.
4. Tighten the nut clockwise.

Spindle Oil Chiller

The optional spindle oil chiller is used to maintain the temperature of oil that circulates around the spindle cartridge. Cooling spindle oil reduces thermal growth, which improves machining accuracy. If the oil level in the tank is not maintained at or above the low mark, the system's pump could be damaged and spindle cooling would be impaired.

Service the spindle oil chiller according to the schedule in the Maintenance Checklist at the beginning of the manual.

Maintain Oil Level in Spindle Oil Chiller Tank

Follow these steps to maintain the oil level in the spindle oil chiller tank.

1. Check the oil level. Units typically have a sight gauge.
2. If the level is low, shut off the oil chiller.
3. Add the recommended oil to the tank. Leave space at the top to allow for hot oil expansion. Do not overfill.

Inspect the Air Filter Screen

To inspect the air filter screen, follow these steps:

1. Shut off the spindle oil chiller.
2. Clean the air filter screen if it is dirty.

Maintain Oil in Chiller Tank

Drain, flush, and refill the chiller tank yearly, and any time the oil shows signs of contamination or overheating.

Follow these steps to drain, flush, and refill the spindle oil chiller tank:

1. Shut off the spindle oil chiller.
2. Drain and flush the tank. Use a non-volatile flushing agent suitable for use in a mineral-type hydraulic system. This agent must be compatible with the oil.
3. Add the recommended oil to the tank. Leave space at the top for hot oil expansion. Be careful not to overfill.

Coolant System and Chip Conveyor

The flood coolant system pumps coolant to the tool in the 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 from inside the enclosure.

Used coolant is cleaned of chips and oil and recirculated into the coolant tank. Filters remove contaminants from the coolant.

Selecting Coolant

Coolant should have these qualities:

- Suitable for the work piece material and machining operation.
- Soluble in water.
- Mineral content of at least 35%. When synthetic coolants and coolants that contain too little mineral oil contact guideway lube oil, they can gum the guideways.
- Adequate rust protection.
- Anti-foam, anti-bacteria, and anti-fungi agents.
- No skin irritation when prepared to the manufacturer's specifications.
- Penetrating lubrication oil should float on the surface of the coolant (instead of dissolving in the coolant).
- Use the recommended coolant to prevent damage to the machine's oil, guideways, precision ballscrews, and painted surfaces. Use a non- or semi-synthetic water soluble coolant.
- 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.

Preparing Coolant

Follow these guidelines when preparing coolant:

- Mix the coolant according to the 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, and anti-foam corrosion agents, only if recommended by the manufacturer.
- Do not allow foreign matter to mix with the coolant. Contaminated coolant can damage machine parts.

Maintaining the Coolant

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. Find the level indicator on the coolant tank and maintain the level as follows:

1. 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

To replace coolant, follow these steps:

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 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. Dispose of used coolant and cleaning solution in compliance with applicable pollution control regulations.

Coolant Filter for CTS

The coolant through 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.

The CTS coolant filter should be checked every week and cleaned when necessary. To access the CTS coolant filter:

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

Chip Conveyor Tank

The optional chip conveyor runs horizontal to the machine base, near the floor. Chips that are not flushed out of the machining center collect in the chip conveyor tank. Hurco recommends cleaning the chip conveyor tank at the same time that you replace coolant. To clean the tank:

1. Attach a hose to the plug in the front of the chip conveyor tank to drain contaminated coolant.
2. Pull the tank forward and remove any remaining chips from the tank with a soft brush
3. Remove the two chip screens from the coolant tank (located on the ATC side of the machine). Rinse the screens and dry before replacing them.

Limit Switches and Dogs

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

1. Position the axes at their furthest negative location.
2. Open the enclosure maintenance door.
3. Check the tightness of limit switch and dog fasteners.

Machine Electrical Ground

The machining center's ground is located inside the control cabinet, near the disconnect switch. A licensed electrician should measure the ground impedance (resistance to true earth) every three months.

Machine Level

Inspect the machine's level every six months by placing a precision level (resolution 0.0005 in/ft.) parallel and perpendicular to the worktable surface.

Spindle Taper

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

Wipe the spindle taper clean each day 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.

Troubleshooting

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

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.

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 may be live even though the machine tool is not receiving power.

No Response on the Console

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

- Power supply cord inside the electrical cabinet is properly connected to the power source.
- Power switch inside the electrical cabinet is in the On position.
- No floppy disk is in the floppy drive.

Initialization Error Messages

After power has been switched on, initialization messages appear on the text screen. Errors indicated by the following error messages below can be easily remedied.

"Non-system disk detected. Press any key."	There is a diskette in the floppy drive. Remove the diskette and turn the power off and then back on.
"Security device is invalid or has failed."	The software security device has been removed, is broken, or is not properly connected. Switch off the control and remove the security device. If the device is damaged, replace it. Reconnect the device and switch on power.

Other possible messages during initialization usually indicate missing or corrupted files. The usual solution for such problems is to restore or delete files. For help solving these problems, contact Hurco's service department or the distributor's service department.

⇨ 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.

Error Messages on Input Screen

Occasionally, the system will go through all of the initialization steps, display the Input screen, and then refuse to respond when console keys are pressed.

If this occurs, take careful note of any error messages on the Input screen. If there are no error messages, the cable to the front panel may be loose or defective. Check the custom cable inside a conduit. If a custom cable needs to be replaced, call technical services to perform the operation.

Corrective Measures

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

Swap Out a Printed Circuit Board

Sometimes, the printed circuit (PC) board is bad or has an intermittent problem, or the connector on the board is not making sufficient contact. In this situation, the PC board is suspect. If possible, swap out the suspect PC board with a replacement.

If swapping out a board corrects the error, install the original PC board to see whether the error returns. If not, the connector probably was not seated properly or the contacts need cleaning.

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.
- Unplug and reseat circuit boards; sometimes connectors become tarnished and do not conduct well. If the contact points on a PCB are dull looking, polish them with a rubber eraser.

Perform a Reset

Technical assistance personnel may ask you to reset a circuit board or the machine.

- To reset a PC board, press the board's reset button.
- To reset the machine, switch the main power off and then back on.

Emergency Stop Condition

Pressing the Emergency Stop button removes all servo power and power to the way lubrication pumps, and resets the current program to the beginning. A message on the screen indicates the Emergency Stop condition. To remove the Emergency Stop condition, execute these steps:

1. If the Emergency Stop button is depressed, twist and lift it.
2. Press these console buttons in this order:
   a. Manual
   b. Power On
   c. Start Cycle

Machine Diagnostics

The control detects the status of various machine components, and presents this information on the Machine Diagnostics screen.

To reach the Machine Diagnostics screen, follow these steps:

1. Press the Machine Mode Manual console key.
2. Select the MANUAL FUNCTION SETUP softkey.
3. Select the CE DIAGNOSTICS softkey. The CE Status and Diagnostic screen appears.

If an error condition is displayed, follow these steps:

1. Follow the instructions on the CE Status and Diagnostic screen.
2. Once the error status is corrected, exit the CE Status and Diagnostic screen.
3. Restart and calibrate the machine.

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.

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 screen instructions.

Machine Voltages

Missing or faulty connections can cause a combination of problems.

Connections	Description
Missing	• Open grounds • Open neutrals • Open phase connections • Missing neutral-to-ground strap at main source
Improper	• Phase and neutral reversed • Phase and ground reversed • Ground and neutral reversed • Ground and neutral shorted at panel
Loose	• At main panels • At equipment • At other equipment in system • At service entrance

Table 3–2. Missing or Faulty Connections

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

Problems	Causes	Solutions
Fuse blows	Power sag	Repair faulty in-plant wiring. Move any other machines on the circuit to separate circuits.
Power is lost	Power sag	Repair faulty in-plant wiring. Move any other machines on the circuit to separate circuits.
Motor(s) overheat	Power sag	Repair faulty in-plant wiring. Move any other machines on the circuit to separate circuits.
Control PC boards and/or microprocessor fail	Power spike	Move any nearby high current switching devices (arc welders, inductive motors) away from the machine.
Machine stops	Power spike	Properly ground equipment and install surge protection to insulate against lightning strikes.
Data is lost	Power spike	Properly ground equipment and install surge protection to insulate against lightning strikes.

Table 3–3. Problems Due to Power Fluctuation

If a machine malfunction occurs, 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

If a problem occurs with the coolant system, check these possibilities:

Problem	Cause	Solution
Coolant flows slowly or stops.	• Clogging due to dirty coolant. • Pump is not working properly.	• 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 mist nozzle.	• Coolant tank is empty. • There is too much air in the system.	• Fill coolant tank with fresh coolant. • Close off valve, then slowly open again to get desired flow.
Coolant fails to start when head lowers to Z up level or below.	• Coolant valve is not turned On. • Coolant is not programmed to be On.	• Turn on the valve (via the control). • Check the operating mode (auto or manual) or programming.
Coolant fails to stop when head is up to Z retract level.	• Incorrect program parameters.	• Check parameters and correct the setting.

Table 3–4. Coolant System Problems

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

Motion and Spindle Rotation

If the spindle or an axis does not move the way it was programmed to, moves without being instructed to, or spindle rotation is incorrect, refer to the following table.

Spindle does not turn

Cause	Solution
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.

The machine's control power is Off and the screen shows a Motion Error message

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.
Error LED is On servo(s).	Note the location of lighted LED(s). Phone for technical assistance.
Servo encoder or decoder not working properly.	Jog the machine 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.

The machine chatters while machining or cutting.

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

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 3–5. Motion and Spindle Rotation Problems

Environmental Conditions

When the electrical cabinet overheats, the machine shuts down until the cabinet's temperature sensor registers that the temperature has dropped to an acceptable level. If this error occurs, check the temperature around the electrical cabinet to be certain the cabinet is not subjected to an additional heat source, such as a space heater or bright sunlight from a nearby window.

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

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 typical, and/or the environment is too humid or dusty.	Improve the machine's environment. For example, close the machining area to outside dust, etc., and install air conditioning to lower room temperatures and humidity.

Table 3–6. Environmental Factors

Ordering Replacement Parts

⇨ If your local distributor is certified as a full service distributor, your call for replacement parts should be to that distributor.

Hurco maintains a large inventory of service parts. If your distributor is not a full service distributor, you may order parts from Hurco by telephone, fax, or mail:

Hurco Companies, Inc.
One Technology Way
P.O. Box 68180
Indianapolis, IN 46268-0180
Tel. (317) 293-5309 (products)
(317) 298-2635 (service)
(800) 638-1849 (service parts)
Fax (317) 298-2621 (service)

Hurco subsidiary contact information can be found on the Hurco Web site:
www.hurco.com

Providing Information Required for Parts Orders

In order for your full service dealer or Hurco to process your order and supply you with the correct part(s), you must provide the detailed information described below:

- Your company's purchase order number.
- **Serial Number** of the Hurco machine. The machine serial number is located on the identification/data plate, which is attached to the electrical cabinet door.
- The part number, part name (description) and quantity desired. State where you found the part number. If you found the part number in a manual, include the manual's part number, revision or date, and page. If you located the number on the part, write "old part."
- Your company's name and complete address.
- Name and telephone number of person ordering the parts.
- Complete shipping address for the parts, including name of the person to ship to, delivery date, department, etc.
- Provide any special shipping instructions, including mode of shipment. Parts will be shipped prepaid and billed via invoice.
- Indicate the condition of the machine (inoperable or functional, etc.).
- Address to which invoices are to be mailed.

Returning Parts

When returning a part to Hurco, fill out a Return Authorization Tag and ship the part in its original container. All parts are subject to inspection before credit is issued. Non-warranty parts returned for credit are assessed a restocking charge. The purchaser is responsible for all shipping charges. Returned parts should be shipped prepaid. Hurco will not accept parts shipped COD or without a Return Authorization Number displayed clearly on the outside of the shipping container.

After you contact either your full service dealer or Hurco, they will provide you with a Return Authorization Tag that includes the Return Authorization Number for you to display on the shipping container.

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

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