Installation, Setup and Operation

INSTRUCTIONS

for

SUNNEN® POWER STROKED HONING MACHINE

Model: ML-2000

READ THE FOLLOWING INSTRUCTIONS THOROUGHLY AND CAREFULLY BEFORE UNPACKING, INSPECTING, OR INSTALLING THE SUNNEN® ML-2000 POWER STROKED HONING MACHINE.

SUNNEN® PRODUCTS COMPANY • 7910 MANCHESTER AVENUE • ST. LOUIS, MO 63143, U.S.A. • PHONE: 314-781-2100

GENERAL INFORMATION

The Sunnen® equipment has been designed and engineered for a wide variety of parts within the capacity and limitation of the equipment. With proper care and maintenance this equipment will give years of service.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY AND THOROUGHLY BEFORE UNPACKING, INSPECTING, OR INSTALLING THIS EQUIPMENT.

IMPORTANT: Read any supplemental instructions BEFORE installing this equipment. These supplemental instructions give you important information to assist you with the planning and installation of your Sunnen equipment.

Sunnen Technical Service Department is available to provide telephone assistance for installation, programming, & troubleshooting of your Sunnen equipment. All support is available during normal business hours, 8:00 AM to 4:30 PM Central Time. Emergency breakdown support is available on a 24 hour / 7 day basis.

Review all literature provided with your Sunnen equipment. This literature provides valuable information for proper installation, operation, and maintenance of your equipment. Troubleshooting information can also be found within the Instructions. If you cannot find what you need, call for technical support.

Where applicable, programming information for your Sunnen equipment is also included. Most answers can be found in the literature packaged with your equipment.

Help us help you. When ordering parts, requesting information, or technical assistance about your equipment, please have the following information available:

- Have ALL MANUALS on hand. The Customer Services Representative or Technician will refer to it.
- Have Model Number and Serial Number printed on your equipment Specification Nameplate.
- Where Applicable: Have Drive model and all nameplate data. Motor type, brand, and all nameplate data.

For Troubleshooting, additional information may be required:

- Power distribution information (type - delta, wye, power factor correction; other major switching devices used, voltage fluctuations)
- Installation Wiring (separation of power & control wire; wire type/class used, distance between drive and motor, grounding).
- Use of any optional devices/equipment between the Drive & motor (output chokes, etc.).

For fast service on your orders call:

Sunnen Automotive Customer Service toll free at: 1-800-772-2878

Sunnen Industrial Customer Service toll free at: 1-800-325-3670

Customers outside the USA, contact your local authorized Sunnen Distributor.

Additional information available at: http://www.sunnen.com or e-mail: sunnen@sunnen.com

NOTE: Sunnen reserves the right to change or revise specifications and product design in connection with any feature of our products contained herein. Such changes do not entitle the buyer to corresponding changes, improvements, additions, or replacements for equipment, supplies or accessories previously sold. Information contained herein is considered to be accurate based on available information at the time of printing. Should any discrepancy of information arise, Sunnen recommends that user verify the discrepancy with Sunnen before proceeding.

ESD PREVENTION REVIEW

Let's review the basics of a sound static control system and its effective implementation. First, in the three step plan:

1. Always ground yourself when handling sensitive components or assemblies.
2. Always use a conductive or shielded container during storage or transportation. These materials create a Faraday cage which will isolate the contents from static charges.
3. Open ESD safe containers only at a static safe work station.

At the static safe work station, follow these procedures before beginning any work:

A. Put on your wrist strap or foot grounding devices.

B. Check all grounding cords to make sure they are properly connected to ground, ensuring the effective dissipation of static charges.

C. Make sure that your work surface is clean and clear of unnecessary materials, particularly common plastics.

D. Anti-static bubble wrap has been included for use at the machine when an ESD safe workstation is not available.

You are now properly grounded and ready to begin work. Following these few simple rules and using a little common sense will go a long way toward helping you and your company in the battle against the hazards of static electricity. When you are working with ESD sensitive devices, make sure you:

GROUND

ISOLATE

NEUTRALIZE

SUNNEN® LIMITED PRODUCT WARRANTY

Sunnen® Products Company and its subsidiaries (SPC) warrant that all new SPC honing machines, gaging equipment, tooling, and related equipment will be free of defects in material and/or workmanship for a period of one year from the date of original shipment from SPC.

Upon prompt notification of a defect during the one-year period, SPC will repair, replace, or refund the purchase price, with respect to parts that prove to be defective (as defined above). Any equipment or tooling which is found to be defective from improper use will be returned at the customer's cost or repaired (if possible) at customer's request. Customer shall be charged current rates for all such repair.

Prior to returning any SPC product, an authorization (RMA#) and shipping instructions must be obtained from the Customer Service Department or items sent to SPC will be returned to the customer.

Warranty Limitations and Exclusions This Warranty does not apply to the following:

- Normal maintenance items subject to wear and tear: (belts, fuses, filters, etc).
- Damages resulting from but not limited to:
  - › Shipment to the customer (for items delivered to customer or customer's agent F.O.B., Shipping Point)
  - › Incorrect installation including improper lifting, dropping and/or placement
  - › Incorrect electric power (beyond +/- 10% of rated voltage) including intermittent or random voltage spikes or drops
  - › Incorrect air supply volume and/or pressure and/or contaminated air supply
  - › Electromagnetic or radio frequency interference from surrounding equipment (EMI, RFI)
  - › Storm, lightning, flood or fire damage
  - › Failure to perform regular maintenance as outlined in SPC manuals
  - › Improper machine setup or operation causing a crash to occur
  - › Misapplication of the equipment
  - › Use of non-SPC machines, tooling, abrasive, fixturing, coolant, repair parts, or filtration
  - › Incorrect software installation and/or misuse
  - › Non-authorized customer installed electronics and/or software
  - › Customer modifications to SPC software

THE LIMITED WARRANTY DESCRIBED HEREIN IS EXPRESSLY IN LIEU OF ALL ANY OTHER WARRANTIES. SPC MAKES NO REPRESENTATION OR WARRANTY OF ANY OTHER KIND, EXPRESS OR IMPLIED, WHETHER AS TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER MATTER. SPC IS NOT RESPONSIBLE FOR THE IMPROPER USE OF ANY OF ITS PRODUCTS. SPC SHALL NOT BE LIABLE FOR DIRECT, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES INCLUDING BUT NOT LIMITED TO: LOSS OF USE, REVENUE, OR PROFIT. SPC ASSUMES NO LIABILITY FOR PURCHASED ITEMS PRODUCED BY OTHER MANUFACTURERS WHO EXTEND SEPARATE WARRANTIES. REGARDLESS OF ANY RIGHTS AFFORDED BY LAW TO BUYER, SPC's LIABILITY, IF ANY, FOR ANY AND ALL CLAIMS FOR LOSS OR DAMAGES WITH RESPECT TO THE PRODUCTS, AND BUYER'S SOLE AND EXCLUSIVE REMEDY THEREFORE, SHALL IN ALL EVENTS BE LIMITED IN AMOUNT TO THE PURCHASE PRICE OF THAT PORTION OF THE PRODUCTS WITH RESPECT TO WHICH A VALID CLAIM IS MADE.

Shipping Damages

Except in the case of F.O.B., Buyer's destination shipments, SPC will not be liable for any settlement claims for obvious and/or concealed shipping damages. The customer bears the responsibility to unpack all shipments immediately and inspect for damage. When obvious and/or concealed damage is found, the customer must immediately notify the carrier's agent to make an inspection and file a claim. The customer should retain the shipping container and packing material.

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Any alteration or reverse engineering of the software is expressly forbidden and is in violation of this agreement.

SPC reserves the right to update the software covered by this agreement at any time without prior notice and any such updates are covered by this agreement.

SAFETY INSTRUCTIONS
READ FIRST

The ML-2000, like any machine tool, may be dangerous if used improperly. As a result of our commitment to continual safety improvement, many new safety features have been incorporated into this machine. However, these features cannot protect the operator from all hazards of misuse or abuse of the product. Please read all warnings and instructions before attempting to use this machine.

DO NOT turn power on until all guards and covers are securely in place.

DO NOT remove or defeat any safety device.

Depressing foot pedal with power "ON" can start spindle and stroker motion. Use foot pedal ONLY to start a honing cycle after workpiece is securely fixtured and located on honing tool.

Begin each new setup by depressing Emergency Stop button to clear all previous spindle and stroker speed settings.

NEVER open or remove any machine cover or protective guard with power "ON." Always disconnect power at main enclosure before servicing ML-2000.[1]

Always wear eye protection when operating ML-2000.

DO NOT attempt any repair or maintenance procedure beyond those described in this book. Contact your Sunnen Service Representative for repairs not covered in this book.

Manual stroked honing and truing should only be performed by operators trained to use safe manual honing practices. The key for switch to disable stroker and allow manual honing should be kept by a supervisor or skilled honing operator to prevent unauthorized manual honing.

Much of the safety of the honing operation is dependent on how workpiece is fixtured. Several standard fixturing components are available but each is limited to certain types of applications. "Homemade" fixtures are also not uncommon and can be quite effective if designed and used properly. Sometimes it is necessary to clamp workpieces lightly when honing with special fixtures to minimize bore distortion. Likewise, tooling for small diameter honing is inherently fragile. Therefore, ***Always start a new setup with speeds and feed forces that are much lower than recommended to test stability of tooling and fixturing***. After that, speeds and feed forces may be increased slowly to recommended values.

If specially built automation components are added to this system, be sure that safety is not compromised. If necessary, obtain special enlarged work area safety system from Sunnen® Products Co.

CE Indicates CE version ONLY.

[1] DO NOT touch electrical components until main input power has been turned off and *CHARGE* lamps are extinguished. WARNING: The capacitors are still charged and can be quite dangerous.

IMPORTANT NOTE

The temperature requirements of the Sunnen® ML-2000 Power Stroked Honing Machine have been established as 35 degrees C (95 degrees F). Above this temperature, an optional cooler will be available to handle temperatures from 35º to 46º C (95º to 115º F). IT IS NOT recommended that the ML Machine be operated at temperatures above 46º C (115º F). Sunnen Products Company warrants the ML Machine for operating environments up to 35ºC (95º F). For operating environments of 35º to 46º C (95º to 115º F) the warranty only applies if the optional cooler is installed on the Machine. No warranty coverage is offered for operating environments above 46º C (115º F).

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APPENDIXES

GENERAL INFORMATION & SPECIFICATIONS

Sunnen® Power Stroked Honing Machines - Model ML-2000

Diameter Range (I.D.)* -	
Manual Stroking:	1,5 - 165 mm (.060 - 6.5 in.)
Power Stroking:	1,5 - 101,6 mm (.060 - 4.0 in.)
Range of Standard Probes for Automatic Sizing:	3,1 - 51 mm (.125 - 2.0 in.)
Stroke Length*:	6 - 170 mm (.236 - 6.7 in.)
Spindle Speeds:	200-3000 rpm - Variable in fine increments
Stroke Rate:	60-350 strokes / min - Variable in fine increments
Spindle Motor:	2,2 KW (3 HP)
Stroker Motor:	0,75 KW (1 HP)
Feed System Type:	Variable Maximum Feed Rate Regulator
Size Control (Opt):	Zero Shut-Off or Automatic Size Control (ASC)
Coolant System (Roll Out Coolant Cart):	Pump and Sediment Tray Filtration
Coolant Filtration (Opt):	PF-150 Grit Guard Unit
Pump Motor:	0,23 KW (1/3 HP)
Coolant Pump:	11,2 L/Min (3 GPM)
Coolant Capacity:	105 L (28 Gal.)
Coolant Requirements:	Sunnen Industrial Honing Fluids
Floor Space:	1625,6D x 1219,2W x 1905H mm (64 x 48 x 75 in.) w/covers open
Color:	Pearl Gray / Pewter Gray / Black Trim
Machine Weight (Less Coolant Cart):	725 kg (1600 lbs.)
Pneumatic Requirements:	5,5 Bar (80 PSI)
Power Requirements:	See Machine Nameplate or Electrical Specification Plate.
Noise Emission:	Less than 72 db(A) continuous Less than 74 db(A) peak load (max. noise) condition in a typical factory environment.

*Stroke length, diameter range, and workpiece weight are contingent on machine configuration, workpiece, and application.

INTRODUCTION

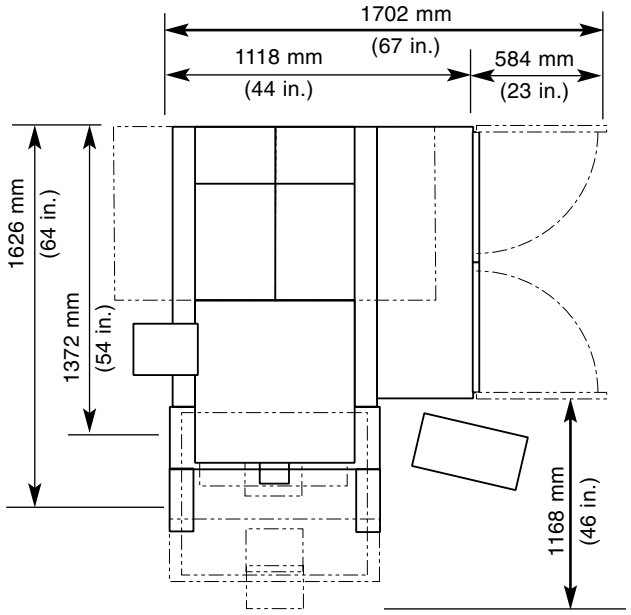
This Instruction Manual provides information required to install, operate, and maintain Sunnen® ML-2000 Power Stroked Honing Machine.

When ordering parts for, or requesting information about your Machine, include model and serial numbers, located on Electrical Enclosure of your Machine.

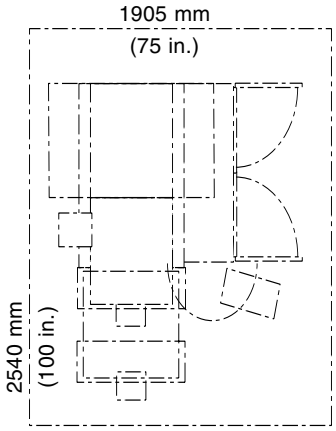
In this book symbol CE indicates steps or information that are only for CE version of this machine. The CE version is constructed to meet highest level of safety standards as required by European Machinery Directive. Required for European market, this CE version is available for any customer. The regular version of this machine is quite safe for any operator exercising a normal degree of caution associated with machine tool use. The CE version provides an extra level of protection by minimizing risks of operator carelessness.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY AND THOROUGHLY BEFORE UNPACKING, INSPECTING, OR INSTALLING THE SUNNEN ML-2000 POWER STROKED HONING MACHINE.

The ML-2000 Production Honing Machine is to be used for finishing bores in small workpieces. In finishing bores, this machine can achieve any or all of following results: fast stock removal, consistent final size, a high degree of cylindricity, fine surface finish. To achieve best results and ensure safe operation, ONLY Sunnen Tools and Abrasives are to be used in ML-2000.



TOP VIEW

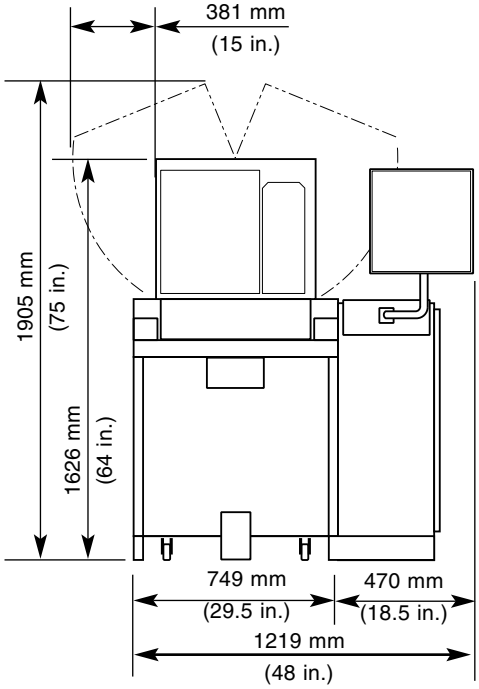


OUTLINE LAYOUT

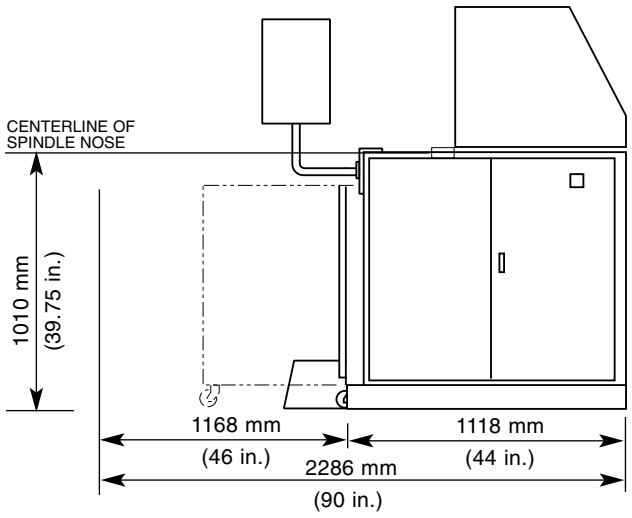
Scale:
1/4 in. = 1 ft.
1 mm = 48 mm

Weight Installed:
Approximately 850 kg. (1875 lbs.) including coolant.

Floor Loading:
Less than 770 kg/sm (160 lbs/sf).



FRONT VIEW



SIDE VIEW

FIGURE 1-A, Floor Plan Layout (System Configuration)

SECTION 1
INSTALLATION

GENERAL

Consult this section when unpacking, inspecting, and installing Sunnen® ML-2000 Power Stroked Honing Machine (see Figure 1-1). Hereafter referred to as the machine.

TOOLS & MATERIALS

The following tools and materials are required for unpacking and installing of your Machine:

Knife	Hex Wrenches
Hammer	Open End Wrenches
Crow Bar	Cleaning Solvent
Tin Snips	

INSTALLATION

Read the following instructions carefully and thoroughly before unpacking, inspecting and installing the machine. All references to right and left in these instructions, unless otherwise noted, are as seen by operator as one looks at machine or assembly being described (refer to Figure 1-1).

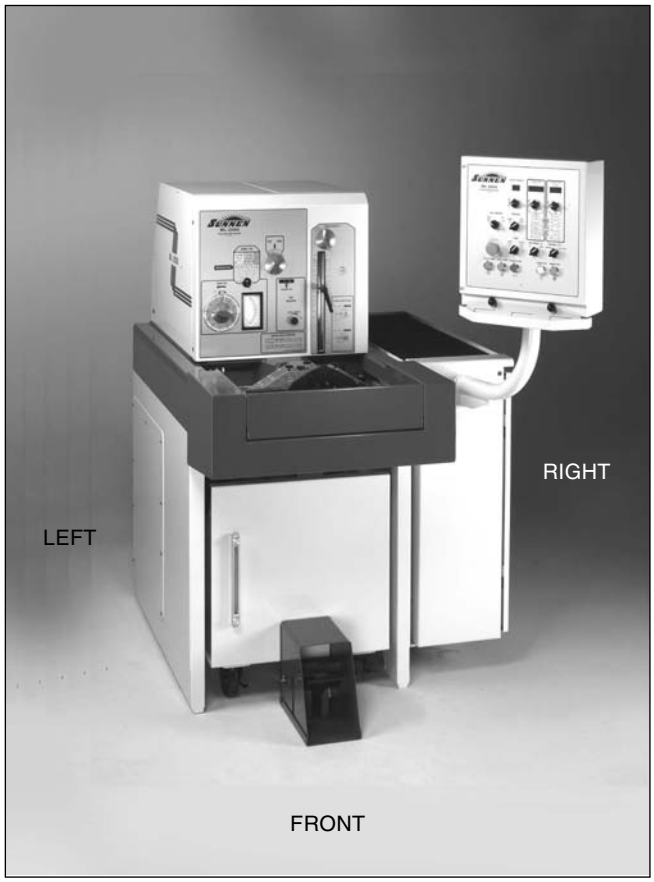


FIGURE 1-1, Power Stroked Honing Machine

NOTE: When ordering parts for, or requesting information about your Machine, include Model and Serial Number printed on Nameplate of your Machine.

1. Remove banding straps and shipping crate from around Machine.

2. Remove all loose components and boxes packaged with your Machine.

3. Inspect Machine and components for dents, scratches, or damage resulting from improper handling by carrier. If damage is evident, ***immediately*** file a claim with carrier.

CAUTION

MACHINE IS VERY HEAVY. Use care when lifting and moving Machine.

4. Lift Machine using a 6-ton forklift (see Figure 1-2).

NOTE: Only qualified riggers familiar with moving and setting of large and heavy machinery should be permitted to handle Machine. Machine is a precision machine and should be handled with the utmost care.

To lift and move ML-2000, fork only from front or rear of machine. Place one fork under machine base and one under electrical enclosure but close to machine base. (Structural steel under electrical enclosure is welded to machine base to prevent actually lifting machine by enclosure.)

FIGURE 1-2, Fork Lift

CAUTION

Foot Pedal and its conduit to machine are located loosely in front opening of machine. Be careful not to pinch conduit with forks. Place Foot Pedal assembly on a fork so that it does not drag when moving machine.

5. Move Machine to desired location.

NOTE: Machine should be locate on a leveled concrete floor away from heavy traffic. Allow 457 mm (18 in) from rear of machine to any adjacent walls and 1 mm (3 ft.) from right side of machine to any adjacent walls to give the operator room to service Machine. There should be an overhead track and chainfall located directly over Machine to aid in head installation. If no overhead track is available, allow ample space around Machine for use of a portable hoist-stand for heavy lifting.

6. After machine is placed in desired location, it will be necessary to stabilize machine with screw located on bottom of right rear corner of machine base. For best results place a small block of steel, 5 to 8 mm thick (3/16 to 5/16"), under stabilizing screw. Adjust screw until machine cannot be made to rock on two corners. Then tighten jam nut to lock screw in place.

7. Open machine covers use a 4mm hex key wrench to release quarter turn latch near rear corner of each cover. Place hood prop securely into bracket on hood to hold it open (see Figure 1-3).

8. After removing packing material from inside machine, close both hoods and make sure hoods are latched securely.

WARNING

Hoods do not need to be opened for setup. Never have hoods open when power is on. Access to internal systems is only necessary for maintenance which should only be done with power turned off.

9. Unpack boxes packaged with Machine and check all items against enclosed packing list. Notify Sunnen Products Company of any missing or damaged items.

10. After unpacking and installing Machine, clean and lubricate. Use a good quality industrial solvent to remove all grease and preservative from the machine surfaces (refer to Section 4).

SIDE TRAY

Unpack side tray. Place mat provided into tray. Tray can hang on either side of machine or on side of coolant cart. Plastic spacers on bottom of tray bracket can be placed in two different positions to accommodate different widths of machine side and coolant cart side (see Figure 1-4). Only one tray is provided as standard. If needed, a second tray can be ordered (Sunnen part # ML-6510).

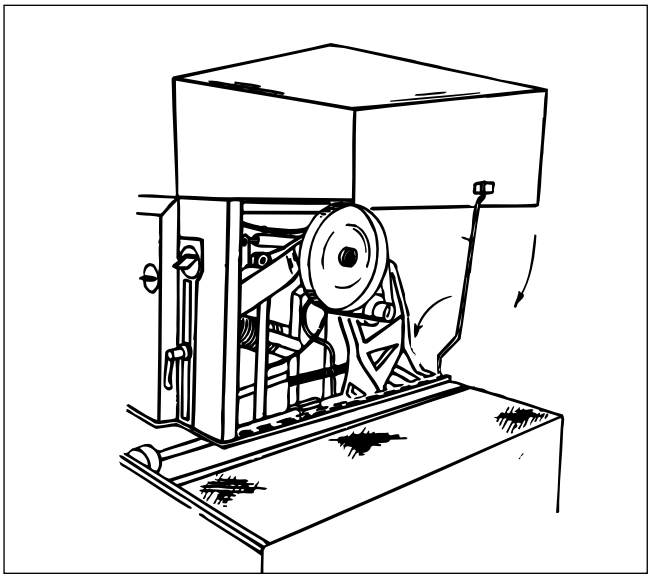


FIGURE 1-3, Hood Prop

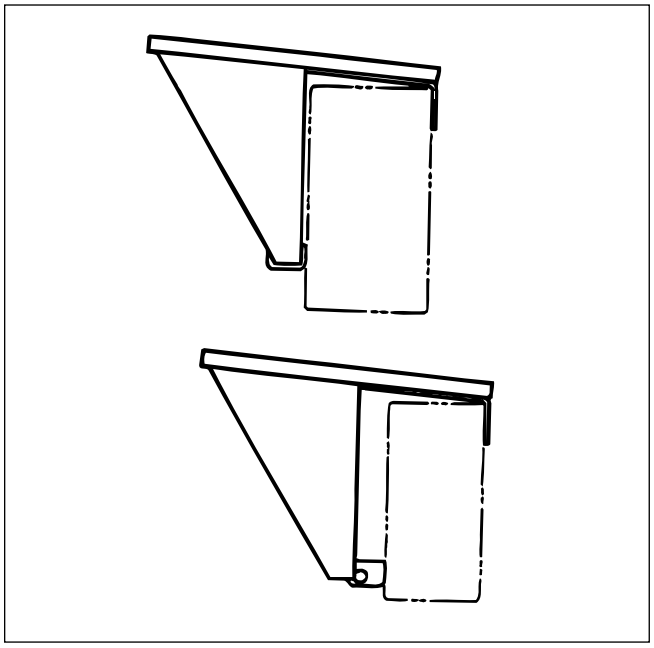


FIGURE 1-4, Side Tray

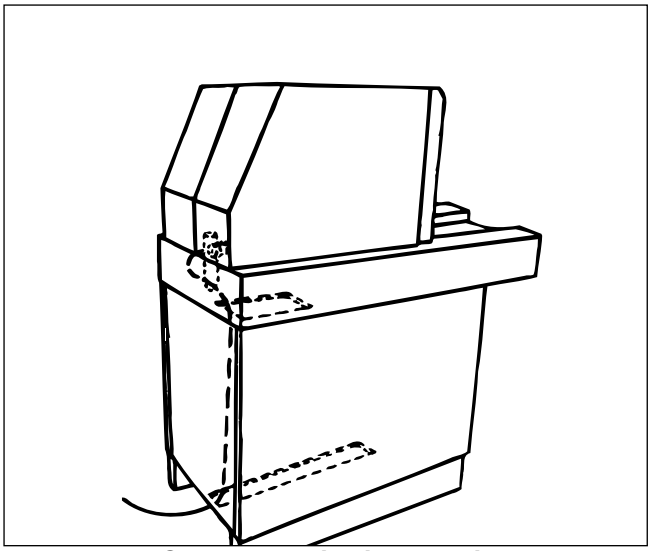


FIGURE 1-5, Air Line Routing

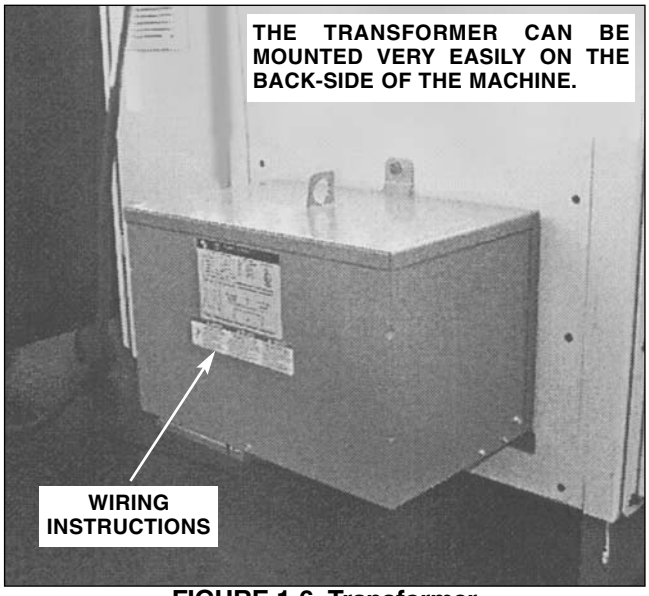


FIGURE 1-6, Transformer

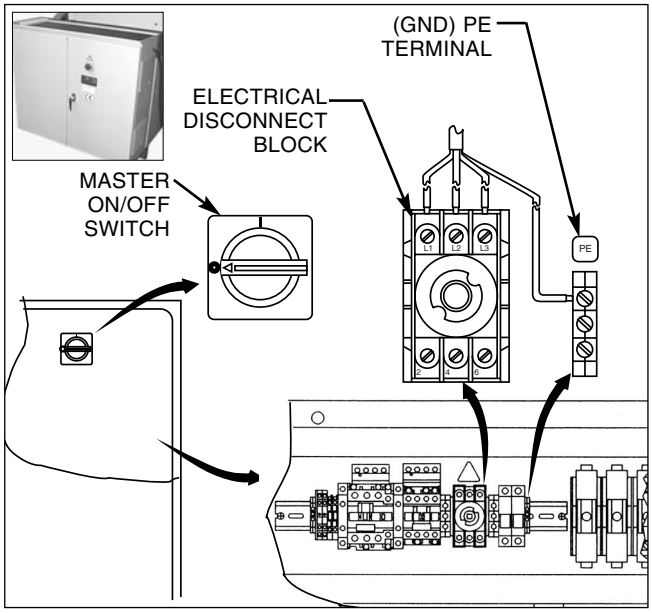


FIGURE 1-7, Electrical Connection

PNEUMATICS

Connect pneumatic line (airline) as follows (see Figure 1-5):

NOTE: The Factory Air Supply Line is not supplied. A minimum of 0,55 MPa (80 psi) clean, dry compressed air is required for proper operation.

1. Remove hose barb and install Quick-Disconnect (not supplied) in airline port on Airline Filter Regulator.

NOTE: Elbow has 1/8 NPT threads. Elbow and adapter can be removed to access R 1/8 (BSPT) threads in inlet port of filter-regulator.

CAUTION

Do not connect ML-2000 to any air supply with a pressure greater than 1,4 MPa (200 psi).

2. CONNECT 1/2 in. (50 mm) factory air supply line (not supplied) to Quick-Disconnect.

Route a 6 mm (1/4 IN.) ID air supply line through slot in bottom of machine base, up through openings in top of base to air filter-regulator. Do not route air supply line over top of base or hood will not be able to close properly and will pinch air supply line.

3. Filter-regulator has been factory set to .55 MPa (80 psi). Air supply to machine must be at least this or machine will not operate properly. With air supply connected, check regulator gage for .55 MPa (80 psi). If not set correctly, lift knob on top of regulator and turn to adjust. After setting correct regulated pressure push knob down to lock.

TRANSFORMER INSTALLATION

Most machine models are shipped wired for 230 volt. To install optional transformer for other voltages, refer to wiring instructions on front of transformer (see Figure 1-6).

CAUTION

A step-down transformer is optional on some machine models. Be certain to verify transformer Kva rating (where applicable), as well as local electrical code requirements before sizing and installing the incoming power wiring. End user must use a step-down transformer where factory electrical power varies more than ±10% of machine's nameplate voltage.

All wiring is to be preformed by a competent, licensed electrician.

Note: Step-down or voltage regulating transformers are external (peripheral) to machine tool and are considered primary input line (source) for machine. Local electrical code or practice may require a circuit breaker or other switching device for isolation of electrical power when this type of transformer is used. In such cases, machine tool end user is required to supply necessary circuit breaker or switching device. **FAILURE TO COMPLY CAN RESULT IN PERSONAL INJURY AND/OR DAMAGE TO MACHINE.**

ELECTRICAL

All wiring is to be performed by a competent, Licensed Electrician in accordance with all local, state, and federal codes and regulations. Along with the information provided on the machine Electrical Specification Plate.

1. Loosen Safety Latches, using a screwdriver; or if applicable, unlock doors to Electrical Control Enclosure using key supplied with machine.

WARNING

Residual Voltage exists for 2-3 minutes after Master ON/OFF Switch is turned OFF.

2. Turn Master ON/OFF Switch to OFF position and open doors *(see Figure 1-7).*

3. Insert Electrical Supply Cord through Oil Tight Fitting in enclosure entrance hole.

4. Strip 254 mm (10 in.) off cable's outer jacket.

5. Strip 6 mm (1/4 in.) of insulation off each wire.

6. Connect Green Wire (GRN) to PE Terminal.

7. Connect other three wires to Electrical Disconnect Block.

8. Route and secure cord inside of Enclosure.

9. Tighten Oil Tight Fitting.

10. Close and secure/lock Door(s) to Electrical Control Enclosure.

11. Route and connect Electrical Supply Cord to main power source.

12. Turn ON Master ON/OFF Switch.

ELECTRICAL - OPTIONAL PF-150

WARNING

All wiring must be performed by a competent Licensed Electrician in accordance with all local, state and federal codes and regulations; along with any special information provided on the machine nameplate or electrical specification plate.

Verify supply voltage is the same as voltage on Machine nameplate or Electrical Specification Plate. Please note some models are sold with an external transformer that steps down the voltage to the machine's nameplate voltage. PF-150 nameplate voltage MUST BE THE SAME as ML2000 nameplate voltage.

ML-2000 has fuse blocks pre-wired for PF-150 Filter Unit. These are located in main electrical enclosure and are labeled as described on wiring diagram *(see Figure 1-8)*. PF-150 is supplied with a cable that is to be installed into ML-2000 main electrical enclosure. Fuses that protect PF-150 from short circuit conditions are shipped with PF-150. *(Refer to ML-2000 wiring diagram for electrical connection.)*

1. Open door to ML-200 electrical enclosure.

2. Install fuses (supply with PF-150) as shown.

3. Route cable into ML-2000 Electrical Enclosure and attach wires as shown:

   Red Wire (10L1) to Fuse (4/5FU1) / Line (L1);
   White Wire (10L2) to Fuse (4/5FU2) / Line (L2);
   Black Wire (10L3) to Fuse (4/5FU3) / Line (L3);
   Green Wire to Ground Lug (PE).

COOLANT SYSTEM

Add coolant as follows *(see Figure 1-9)*:

1. Remove packing materials from coolant system.

2. Move coolant cart close enough to machine to connect coolant system cable from machine.

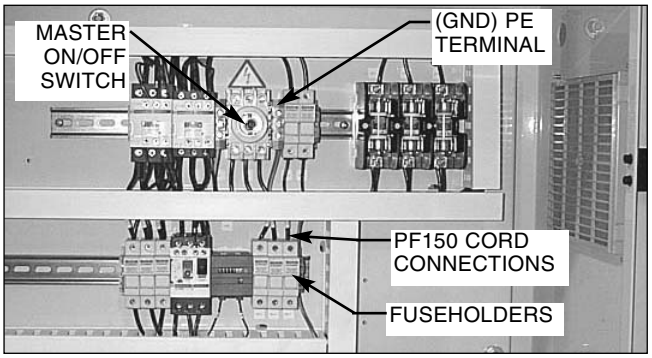


FIGURE 1-8, Electrical Connection

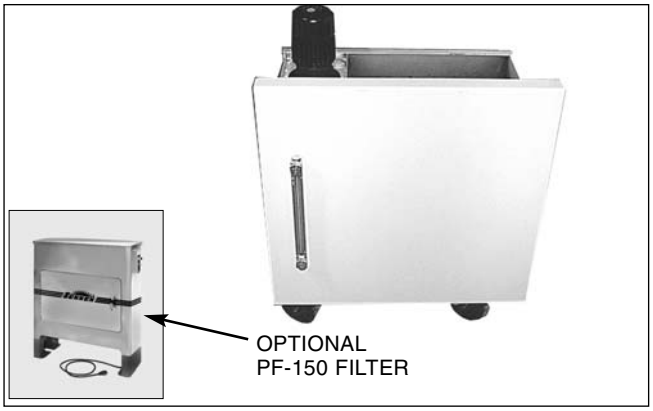


FIGURE 1-9, Coolant Cart

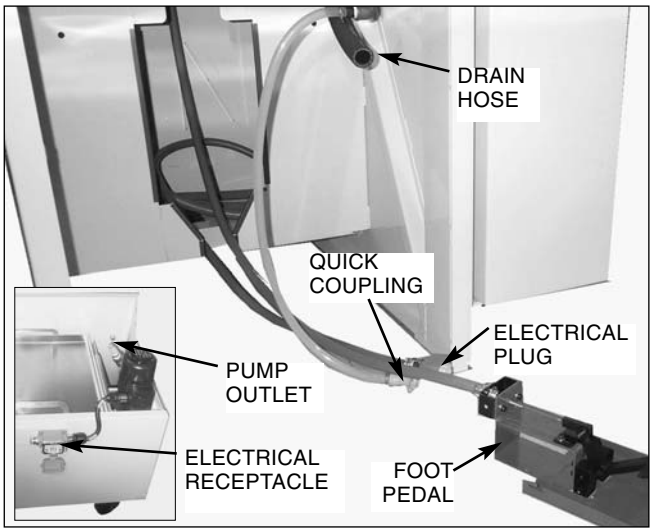


FIGURE 1-10, Quick Coupling

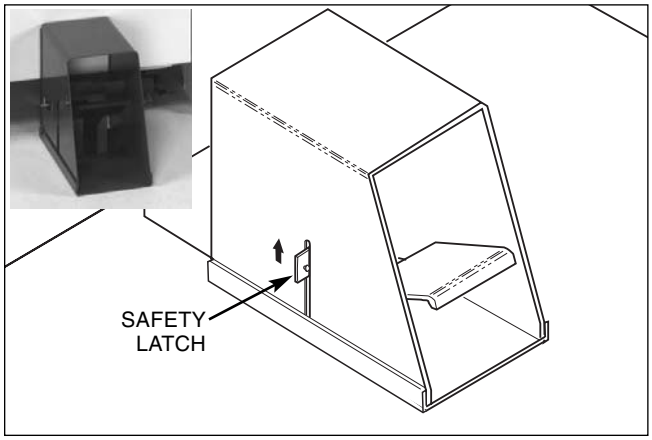


FIGURE 1-11, Foot Pedal Safety Latch

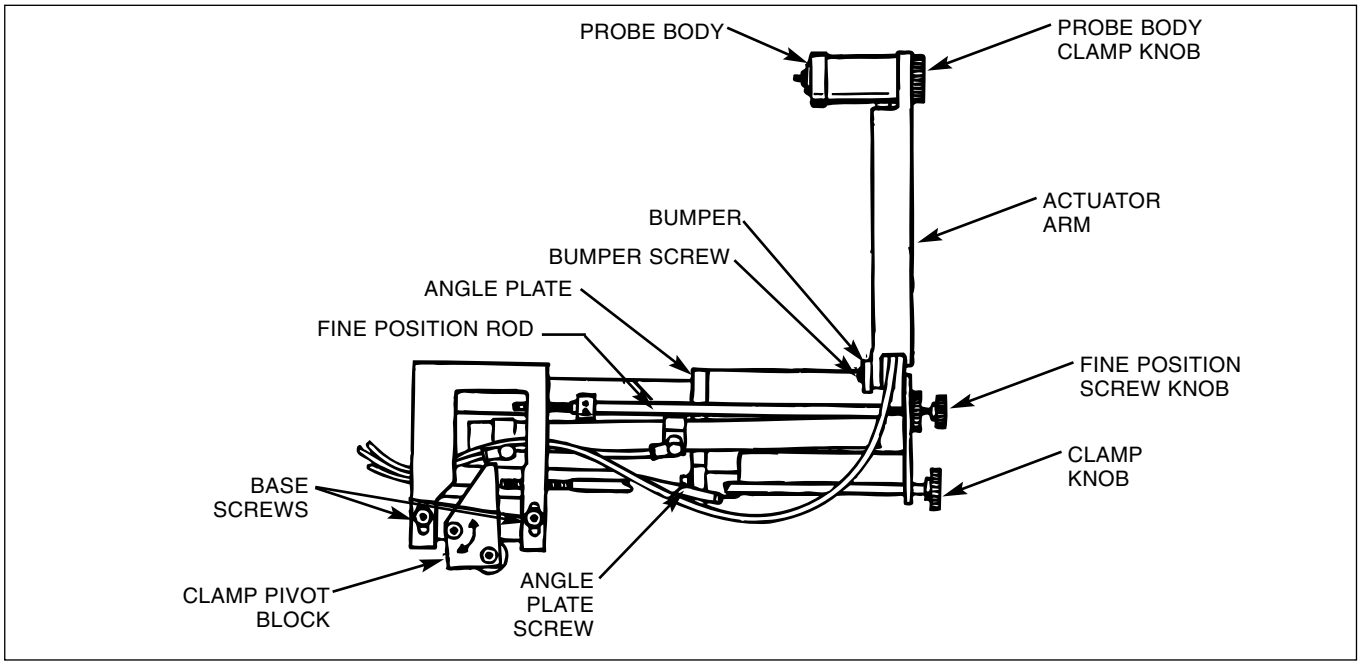


FIGURE 1-12, Automatic Size Control

NOTE: If Sunnen PF-150 Filtration Unit is used, make connections following instructions supplied with PF-150.

3. On operator station turn coolant selector to CONSTANT and turn machine power on momentarily to check pump motor rotation. An arrow marked on pump indicates proper direction for rotation. If pump is rotating backwards, turn power off and turn off main power supply to machine. Reverse any two leads from electrical supply cord coming into machine. Do not change any machine or motor wiring or pump may not rotate in right direction if coolant system is moved to another machine.

4. Connect Quick Connect Coupling from bottom of Drip Tray to Pump Outlet *(see Figure 1-10)*.

5. Foot pedal assembly must slide under coolant cart as coolant cart is pushed in. First, make sure machine power is off.

WARNING

Never remove foot pedal cover with power on. Machine cycle will start any time foot pedal is depressed with power on.

6. Squeeze lower front corners of foot pedal cover together to disengage it from foot pedal assembly and lift it off. Lift safety latch with a finger and depress foot pedal by hand. Release safety latch and then release pedal. Pedal will be locked in an intermediate position so that whole assembly can slide underneath coolant cart.

7. Pull foot pedal assembly under coolant cart so that it is in front of cart.

8. Push down on foot pedal. Lift foot pedal safety latch and hold it up while releasing foot pedal. Let go of safety latch and replace foot pedal cover. When replacing cover, reach inside and hold safety latch up. Make sure that latch will be held up by brace on inside of foot pedal cover *(see Figure 1-11)*. Squeeze lower front corners of cover together to insert pins on cover in holes on foot pedal base plate.

9. Push coolant cart into machine. Be sure that flexible conduit retracts into opening in machine base as cart is pushed in.

10. Place cart in a position where no coolant can escape work area and where operator has comfortable access to front panel and work area. Lock casters on coolant cart to keep it from moving during operation.

11. Pour coolant into drip tray and let drain down to cart below. Watch coolant level gage during filling. Do not overfill coolant system. Level of reservoir should be below to high mark on fluid level gage or coolant will overflow onto floor.

NOTE: Use only Sunnen Industrial Honing Fluids. Substituting other cutting fluids or diluting Sunnen Honing Oil can adversely affect workpiece surface finish and stone/tool life. If using Sunnen Coolant Concentrate, dilute with water as specified and check concentration daily.

12. Check:

- Turn Power ON.
- Check that valves inside work area Drip Tray are closed.

CAUTION

Open Valves slowly. Coolant may spray first time coolant flow is turned on.

•Turn Coolant Selector Switch on operator station to CONSTANT. Open valves inside work area to check flow of coolant.

AUTOMATIC SIZE CONTROL (Opt)

Install *optional* Automatic Size Control (ASC) Unit as follows *(see Figure 1-12)*:

1. Unpack Automatic Size Control (ASC) Unit. Turn Clamp Knob on ASC unit counter-clockwise and pivot Clamp Pivot Block clockwise to open clamp. Position clamp on Rail as shown and tighten clamp to secure ASC unit to machine frame.

2. Check that ASC unit movement will not interfere with stroker or fixturing. Turn ASC PROBE selector switch to DOWN. Pull Actuator Arm away from machine so that cylinder is extended and Arm is horizontal. Plug in and thread on keyed Cable End to connector at back lower left corner of work area. Connect white air line by pushing into place into air fitting with white washer. Connect black air line to other fitting.

WARNING

Keep hands away from ASC unit when turning ASC PROBE selector to move ASC probe up or down.

3. Turn ASC PROBE selector switch back and forth between UP and DOWN. ASC unit movement should be smooth and crisp without bouncing. If necessary, adjust speeds by turning flow control valves on black and white air lines inside left hood of machine.

NOTE: Following steps 4 & 5 are used to adjust ASC unit to machine. They are listed here because they need only be done once. However it may be easier to do this during first setup where ASC will be used. (See Section 3, Setup: Power Stroked Honing.)

4. Set coarse vertical position of Probe:

Select and install honing unit according to instructions. Adjust runout of tool using concentric part or alignment bushing. Lock bushing onto mandrel with EXPAND switch leaving about 12 mm (1/2 in.) of bore extended past tool.

Select ASC probe of correct size to fit bushing hole size and screw onto stud on Probe Body. Center Probe Body in ASC Arm by loosening Probe Clamp Knob, repositioning, and reclamping.

Turn ASC PROBE selector switch to UP. Loosen Clamp Knob and slide ASC unit forward until Probe meets bushing bore. Retighten Clamp Knob.

Loosen Angle Plate screw and reposition Angle Plate to set Probe at same height as bushing hole. Retighten Angle Plate screw. To help guide Probe toward work piece, loosen Bumper screw, slide Bumper to contact Fine Position Rod and retighten screw.

5. Set horizontal position of Probe:

Note distance from center of Probe to center of bushing.

FIGURE 1-13, Light Curtain

Loosen Clamp Knob and slide ASC unit toward front of machine to access two Base screws. Loosen two Base screws and slide Base along screw slots distance noted. Retighten Base screws and slide ASC unit forward to bring Probe in front of bushing. Probe should be centered in front of bushing.

Set this horizontal position so that Clamp Knob will not touch machine frame when ASC Unit is slid along Rail.

LIGHT CURTAIN (Opt)

(CE Machines Only) CE machines come with optional Light Curtain and guarding installed. Light Curtain alignment is preset at the factory. Light Curtain Set consists of a Transmitter and Receiver Unit *(see Figure 1-13)*.

Indicator Light on bottom of light curtains:

Transmitter

Yellow indicates that power is applied to Transmitter.

Receiver

Green indicates that light curtains are aligned and no object is in light curtain detection zone.

Red indicates light curtains are not aligned or an object is in light curtain detection zone. Machine cannot be run when this light is on or afterwards until machine error 4 has been cleared. Pressing Cycle Stop button clears error 4.

Individual Beam Indicates:

Receiver Unit has a red visible Individual Beam Indicator (IBI) adjacent to each infrared beam. Infrared beams have a vertical spacing of 30mm. The IBI will light when an object blocks detection zone of light curtains or light curtain units are not aligned with each other.

SECTION 2
PREPARING FOR OPERATION

GENERAL

Consult this section when preparing the Machine for operation.

MAJOR COMPONENTS

For location of major components on your machine, (see Figure 2-1).

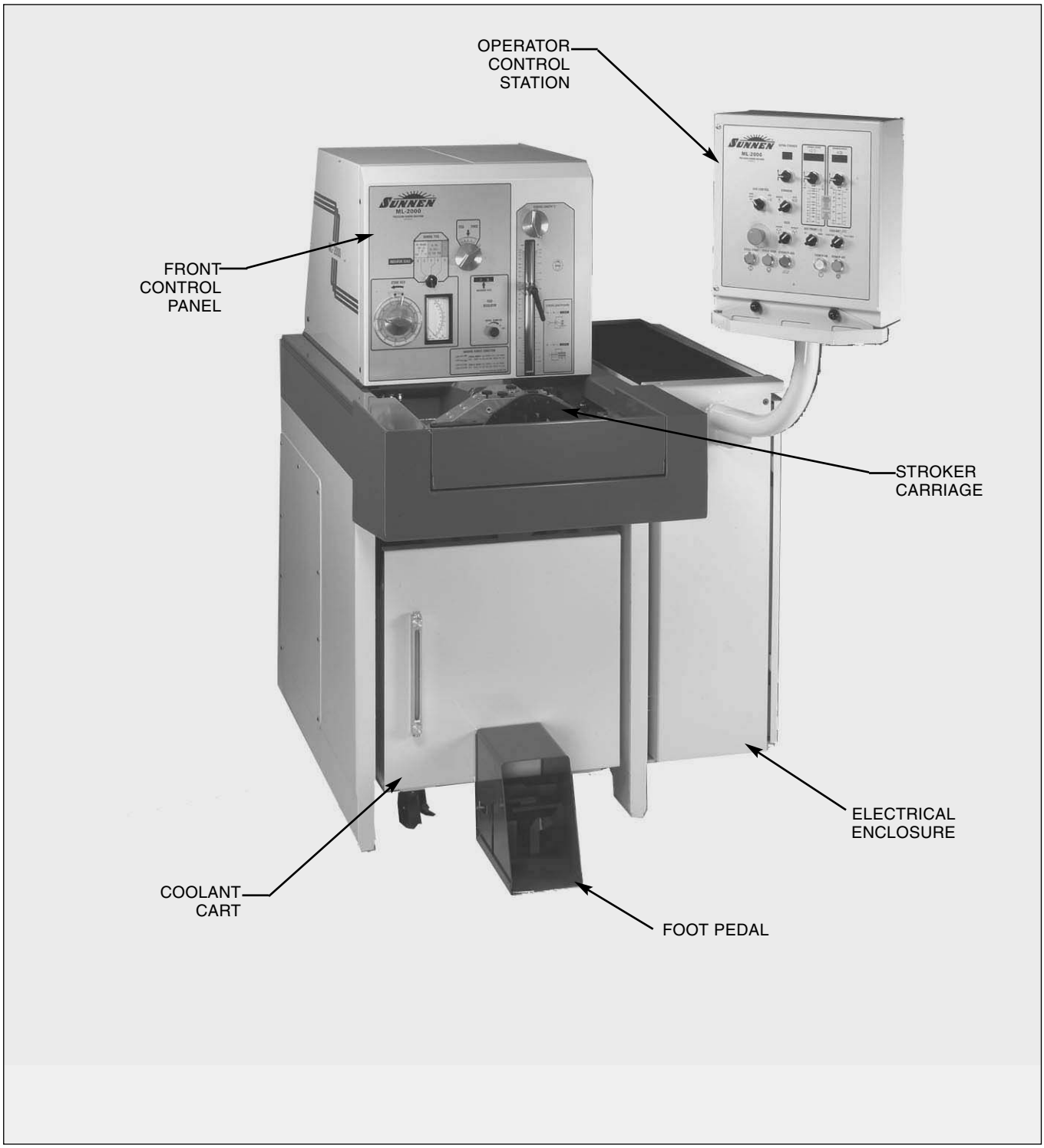


FIGURE 2-1, ML-2000 Honing Machine

OPERATOR CONTROLS

For location and function of the operator controls for your machine, refer to Figures 2-2 thru 2-5. (Refer to Table 2-2 for symbols used on CE machines).

1. POWER OFF - Turns machine power off. All functions are disabled, however spindle speed, stroker speed, and extra stroke settings are retained.

2. POWER ON - Turns machine power on. Lighted button is an indication of power on status.

3. STROKER JOG - Pressing this and holding it down causes stroker carriage to move slowly to one end of stroke. Repeating this will cause stroker to move slowly to other end of stroke. Releasing button will stop stroker immediately even though end of stroke may not have been reached.

4. CYCLE STOP - Stops honing cycle.

5. CYCLE START - Starts honing cycle if STROKING selector is set to "POWER".

6. COOLANT - Two position selector switch:

CONSTANT - Coolant flow at all times when power is on.

CYCLE ONLY - Coolant flow only during honing cycle.

7. ASC PROBE - Two position selector switch:

UP - Automatic Size Control actuator lifts probe into gaging position.

DOWN - Automatic Size Control actuator moves probe to its retracted position.

8. FEED - Two position selector switch:

EXPAND - Used for setup only. Expands honing tool until stone contacts workpiece for setting Stock Removal amount. Locks an alignment bushing on honing tool for checking and adjusting tool runout. Honing cycle cannot be started when "EXPAND" is selected.

RETRACT - Retracts honing tool.

9. EMERGENCY STOP - Opens electrical circuits to stop all machine functions. Cancels all setup information requiring operator to re-enter setup before continuing. Button must be rotated clockwise until it pops up before machine can be re-started with POWER ON button.

10. SIZE CONTROL - Two position selector switch sets size control mode:

ZERO SHUT-OFF - Honing cycle will end when needle on Honing Indicator reaches zero. This corresponds to a consistent feed system position. If stone and shoe wear are negligible or properly compensated, then this position will correspond to a consistent final bore size.

ASC - Automatic Size Control unit will determine when honing cycle is complete by checking workpiece bore size with a plug gage type probe once every stroke.

11. STROKING - Three position selector switch sets stroking mode:

MANUAL - Stroker will not operate in this mode. Stroking must be done manually. Honing cycle can be started only with Foot Pedal.

UNLATCH - In this mode Stroker Carriage is disengaged from power stroking unit. This mode is used only during setup. Machine will not run in this mode.

AUTOMATIC - Stroker will operate during honing cycle at speed and stroke length selected. Cycle can be started with Foot Pedal or CYCLE START button.

12. EXTRA STROKES - After size control device (either Zero Shut-Off or ASC) signals completion of honing cycle, honing cycle will continue for number of strokes shown on display before stopping. Return-to-center selector switch changes number of extra strokes up or down to a maximum of 99.
If ASC mode of size control is selected, but ASC unit is disconnected, then honing cycle will be a "timed" cycle lasting for only number of strokes displayed on counter.

13. SPINDLE SPEED - Return-to-center selector switch changes spindle speed setting displayed above switch. Chart below recommends spindle speed in RPM based on workpiece bore diameter.

14. STROKER SPEED - Return-to-center selector switch changes stroker speed setting displayed above switch. Chart below recommends stroker speed in SPM (strokes per minute) based on stroke length.

15. STROKE LENGTH INDICATOR & LOCK - Index mark on clear piece indicates stroke length setting. Tightening handle locks stroke length in place. Loosening handle frees stroker for setting a different stroke length with STROKE LENGTH Handwheel.

16. STROKE LENGTH - Handwheel changes stroke length as indicated by index piece when handle is unlocked. A Stroke Length Guide printed on front panel shows how to use bore length and stone length to determine proper stroke length for most applications.

17. FEED FORCE - Sets feed force level as indicated on dial above knob.

18. HONING TOOL / INDICATOR SCALE SELECTOR - Four position selector switch sets Honing Indicator for honing tool used and indicator scale desired.

19. STONE FEED - Handwheel feeds up tool to set amount of stock removal, to adjust final bore size, and to compensate for stone wear manually. Three scales are color coded to match three sets of tool families displayed in HONING TOOL box above. Counter-clockwise rotation (increasing numbers) feeds tool to a larger diameter.

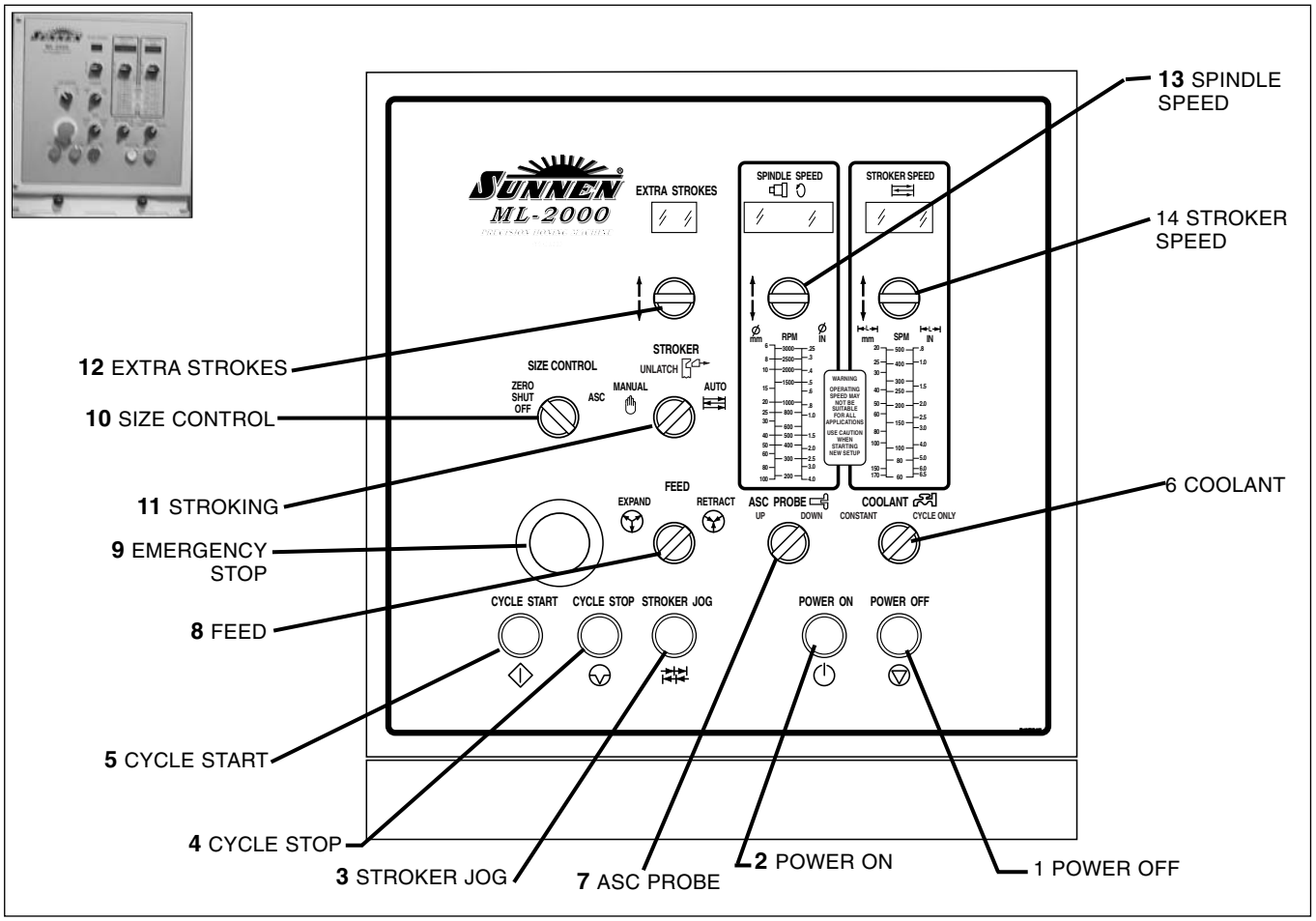


FIGURE 2-2, Operator Control (Non-CE Machines)

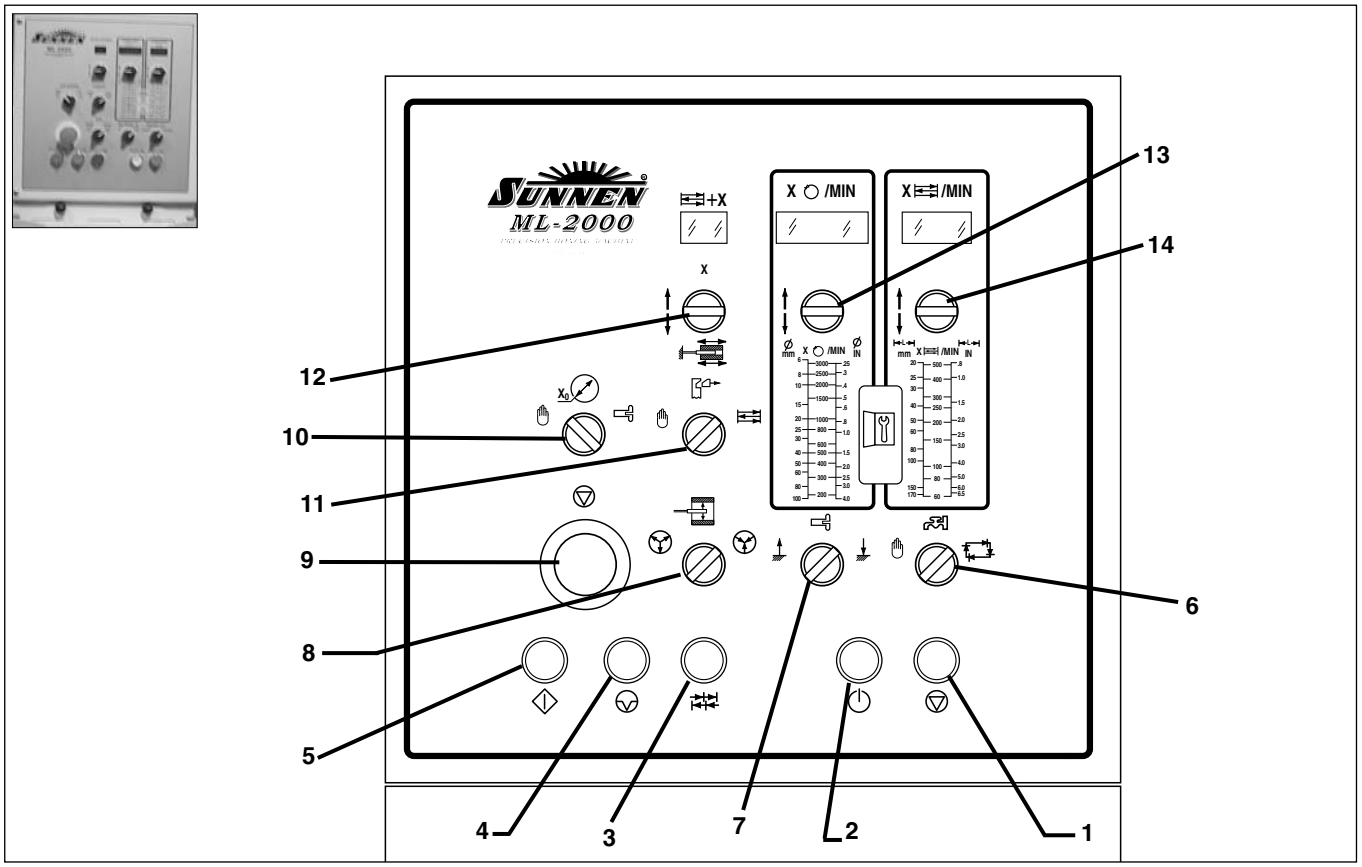


FIGURE 2-3a, Operator Controls (CE Machines)

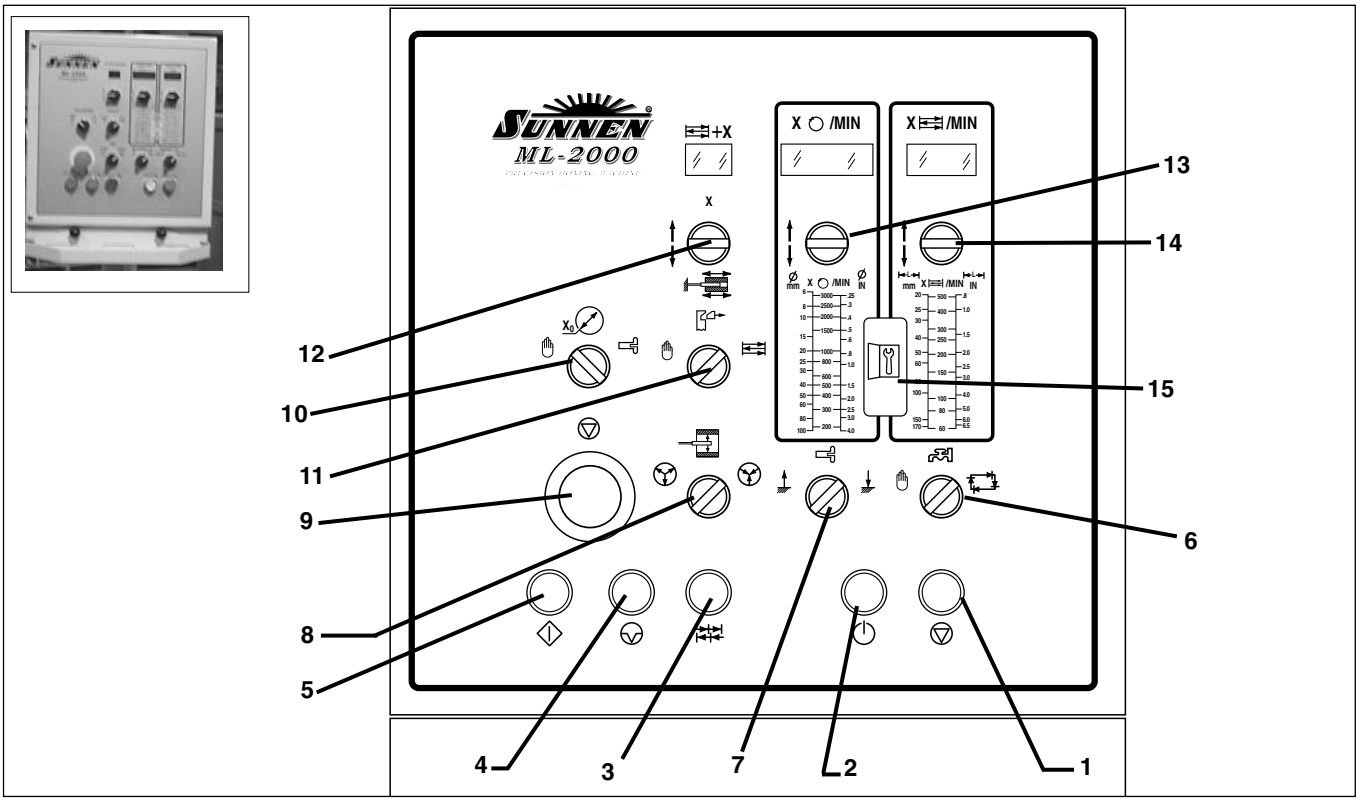


FIGURE 2-3b, Operator Controls (CE Machines)

TABLE 2-1, Symbols used on Operator Controls (CE Machines)

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	1. POWER OFF		8. FEED		12. EXTRA STROKE
	2. POWER ON		8. EXPAND TOOL FEED	X /MIN	13. SPINDLE SPEED
	3. STROKER JOG		8. RETRACT TOOL FEED	X /MIN	14. STROKER SPEED
	4. CYCLE STOP		9. EMERGENCY STOP		WARNING
	5. CYCLE START		10. SIZE CONTROL		
	6. COOLANT		10. SIZE CONT. ZERO SHUT-OFF		
	6. CONSTANT COOLANT FLOW		10. ASC (AUTO SIZE CONTROL)		
	6. COOLANT ON DURING CYCLE ONLY		11. STROKING		
	7. ASC PROBE		11. MANUAL STROKING		
	7. MOVES PROBE UP		11. UNLATCH WORKPIECE		
	7. MOVES PROBE DOWN		11. AUTOMATIC STROKING		

20. HONING INDICATOR - Needle shows feed system position. This position corresponds to amount of stock to be removed from bore diameter if Zero Shut-Off is size control mode. Two scales have different levels of magnification. "A" scale shows stock removal up to 240µ (.009") and "B" scale shows stock removal up to 480µ (.018").

21. FEED REGULATOR MAXIMUM RATE - Feed Regulator is a system to limit maximum rate of feed. MAXIMUM RATE dial is turned to set maximum feed rate limit. On numbered scale larger numbers indicate faster maximum rates. Setting dial to "9" or higher will effectively turn off regulator. (Note: This system is similar to STONE SAVER feature on earlier model Sunnen Honing Machines.)

22. FEED REGULATOR INITIAL DIAMETER - This knob sets feed system position at which Feed Regulator begins to limit maximum feed rate. If stone and shoe wear are negligible or properly compensated then this position corresponds to a consistent tool diameter. Counterclockwise rotation reduces diameter where Feed Regulator starts (longer regulated honing cycle). Clockwise rotation increases diameter where Feed Regulator starts (shorter regulated honing cycle). Turning knob clockwise until it stops will turn off Feed Regulator System.

23. FOOT PEDAL - Depressing Foot Pedal will start honing cycle if power is ON. Feed system (wedge) travel is controlled by foot pedal so that speed at which stone contacts workpiece bore is related to speed of operator's foot. Likewise, raising foot will move wedge back. If STROKING is set to MANUAL, spindle will run only when Pedal is depressed and honing cycle will stop when Foot Pedal is released. If STROKING is set to AUTOMATIC, Foot Pedal will control feed until it is completely depressed. As soon as Foot Pedal is at bottom of its travel, feed system will be controlled by machine and foot pedal can be released without stopping cycle. Releasing foot pedal prior to that point will stop cycle.

24. STROKE POSITION LOCK - This hand lever tightens a screw to lock stroker in position. To adjust stroke position, this hand lever screw must be loosened.

25. STROKE POSITION HANDWHEEL - When Stroker Position Lock is loosened, this handwheel changes position of stroke relative to spindle and honing tool. Graduations are in millimeters. Turning in direction of increasing numbers moves carriage out away from spindle.

26. SPINDLE SPLASH GUARD - Attaches to rear of stroker carriage with a knurled thumb screw. Contains coolant spinning off spindle in most applications. May have to be removed if stroker carriage must stroke too close to spindle housing.

27. COOLANT MANIFOLD - Valves regulate flow of coolant through each of four coolant lines, and one Main Valve controls total amount of coolant flow.

28. MASTER ON/OFF SWITCH - Disconnects power from switch to components in electrical enclosure. Enclosure doors cannot be opened with this switch in ON position.

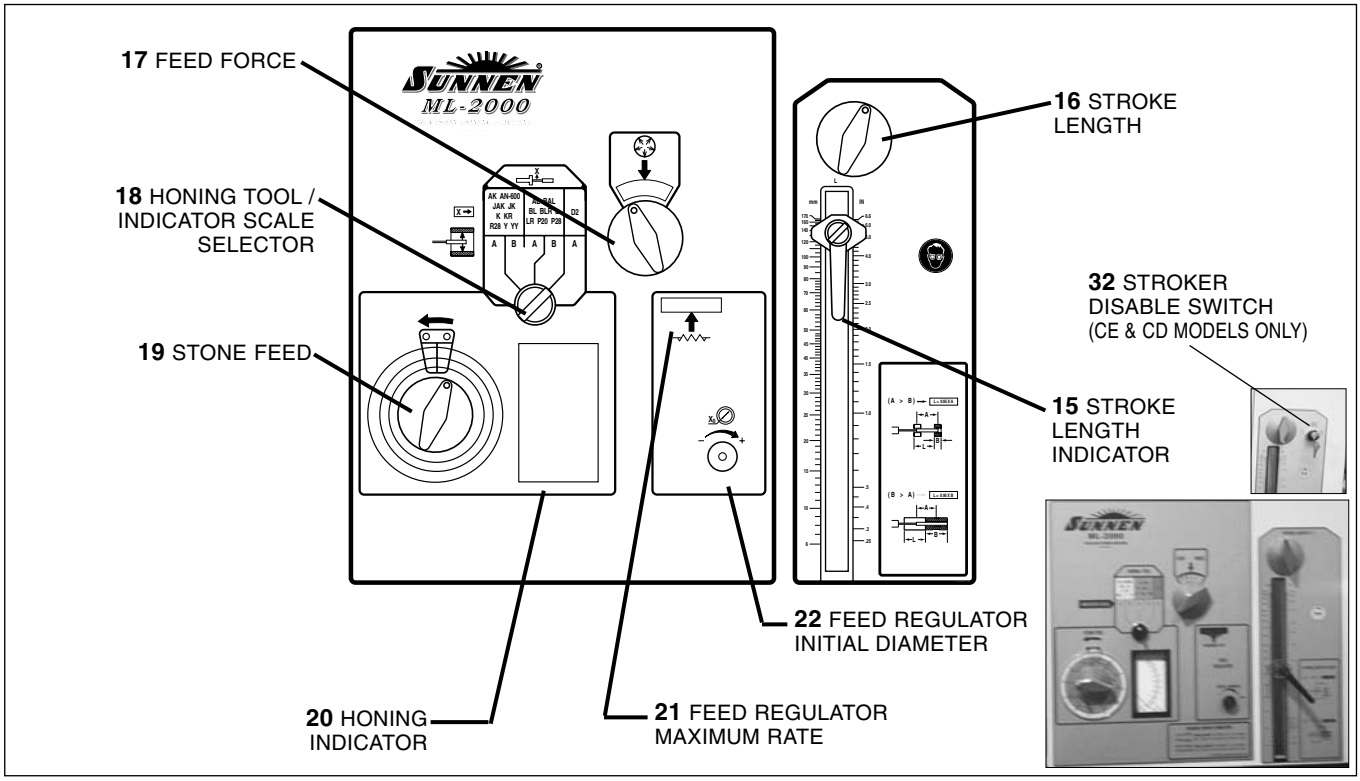


FIGURE 2-4, Front Panel

29. ASC UNIT CLAMP - Turning this knob clockwise locks Automatic Size Control unit in place. Counter-clockwise rotation frees unit so that it can be positioned to gage workpiece at end of stroke. With further loosening, entire ASC unit can be removed from machine.

30. ASC FINE POSITION SCREW - Adjusts position of ASC unit. Clockwise rotation moves ASC unit closer to workpiece 1mm per revolution. This direction of rotation is matched to STROKE POSITION HANDWHEEL rotation for easy adjustment after making a stroke position adjustment. A knurled locknut holds screw in place after making adjustment.

31. PROBE BODY CLAMP KNOB - Locks ASC Probe Body to actuator arm. When loosened probe body can be aligned with workpiece bore, then locked in position.

32. STROKER DISABLE SWITCH (CE & CD models only) - This key switch can be turned to disable stroker for manual honing. When DISABLE is selected automatic stroker cannot run and light curtain is also disabled.

SAFETY SYMBOLS

For a description of safety symbols used on this machine, refer to Table 2-2.

WORKHOLDING FIXTURE

Fixtures used on these machines are custom made for each job (refer to Appendix E).

RUNOUT - MANDREL

Reduce mandrel runout as follows:

NOTE: Mandrel runout should be adjusted before truing mandrel and stone. Then, if required, adjust for conical and parallel runout as outlined later in this section.

1. Select a concentric alignment bushing or truing sleeve with a bore size close to final honed bore size (see Sunnen Honing Supplies Catalog). Place alignment bushing on mandrel so that it is centered on stone and shoe section of mandrel.

WARNING

Do NOT step on foot pedal to lock alignment bushing on mandrel. Spindle will turn if foot pedal is depressed.

TABLE 2-2, Safety Symbols

SYMBOL	DESCRIPTION	FUNCTION
	Warning Label	Warns that an *electrical hazard* exists.
	Label	Designates this machine is *"CE" compliance*.
	Warning Label	Warns that no drilling is allowed. Drilling any new holes may void warranty.
	Warning Strip	Warns that a *physical hazard exits*, and that proper precautions should be taken.
	Caution Label Moving Parts	Warns that a finger hazard exists. Do not touch while stroker is operating.
	Warning Label (Light)	Warns that power must be OFF when belt guard is opened, to prevent injury.
	Warning Label (Safety Glasses)	Warns that safety glasses should be worn at all times when operating this machine.
	Warning Label (Use Fixture)	Warns that a holding fixture should be used to secure part when manual honing.
	Warning Label (Do Not Hold)	Warns that part should not be held in hand for honing.
	Warning Label (Foot Pedal)	Warning.
	Warning Label (Foot Pedal)	General Warning.

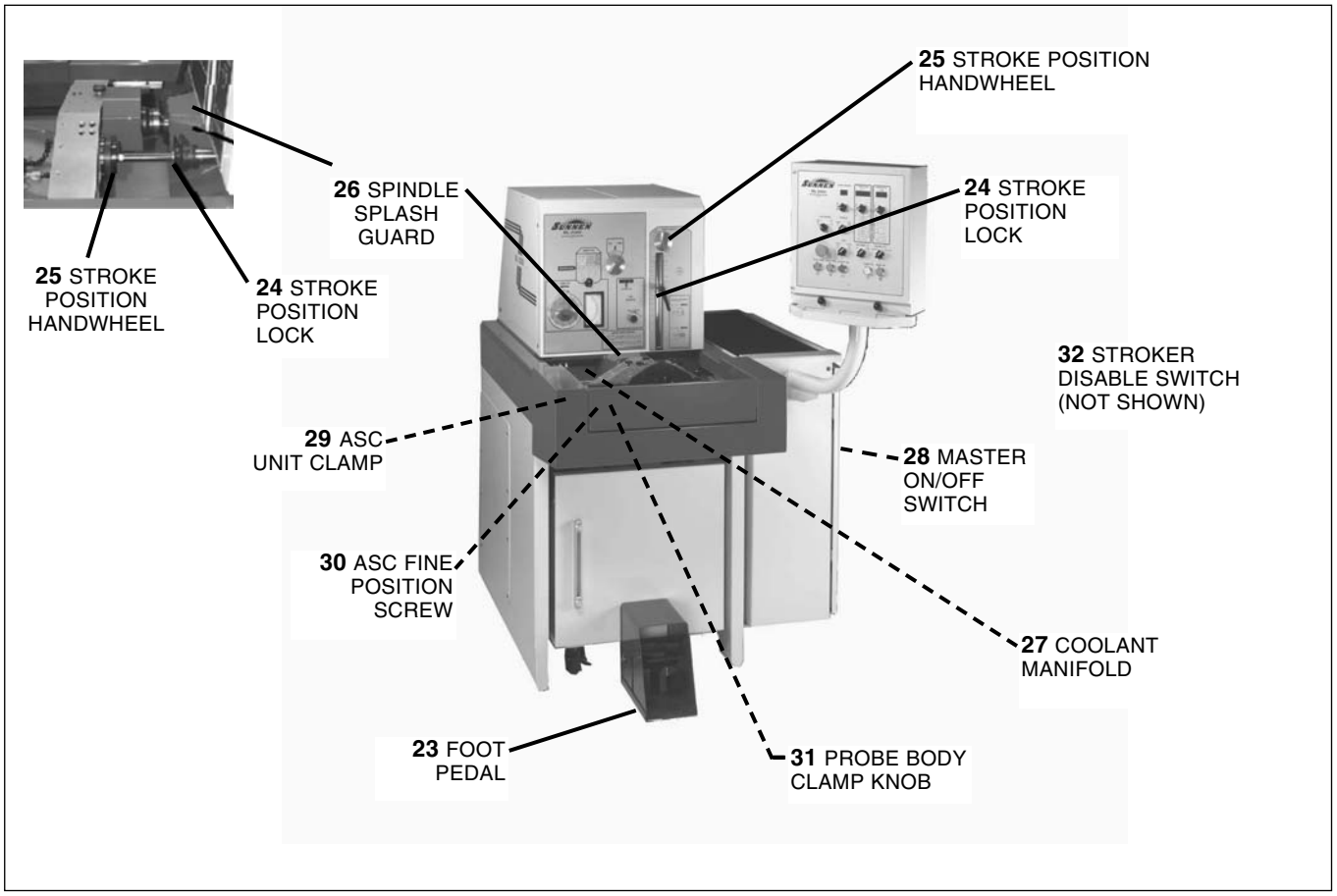


FIGURE 2-5, Machine Controls

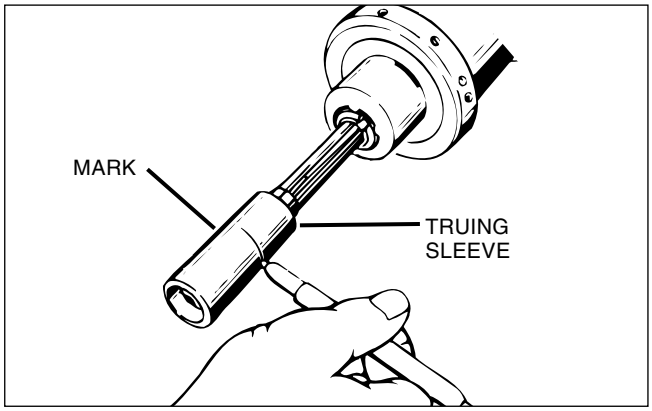


FIGURE 2-6, Mandrel Runout

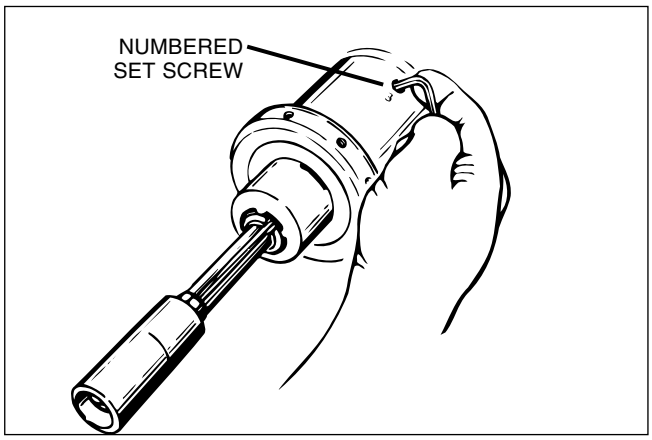


FIGURE 2-7, Numbered Set Screws

2. Turn FEED selector to EXPAND to lock alignment bushing on mandrel. Look to Honing Indicator. If needle reads somewhere on scale then alignment bushing is properly locked on. If not turn STONE FEED DIAL until there is an indicator reading. (Turn Dial same direction as you wish needle to move.)

3. Turn FEED selector to RETRACT.

4. Set Spindle Speed to 200 rpm.

WARNING

Do not attempt to adjust mandrel runout at any speed higher than 200 rpm.

5. Depress Foot Pedal fully to start spindle with alignment bushing on mandrel. If runout is excessive, center honing unit following steps 6 & 7. If runout does not seem excessive, then mandrel runout adjustment is complete.

6. With bushing or sleeve rotating on honing unit, touch a marking pencil to sleeve to indicate high side (see Figure 2-6).
Turn FEED selector to EXPAND. This stops spindle while keeping sleeve locked on mandrel. This also will disable Foot Pedal to prevent accidental starting.

7. Loosen numbered set screw on spindle nose that is on same side as high pencil mark and tighten screw on opposite side (see Figure 2-7).

8. Turn FEED selector to RETRACT and repeat steps 5-7 as necessary until minimum runout is obtained.

TRUING MANDREL & STONE

True mandrel and stone as follows:

NOTE: Adjust for mandrel runout before truing mandrel and stone.

1. CE & CD Models ONLY: Turn keyed Stroker Disable Switch to DISABLE.

2. For safety start truing with a very low Feed Force: 1: For tools smaller than 6 mm (.25 in.)
1.2: For larger tools

3. Place a truing sleeve, or suitable undersized workpiece, in a torque absorbing fixture and on mandrel.

4. Set FEED selector to EXPAND and turn STONE FEED DIAL until HONING INDICATOR shows a reading.

5. Return FEED selector to RETRACT.

6. Set COOLANT selector to CONSTANT.

7. Slowly open main coolant valve on coolant manifold until there is flow at one or more coolant nozzle. Wet shoes and stone with coolant, then turn coolant off.

8. Center truing sleeve over stone and shoes. Grasp truing sleeve and holding fixture firmly with your left hand and slowly depress foot pedal.

9. As mandrel begins its rotation, stroke truing sleeve forward and back. Use short strokes at first, then gradually lengthen strokes until stroke is about as long as sleeve or stone whichever is longer.

10. Reverse truing sleeve frequently.

WARNING

Always release pedal before removing truing sleeve or workpiece from tool.

11. If honing indicator needle is not moving and feed force feels too light, then stop and increase Feed Force by a small amount.

12. If needle on honing indicator goes below zero, then stop and feed stone up.

13. If mandrel dries out, apply a little more coolant.

14. Concentrate truing on area where you feel most pull or resistance.

15. Frequently stop and examine shoes and stone. For most applications at least a full line of contact should be seen on stone and both shoes. If wear does not show sufficient contact use truing sleeve some more (see Figure 2-8).

NOTE: When using keyway mandrels, stone and shoes must fully radius to within 0,13 mm (.005") before bores with keyways can be honed.

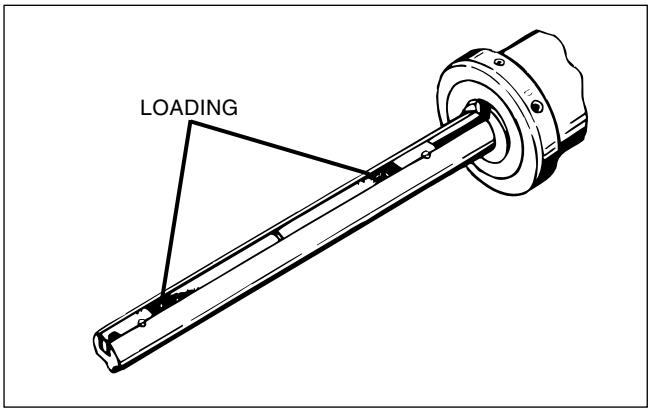


FIGURE 2-8, Stone Loading

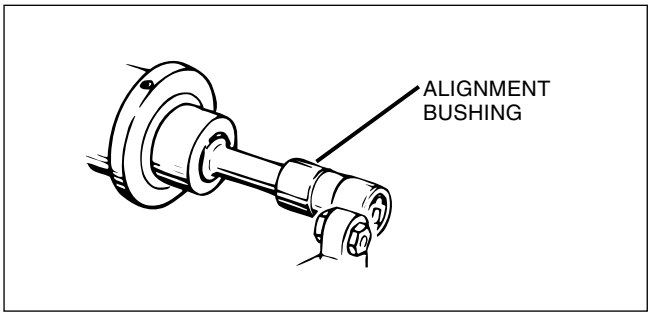


FIGURE 2-9, Alignment Bushing

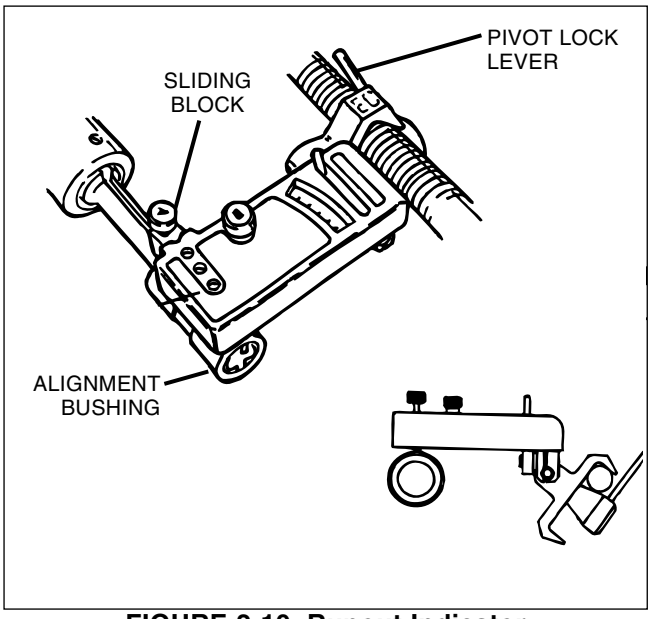


FIGURE 2-10, Runout Indicator

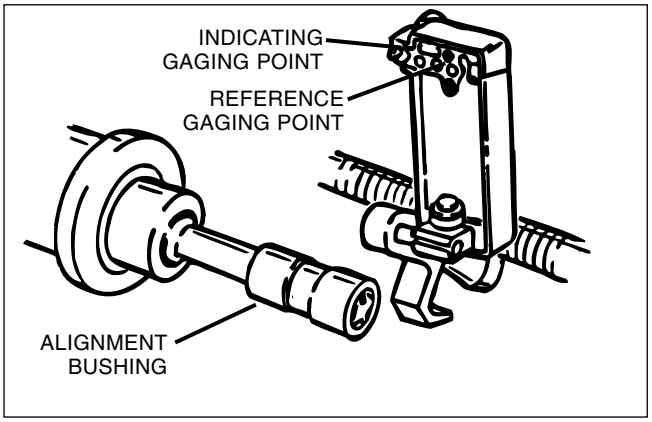


FIGURE 2-11, Runout Indictor Gaging Point

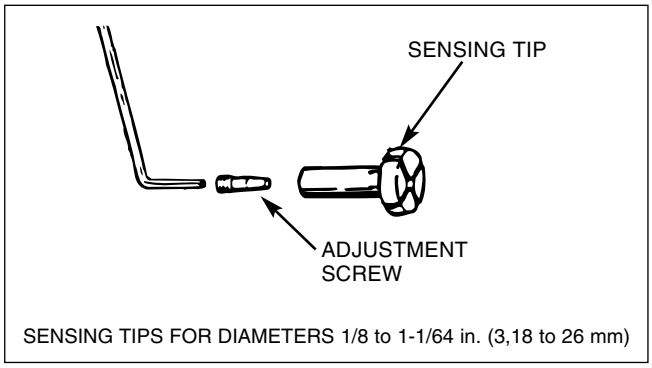


FIGURE 2-12, Sensing Tip

16. When finished truing return STROKER key switch to ENABLE and remove key.

RUNOUT - CONICAL & PARALLEL

Eliminate conical and parallel spindle runout as follows:

NOTE: Mandrel runout should be adjust; and mandrel and stone should be trued before adjusting for conical and parallel runout.

1. Select a concentric alignment bushing with a bore size close to final honed bore size (see Sunnen Honing Supplies Catalog). Place alignment bushing on mandrel so that it is centered on stone and shoe section of mandrel (see Figure 2-9).

WARNING

Do NOT step on foot pedal to lock alignment bushing on mandrel. Spindle will turn if foot pedal is depressed.

2. Turn FEED selector to EXPAND to lock alignment bushing on mandrel. Look to Honing Indicator. If needle reads somewhere on scale then alignment bushing is properly locked on. If not turn STONE FEED DIAL until there is an indicator reading. (Turn Dial same direction as you wish needle to move.)

3. Release stroker carriage and pull it out toward front of work area.

4. Attach RUNOUT INDICATOR supplied with machine to threaded stroker drive shaft as shown *(see Figure 2-10)*. Position aluminum indicator base so that letters "EC" are up and facing you, with that surface approximately level. Move clamp handle until plastic cone on cam grips threaded stroker drive shaft.

5. Note reference gaging point and indicating gaging point on indicator *(see Figure 2-11)*. They should be spaced as far apart as possible without exceeding length of alignment bushing. If necessary, remove Knob A (reference gage point) by unscrewing it and inserting it in another hole. Sliding Block will slide out to provide even greater separation of gaging points.

6. Position stroker carriage so that gaging points will contact alignment bushing.

7. Move pivot lock lever to "Release" position so that entire indicator will follow alignment bushing by contact of reference gaging point.

8. With pivot lock lever in "Release" position, Runout Indicator is now set to measure conical runout of honing unit. Rotate spindle by hand while observing indicator. If necessary turn Knob A to get an indicator reading. Turn spindle until high point is found. Loosen nearest lettered screw (A-B-C-D) on front of spindle nose, and tighten screw on opposite side. Repeat this procedure until conical runout is within acceptable limits. (Conical runout of less than two divisions on indicator is acceptable for most honing applications. For close tolerance applications, conical runout should be less than one division.)

9. With runout indicator remaining on alignment bushing, move pivot lever to "Lock", and turn Knob A counterclockwise two or three revolutions.

10. With pivot lock lever in "Lock" position, Runout Indicator is now set to measure parallel runout of honing unit. Rotate spindle by hand while observing Runout Indicator. If necessary turn Knob B to get an indicator reading. Turn spindle until high point is found. Loosen nearest numbered screw (1-2-3-4) on rear of spindle nose, and tighten screw on opposite side. Repeat this procedure until parallel runout is within acceptable limits. (Parallel runout of less than two divisions on indicator is acceptable for most honing applications. For close tolerance applications, parallel runout should be less than one division.)

11. Conical runout should not be affected by adjustment of parallel runout, however it is a good practice to double check conical runout again. If amount of parallel adjustment was large then conical runout may have changed slightly. If it is necessary to readjust conical runout, then always recheck parallel runout after that.

12. Remove indicator from threaded stroker drive shaft.

13. Set FEED selector to RETRACT and remove alignment bushing.

AUTOMATIC SIZE CONTROL (Optional)

Set Automatic Size Control (ASC) Unit as follows:

1. If ASC Unit has been removed from machine, then it must be installed.

NOTE: If setting up ASC for first time on a new machine, it may be necessary to adjust ASC unit. (Only necessary for a new machine or a new ASC unit.)

2. Select and adjust proper Sensing Tip or Sensing Tip Unit for final bore size to be gaged (see Table 2-3 & Figure 2-12).

NOTE: A sensing tip is adjustable to any size within its diameter range. However, once adjusted to a bore size near maximum, sensing tip may take a permanent set and not return to minimum sizes. Therefore it may be necessary to have more than one sensing tip if you have more than one application with different sizes within same diameter range. Also, changeover time from one job to next will be minimized if, once adjusted, a sensing tip is dedicated to one particular application only.

All four segments of sensing tip or sensing unit must contact taper on adjustment screw. If one or more segments has been bent away from screw, then back out screw and squeeze sensing tip back into shape.

If final bore size is smaller than 26 mm (1.03") skip steps 3 through 10 and go to step 11.

3. If using Sensing Unit, back out adjustment screw until it is loose in sensing body. Then tighten this screw one full turn after initial contact is made between tapered portion of adjusting screw and sensing body. This initial setting of adjustment screw will allow you to increase or decrease sensing unit size when final size adjustment is made.

4. Determine proper micrometer setting for ASC-50 Setting Fixture or ASC-50M Metric Setting Fixture by following formula:

[Desired Bore Size - 1" (or 25,4mm)] ÷ 2

Set micrometer to this size and lock micrometer spindle.

5. Adjust sensing screws in sensing body so that size is somewhat smaller than desired bore size. Insert sensing unit into setting fixture (see Figure 2-13).

6. Line up one of four screws with micrometer spindle and tighten clamp screw on setting fixture. As you tighten clamp screw, press downward on sensing unit as shown (refer to Figure 2-13). Downward force assures that sensing unit is flat against frame of setting fixture. This is necessary for best accuracy.

With wrenches provided, adjust sensing screw to just touch micrometer spindle tip and tighten locking nut. Repeat step for each sensing screw.

7. Note micrometer reading. Loosen micrometer spindle lock, and back off spindle. Check each of four sensing screws with micrometer ratchet. All sensing screws should read within 0,03 mm (.001"). Be sure to hold sensing unit flat on setting fixture frame each time you tighten clamp screw.

8. Back off adjustment screw slightly so that first part honed will be undersized rather than oversized if there was any inaccuracy in setting.

9. Sensing tip or sensing unit is adjusted by turning adjustment screw inside stem of tip with a 1/16" hex wrench. Sensing tip or sensing unit can be set to size with a micrometer or by inserting it into a

TABLE 2-3, ASC Sensing Tips

SENSING TIP	INCHES			MILLIMETERS		
	NOMINAL	DIAMETER RANGE		NOMINAL	DIAMETER RANGE	
PART NUMBER	DIAMETER	LOW	HIGH	DIAMETER	LOW	HIGH
ASC-0125	1/8	.120	.139	3,18	3,05	3,53
ASC-0141	9/64	.135	.154	3,57	3,42	3,91
ASC-0415	5/32	.150	.169	4,00	3,81	4,29
ASC-0172	11/64	.166	.185	4,36	4,22	4,70.
ASC-0188	3/16	.180	.I99	4,76	4,57	5,05
ASC-0203	13/64	.191	.210	5,00	4,85	5,33
ASC-0219	7/32	.211	.230	5,56	5,36	5,84
ASC-0234	15/64	.226	.245	6,00	5,74	6,22
ASC-0250	1/4	.240	.259	6,35	6,10	6,58
ASC-0266	17/64	.256	.275	6,75	6,50	6,99
ASC-0281	9/32	.269	.288	7,00	6,83	7,32
ASC-0297	19/64	.2B7	.306	7,54	7,29	7,77
ASC-0312	5/16	.304	.323	8,00	7,72	8,20
ASC-0328	21/64	.318	.337	8,33	8,0	8,56
ASC-0344	11/32	.334	.353	8,73	8,48	8,97
ASC-0359	23/64	.347	.366	9,00	8,81	9,30
ASC-0375	3/8	.365	.384	9,53	9,27	9,75
ASC-0391	25/64	.383	.402	10,00	9,73	10,21
ASC-0406	13/32	.396	.415	10,32	10,06	10,54
ASC-0422	27/64	.412	.431	10,72	10,47	10,95
ASC-0438	7/16	.426	.445	11,00	10,82	11,30
ASC-0453	29/64	.443	.462	11,51	11,25	11,74
ASC-0469	15/32	.461	.480	12,00	11,71	12,19
ASC-0484	31/64	.474	.493	I2,30	12,04	I2,52
ASC-0500	1/2	.490	.509	I2,70	12,45	12,93
ASC-0516	33/64	.505	.524	13,00	12,83	13,31
ASC-0531	17/32	.521	.540	13,50	13,23	13,72
ASC-0547	35/64	.540	.559	14,00	13,72	14,20
ASC-0562	9/16	.552	.571	14,29	14,02	14,50
ASC-0578	37/64	.568	.587	14,68	14,43	14,91
ASC-0594	19/32	.583	.602	I5,00	14,81	15,29
ASC-0609	39/64	.599	.618	15,48	15,22	15,70
ASC-0625	5/8	.615	.634	15,88	15,62	16,10
ASC-0630	- - -	.620	.639	16,00	15,75	16,23
ASC-0641	41/64	.631	.650	16,27	16,03	16,51
ASC-0656	21/32	.646	.665	16,67	16,41	16,89
ASC-0672	43/64	.661	.680	17,00	16,79	17,27
ASC-0688	11/16	.678	.697	17,46	17,22	17,70
ASC-0703	45/64	.697	.716	18,00	17,70	18,19
ASC-0719	23/32	.709	.728	18,26	18,01	18,49
ASC-0734	47/64	.724	.743	18,65	18,39	18,87
ASC-0750	3/4	.740	.759	19,00	18,80	19,28
ASC-0766	49/64	.756	.775	19,45	19,20	19,69
ASC-0781	2s/32	.775	.794	20,00	19,69	20,17
ASC-0797	51/64	.787	.806	20,24	19,99	20,47
ASC-0812	13/16	.802	.821	20,64	20,37	20,85
ASC-0828	53/64	.818	.837	21,00	20,78	21,26
ASC-0844	27/37	.834	.853	21,43	21,18	21,67
ASC-0859	53/64	.853	.872	22,00	21,67	22,15
ASC-0875	7/8	.86s	.884	22,22	21,97	22,45
ASC-0891	57/64	.881	.900	22,62	22,38	22,86
ASC-0906	29/32	.896	.915	23,00	22,76	23,24
ASC-0922	54/64	.912	.931	23,42	23,17	23,65
ASC-0938	15/16	.932	.951	24,00	23,67	24,16
ASC-0953	61/64	.943	.962	24,21	23,95	24,44
ASC-0969	31/32	.959	.978	24,61	24,36	24,84
ASC-0984	63/64	.972	.991	25,00	24,69	25,17
ASC-1000	1	.930	1.009	25,40	25,15	25,63
ASC-1016	1-1/64	1.011	1.030	26,00	25,68	26,16

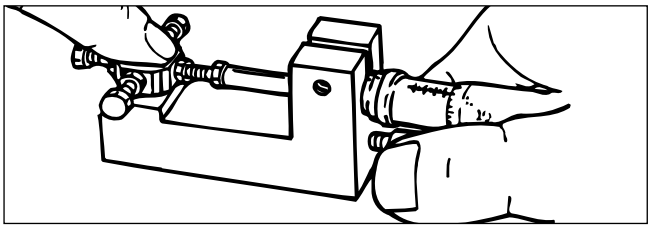


FIGURE 2-13, Sensing Unit Setting Fixture

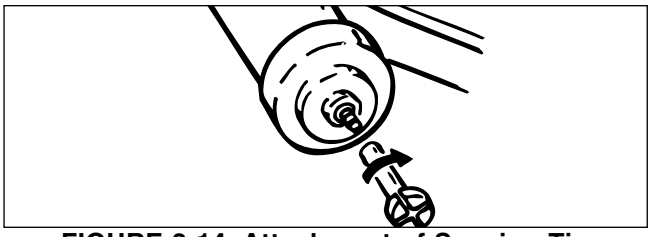


FIGURE 2-14, Attachment of Sensing Tip

workpiece that has already been honed to final size. Set adjustment screw so that sensing tip lightly drags on honed bore. Then back off adjusting screw about 1/4 turn. This will make first part honed undersized by approximately 0,025 mm (.001").

NOTE: Final size can be adjusted after first workpiece by either turning adjustment screw or by changing number of Extra Strokes displayed on operator panel.

10. Screw Sensing Tip or Sensing Unit on to stud on Probe Body (see Figure 2-14). If required, use Probe Extension to reach into counterbore in workpiece or reach past fixturing.

11. Press STROKER JOG and hold in to get stroker to front of stroke

12. Turn spindle by hand until shoes are up and then place a workpiece on mandrel.

WARNING

Keep hands away from ASC unit when turning ASC Probe Selector to move ASC probe up or down.

13. Make sure that ASC unit is a safe distance from honing tool, and with hands away from work area, turn ASC PROBE selector to UP.

14. Loosen Clamp Screw on ASC unit and slide unit up to workpiece. Sensing Tip should be depressed about 3 mm (1/8"). Tighten Clamp Screw.

NOTE: If desired, use Stop Clamp supplied with ASC unit to allow quick return to ASC setup position again if unit needs to be moved back along Rail for honing tool runout adjustment or replacement. Attach Stop Clamp to ASC Rail against back of ASC unit with supplied brass tipped set screw.

15. Loosen locknut on ASC Fine Position Screw. Look through hole near top of ASC arm to red light on proximity switch. Turn ASC Fine Position Screw until point is reached where light is just turned on. From that point, turn ASC Fine Position Screw 1-1/2 turns clockwise. Tighten locknut on Fine Position Screw.

16. Loosen Probe Body Clamp Knob and move whole Probe Body to center Sensing Tip on workpiece bore. Tighten Probe Body Clamp Knob.

17. Press STROKER JOG repeatedly to see how Sensing Tip engages bore and to see if Proximity Switch is being made at end of stroke. It may be necessary to reposition Probe Body or to adjust Fine Position Screw.

NOTE: STROKER JOG will not operate if FEED selector is set to EXPAND.

18. Return ASC PROBE selector to DOWN.

STOCK REMOVAL RATE

1. Make sure Honing Tool / Indicator Scale Selector Switch is set for proper tool and scale.

2. With a measured workpiece seated on mandrel, turn Tool Feed Switch to Expand.

3. Turn Stone Feed Dial until needle on Honing Indicator reads the amount of stock you want removed.

NOTE: There is some backlash in Stone Feed Dial. For best accuracy in setup, always turn Dial until Honing Indicator reads some amount less than desired stock removal and then feed up (counterclockwise) until needle shows correct amount of stock removal.

FEED REGULATOR

Use of FEED REGULATOR is optional. If it is not to be used on this application, then skip this step. (Refer to Appendix A for guidelines on when Feed Regulator may be beneficial.) To set FEED REGULATOR, proceed as follows:

1. Turn MAXIMUM RATE dial to slowest speed.

2. Turn INITIAL DIAMETER knob counterclockwise about two turns.

3. With workpiece removed from tool, turn FEED selector to EXPAND while watching Honing Indicator. Needle will drop quickly to initial diameter point and then move very slowly. If point that needle stops is not desired point, then turn FEED selector to RETRACT, adjust INITIAL DIAMETER knob, and expand again while watching indicator.

NOTE: To use FEED REGULATOR efficiently, initial diameter should be set to a point just smaller than smallest starting bore diameter that you expect to encounter. It may be necessary to measure several workpieces to know how they will vary. Set initial diameter to point where Honing Indicator reads difference between initial diameter and final bore size. There are trade-offs to setting this initial diameter. If it is too large, a workpiece slightly smaller than expected may be contacted at full feed force, possibly damaging stone or tool. If initial diameter is set too small, cycle time gets excessively long with significant time spent just "cutting air". Use your best judgement based on your knowledge of variability of starting diameter of workpieces.

When using Feed Regulator at higher feed forces, "Initial Diameter" (where needle begins to slow down on Honing Indicator) may appear different during a cycle than it did when it was set by recommended procedure. This is normal behavior caused by amount of compression in feed system.

However, this indicates that stones are contacting workpiece bore immediately after cycle begins although not at full feed force selected. If this initial contact still seems too rough, then turn Initial Diameter knob counterclockwise some to make Feed Regulator begin at a smaller diameter.

SECTION 3
SETUP & OPERATION

GENERAL

This section gives step-by-step setup and operating procedures for Sunnen® ML-2000 Power Stroked Honing Machine.

SAFETY PRECAUTIONS

The following precautions should be observed to ensure maximum safety while working on or around your Machine.

• Wear proper Safety Items (such as safety glasses and other personal safety equipment as necessary or required).

• DO NOT wear loose fitting clothes or jewelry while working on or around Machine.

• Keep area around Machine free of paper, oil, water and other debris at all times.

• Keep Machine and area around machine cleaned of excessive lubricant and lubricant spills.

• Keep tools and other foreign objects clear of Machine while in operation.

• Keep tools clean and in their proper storage compartments to maintain them in proper working condition and to prolong tool life.

• Inspect Tools before using. Check for cracks, burrs or bent parts that might effect operation.

• DO NOT force tools when operating. Tools will do a better and safer job when operated at the rate for which they were designed.

• Turn OFF electrical power when performing service on your machine, which does not require power.

• Disconnect Machine from main power supply and allow drives to drain before any work is performed inside of Electrical Enclosure.

• Ensure all Guards are in place and are in proper working order.

• DO NOT override safety switches or lockouts. Where interlocking systems rely on special actuators or keys, DO NOT keep spare/master actuators or keys on, around or near machine.

• Use proper lifting procedures when loading and unloading the Machine.

• Keep all non-essential persons clear of work area. Visitors, especially children, should not be permitted near the work area.

• DO NOT use machine for other than its intended use. Using these Machines for other purposes could result in damage to machine and loss of warranty.

• Be sure to work in a well lit area and to use light supplied to avoid dangerous unseen conditions which may exist otherwise.

• Use ONLY factory authorized or recommended parts or replacement accessories. Using parts or accessories other than those approved by Sunnen could result in damage to machine and loss of warranty.

• Electrostatic discharge can damage the circuitry of the electronic components used in this Machine. Use proper electrostatic controls when working with or around electronic components. Ground Machine and use wrist strap to reduce the chances of static discharge.

• Residual Voltage exists for 2-3 minutes after Master ON/OFF Switch is turned OFF. Before working inside Enclosure, wait for all fans to stop running to allow drives to drain.

OPERATING TIPS

The ML-2000 can be setup and operated a number of different ways. The use of many features is optional. Not all features are beneficial in any given application. Appendix A explains some of these optional features and outlines some guidelines for determining when they might be beneficial. Usually experimentation will be required to find optimum setup.

Although ML-2000 is intended for production honing, manual stroked honing is possible. Manual honing should only be used for honing a very small number of workpieces such as for tooling or repairs. The ease of setting up stroker and fixture makes it practical to power stroke even as few as five or ten workpieces. Power stroking is always more precise, more consistent, and safer.

SETUP - MANUAL HONING

Follow ALL steps for manual honing carefully and in the order listed.

• ALWAYS start with Feed Force set to no more than 1.1 and Spindle Speeds set to no more than 1/2 of recommended speeds. The danger of manual honing increases as speed or feed force is increased.

• (For Models CE & CD): When finished manually honing, return Stroker Key Switch to ENABLE and remove Key, so that spindle can not start if an operator is in work area.

1. Press Emergency Stop to clear any previous setup.

2. Turn OFF coolant supply by turning Main Valve on Coolant Manifold fully clockwise.

3. If ASC unit is attached to machine, loosen Clamp and slide unit out away from spindle. Turn ASC PROBE selector to DOWN. (Unit can also be removed from machine entirely.

4. Set SIZE CONTROL selector to ZERO SHUT-OFF.

5. Set STROKER key switch to DISABLE. Set Stroking selector to MANUAL.

6. Set FEED selector to RETRACT.

7. Turn FEED REGULATOR off by turning INITIAL DIAMETER knob fully clockwise.

8. Remove Spindle Splash Guard.

9. Disengage Stroker Carriage from power stroking unit: Turn STROKING selector to UNLATCH. Then, pull Stroker Carriage forward to provide access to spindle.

10. Select correct honing unit and stone from Sunnen Honing Supplies Catalog.

11. Assemble Honing Unit according to instructions.

12. Set HONING TOOL / INDICATOR SCALE selector to position that matches tool being used and scale you wish to read.

NOTE: It is recommended that "A" scale be used unless stock removal is expected to be more than 240µ (.009"). Finer resolution on "A" scale gives a clearer indication of honing rate.

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13. Turn STONE FEED dial clockwise until you meet resistance, then advance it counterclockwise approximately 10 turns.

CAUTION

Do not force STONE FEED DIAL or damage to feed system may result.

---

14. Pull Mandrel Wedge straight back as far as possible.

15. If required, install Spindle Sleeve (LN-570A, not supplied with machine) on Honing Unit.

16. Rotate spindle by hand until large set screw is up (12 o'clock position).

17. With set screw indentation on honing unit in 9 o'clock position, insert honing unit as far as it will go. Rotate honing unit 1/4 turn clockwise to engage wedge with feed rod, then push honing unit all way in until it bottoms.

18. Test wedge hookup by pulling honing unit straight out (do not rotate). If wedge is hooked up it will not allow unit to come out. If honing unit comes out, repeat step 19. Push honing unit back in until it bottoms.

19. Tighten large set screw in spindle.

20. Release Emergency Stop and turn power on.

21. Set Feed Force Dial to desired level.

CAUTION

When manually honing, always start at a low feed force for safety.

---

22. Reduce Mandrel Runout (refer to Section 2).

23. Set Spindle Speed. Use chart on operator station as a guideline for determining speed.

WARNING

Recommended speeds may not be suitable for all applications. For MANUAL HONING always start with a speed that is no more than half speed recommended on chart, then increase speed in small increments only when job seems to be running safely. Never exceed recommended speed when manually honing.

---

24. Position Stroker Carriage for manual honing:

• Push Stroker Carriage back until it stops. Turn STROKING selector to MANUAL.

• Set STROKER LENGTH to 6 mm (1/4 in).

• Loosen Stroke Position Lock and turn Stroke Position Handwheel to move Stroker Carriage in until it stops. Tighten Stroke Position Lock.

25. Remove any fixturing components that do not provide adequate clearance for manual honing.

26. Install and position Torque Bar on stroker carriage so that work holding fixture can bear against it to resist honing torque.

27. True mandrel and stone (refer to Section 2).

28. Set coolant lines to supply a continuous supply of coolant to front and back of bore. Coolant nozzles are attached to small aluminum bases that can be attached to stroker carriage. Turn COOLANT selector to CONSTANT and adjust valves on coolant manifold. Use as much coolant as possible without losing any to splashing or spraying out of machine.

NOTE: There are two sizes of coolant nozzles provided. Black nozzles have small openings for delivering a steady narrow jet of coolant from a distance. Use these if it is difficult or inconvenient to place nozzle close to workpiece. Orange nozzles have larger openings and can deliver a larger volume of oil with less splash. Larger nozzles are preferred if they can be positioned close to workpiece.

OPERATION - MANUAL HONING

Follow ALL steps for manual honing carefully and in the order listed.

NOTE: Before honing, review your setup of machine.

---

1. Gage bore size using Sunnen Precision Bore Gage to determine amount of stock to be removed.

2. Install workpiece in workholding fixture.

WARNING

To prevent personal injury and possible damage to machine, DO NOT hone without installing workpiece in a workholding fixture that transmits honing torque to a solid machine member. Never try to absorb honing torque by holding workpiece with your hand.

3. Slide workpiece on mandrel and center workpiece over stone. It may be necessary to back off Stone Feed Dial (clockwise) to get workpiece on mandrel.

4. Turn POWER ON.

5. Make sure that Feed Force is set to desired setting and then turn FEED selector to EXPAND. Turn workpiece several revolutions on mandrel to seat workpiece on stone.

WARNING

Do NOT step on foot pedal to set stock removal amount. Spindle will turn if foot pedal is depressed.

6. Turn Stone Feed Dial until needle on Honing Indicator shows amount of stock to be removed. Make sure that Honing Tool / Indicator Scale Selector is set to appropriate mandrel family.

7. Turn FEED selector to RETRACT.

8. Check Spindle Speed setting and verify that STROKING selector is set to MANUAL.

WARNING

Recommended speeds may not be suitable for all applications. For MANUAL HONING always start with a speed that is no more than half speed recommended on chart, then increase speed in small increments only when job seems to be running safely. Never exceed recommended speed when manually honing.

9. Slowly depress Pedal while stroking workpiece. If bore is rough or out of round DO NOT fully depress Pedal until bore has smoothed out as evidenced by diminishing vibration. Use same Overstroke at each end of stroke. If possible, frequently stop machine and reverse workpiece on mandrel.

NOTE: If bore is shorter than stone, then "Overstroke" is amount bore extends past stone at end of stroke. If stone is shorter than bore, then "Overstroke" is amount that stone extends past end of bore at end of stroke. Overstroke should be 1/3 to 1/2 of bore length or stone length, whichever is shorter.

10. If needle on Honing Indicator appears to be moving too slowly, then increase Feed Force. But never increase feed force to point that it is difficult to stroke workpiece smoothly and consistently by hand.

CAUTION

Very small mandrels may break before you encounter significant resistance to stroking. With very small mandrels, do not increase feed force unless needle on Honing Indicator shows that cutting has virtually stopped.

11. Hone until needle on Honing Indicator reaches zero. Do not hone below zero. Below zero feed force drops from set value which can cause glazed stones, poor accuracy, and an unnecessarily long honing cycle.

12. Gage hole size. If workpiece was correctly seated on mandrel when stock removal was set, and if Stone Feed Dial or Feed Force dial has not been moved, then bore should be undersized by amount that stone has worn. Advance Stone Feed Dial by this amount and hone again to zero.

13. If more than one workpiece is to be honed, then place next workpiece on mandrel and repeat honing operation. Do not advance Stone Feed dial at beginning of a cycle unless you are confident that stone will wear at least that much. If you feed up more than stone actually wears then bore will be oversized when you hone to zero.

SETUP - POWER STROKED HONING

Follow ALL steps for power stroked honing carefully and in the order listed.

1. Press Emergency Stop to clear any previous setup.

2. Turn OFF coolant supply by turning Main Control Valve on Coolant Manifold fully clockwise.

3 . If ASC unit is attached to machine, loosen Clamp and slide unit out away from spindle. Turn ASC PROBE selector to DOWN. (Unit can also be removed from machine entirely.)

4. Set FEED selector to RETRACT.

5. Turn FEED REGULATOR off by turning INITIAL DIAMETER knob fully clockwise.

6. Remove Spindle Splash Guard.

7. Disengage Stroker Carriage from power stroker:
- Turn STROKING selector to UNLATCH.
- Pull Stroker Carriage forward to provide access to spindle.

8. Select correct honing unit and stone from Sunnen Honing Supplies Catalog.

9. Assemble Honing Unit according to instructions.

10. Set HONING TOOL / INDICATOR SCALE selector to position that matches tool being used and scale you wish to read.

NOTE: For most applications, it is recommended that "A" scale be used unless stock removal is expected to be more than 240µ (.009 in.). Finer resolution on "A" scale gives a clearer indication of honing rate.

11. Turn STONE FEED dial clockwise until you meet resistance, then advance it counterclockwise approximately 10 turns.

CAUTION

Do not force STONE FEED DIAL or damage to feed system may result.

12. Pull Mandrel Wedge straight back as far as possible.

13. If required, install Spindle Sleeve (LN-570A, not supplied with machine) on Honing Unit.

14. Rotate spindle by hand until large set screw is up (12 o'clock position).

15. With set screw indentation on honing unit in 9 o'clock position, insert honing unit as far as it will go. Rotate honing unit 1/4 turn clockwise to engage wedge with feed rod, then push honing unit all way in until it bottoms.

16. Test wedge hookup by pulling honing unit straight out (do not rotate). If wedge is hooked up it will not allow unit to come out. If honing unit comes out, repeat step 16. Push honing unit back in until it bottoms.

17. Tighten large set screw in spindle.

18. Release Emergency Stop and turn power on.

NOTE: Steps 20 through 29 are instructions for truing stone and shoes of honing tool. Truing is not always necessary. If you don't need to true mandrel, then skipping these steps can save considerable time in set-up. See Appendix A for guidelines on when truing is necessary and when it can be considered optional.

19. Set STROKING selector to MANUAL.
CE Set STROKER key switch to DISABLE.

20. Turn SIZE CONTROL selector to ZERO SHUT-OFF.

21. Set Feed Force Dial to some low value (approximately "1" for tools smaller than 6 mm (.25"), "1.2" for larger tools).

CAUTION

When truing, always start at a low feed force for safety.

22. Reduce Mandrel Runout (refer to Section 2).

23. Set Spindle Speed for truing. Use chart on operator station as a guideline for determining speed.

WARNING

Recommended speeds may not be suitable for all applications. For MANUAL HONING and TRUING always start with a speed that is no more than half speed recommended on chart, then increase speed in small increments only when job seems to be running safely. Never exceed recommended speed when manually honing or truing.

24. Position Stroker Carriage for manual honing:

• Push Stroker Carriage back until it stops. Turn STROKING selector to MANUAL.

• Set STROKER LENGTH to 6 mm (1/4 in).

• Loosen Stroke Position Lock and turn Stroke Position Handwheel to move Stroker Carriage in until it stops. Tighten Stroke Position Lock.

25. Remove any fixturing components that do not provide adequate clearance for manual honing.

26. True mandrel and stone (refer to Section2).

27. Return Spindle Speed setting to zero for safety.

28. Set Feed Force to desired level.

29. Eliminate conical and parallel spindle runout **(refer to Section 2)**.

30. Set stroke length: Loosen Stroke Length Lock on front panel (1/4 turn is usually sufficient) and turn Stroke Length Handwheel until Stroke Length Indicator is aligned with desired stroke length. For most applications, set stroke length to a value that is 95% of bore length or abrasive length, whichever is longer. *(See Stroke Length Guide printed on front panel of Machine.)*

NOTE: Maximum stroke length is bore length or stone length whichever is longer

If workpieces have long counterbores or large overhangs, shorten stroke length to gain stability. For workpieces with blind holes, maximum stroke length should be bore length, including relief, minus 2/3 stone length.

For workpieces with tandem holes using a solid line of stones, stroke length should equal total stone length minus tandem distance.

For workpieces with tandem holes using separated tandem stones, maximum stroke length is tandem land length or individual stone length, whichever is longer.

30. Lock stroke length by tightening Stroke Length Lock securely.

31. Engage Stroker Carriage with power stroking unit: Push Stroker Carriage back until it stops. Turn STROKING selector to AUTOMATIC.

32. If Stroker Carriage is very close to spindle, then loosen Stroke Position Lock and turn Stroke Position Handwheel to move lt away from spindle.

33. Install Workpiece Fixturing. Workpiece must be fixtured to resist honing torque and to drive workpiece back and forth for stroking. The ML-2000 includes following standard fixturing components: A Universal Fixture with Fingers for stroking, and small Torque Arm to absorb honing torque. These can be used for most applications, however other fixturing components are available from Sunnen Products Company for certain types of applications such as square honing. See Catalogs or contact your Sunnen Filed Service Engineer for more information.

NOTE: No standard fixture is provided to grip workpiece to transmit honing torque to torque bar. Several optional fixtures are available. Also some types of workpieces are easily fixtured with common hardware items. Contact your Sunnen Field Service Engineer for fixturing. (Refer to Appendix E for Carriage Hole Pattern.)

34. If using standard Universal Fixture, adjust fingers on gate and on stroker carriage to contact workpiece as close to tool as possible without risking accidental contact with tool. Position gate so that workpiece is captured, but not held tightly between fingers. There should be only a small amount of clearance between fingers and workpiece. Less than 1 mm (.04 in.) is preferable, but more is acceptable if workpiece length is expected to vary.

35. If using standard Universal Fixture, position Torque Arm to resist torque of workpiece as shown (see Figure 3-1). Adjust bar so that torque is taken as far from honing tool as possible but with out risk of workholding fixture slipping past torque bar (refer to Appendix A).

36. If using an optional fixture purchased from Sunnen Products, carefully follow all setup instructions supplied with that fixture. If constructing your own special fixture make sure that honing torque will be resisted adequately, and that workpiece is captured axially for stroking but free to "float" and align itself on tool.

37. Set stroke position: With hands clear from work area, press Stroker Jog and hold it in until stroker carriage stops at one end of stroke.
Measure overstroke, distance from end of stone to end of workpiece bore. (Place workpiece in fixture or hold it next to tool to measure.) Press Stroker Jog and hold it in until stroker carriage moves to other end of stroke. Measure overstroke on that end. If overstroke is not equal on both ends, then adjust stroke by loosening Stroke Position Lock and then turning Stroke Position Handwheel. Handwheel is graduated in millimeters with numbers increasing as carriage is moved away from spindle. Tighten Stroke position Lock and recheck overstroke on each end.

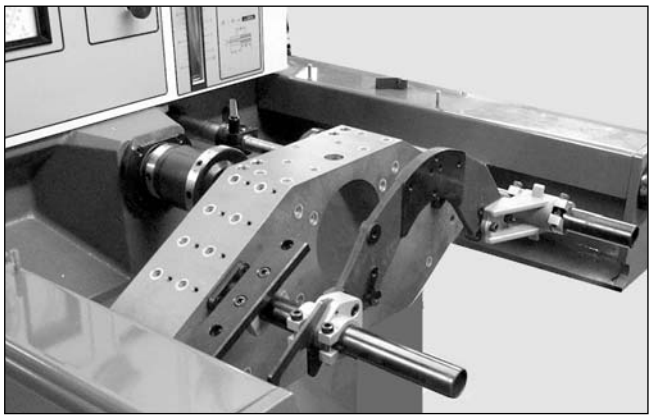


FIGURE 3-1, Universal Fixture

38. Set coolant lines to supply a continuous supply of coolant to front and back of bore. Coolant nozzles are attached to small aluminum bases that can be attached to stroker carriage (see Figure 3-2). Turn COOLANT selector to CONSTANT and adjust valves on coolant manifold. Use as much coolant as possible without losing any to splashing or spraying out of machine.

NOTE: There are two sizes of coolant nozzles provided. Black nozzles have small openings for delivering a steady narrow jet of coolant from a distance. Use these if it is difficult or inconvenient to place nozzle close to workpiece. Orange nozzles have larger openings and can deliver a larger volume of oil with less splash. Larger nozzles are preferred if they can be positioned close to workpiece.

For convenience one coolant nozzle can be clamped in back of stroker carriage on a rib nearest spindle pointing up to rear of workpiece bore (see Figure 3-3). Note that almost all workpieces will be positioned with rear of bore in this location, so this one nozzle will not require adjusting when changing setups.

39. Return COOLANT selector to CYCLE ONLY.

40. Replace Spindle Splash Guard on back of Stroker Carriage. Press STROKER JOG to check Splash Guard clearance.

41. Set STROKING selector to AUTOMATIC.

42. Set SIZE CONTROL selector to desired size control mode.

43. Set Automatic Size Control (ASC) Unit (refer to Section 2).

44. Set EXTRA STROKES to desired value.

NOTE: Changing amount of Extra Strokes is an easy way to compensate for ASC sensing tip wear. However, keep in mind that more extra strokes there are more final bore size can vary, since bore is being plug gaged before extra strokes. If honing rates vary over time more or less extra material may be removed during finishing. If final size tolerances are close, keep amount of extra strokes to a minimum.

45. Using Sunnen Precision Bore Gage, measure bore size of a workpiece and place it on honing tool.

WARNING

Do NOT step on foot pedal to lock alignment bushing on mandrel. Spindle will turn if foot pedal is depressed.

46. Turn Feed Selector to EXPAND. Rotate workpiece by hand some to get it to seat fully on mandrel.

47. Turn stone feed dial until needle on Honing Indicator reads amount of stock to be removed from diameter of workpiece on mandrel.

NOTE: There is some backlash in STONE FEED dial. For best accuracy in setup, always turn dial until Honing Indicator reads some amount less than stock removal and then feed up (counterclockwise) until needle reads correct amount of stock removal.

48. Set FEED REGULATOR.

NOTE: Use of FEED REGULATOR is optional. If it is not to be used on this application, then skip this step and go to step 49. *(See Appendix A for guidelines on when Feed Regulator may be beneficial.)*

49. Set Spindle Speed. Use chart below knob to determine spindle speed based on bore diameter.

50. Set Stroke Speed. Use chart below knob to determine stroke speed based on stroke length.

WARNING

Recommended speeds may not be suitable for all applications and for all fixtures. Always start a new setup with speeds that are much lower than recommended to test stability of tooling and fixturing.

OPERATION - POWER STROKED HONING

Follow ALL steps for power stroked honing carefully and in the order listed.

NOTE: Before honing, review your setup of machine.

1. Install workpiece in workholding fixture.

WARNING

To prevent personal injury and damage to machine DO NOT hone without installing workpiece in a workholding fixture.

2. Install workpiece with workholding fixture in Gate Fixture or other stroking fixture and close fixture so that workpiece is captured for stroking.

3. Turn POWER ON.

4. Turn COOLANT to CONSTANT to check flow of coolant to tool and workpiece. Return selector to CYCLE ONLY if that is desired mode of operation.

5. Start cycle by either pressing Cycle Start or stepping on Foot Pedal. In general it should be not necessary to use Foot Pedal for operation. However, by using it on first workpiece you can make feed system engage workpiece slowly to possibly prevent damage from an improper setup.

NOTE: Cycle stop can interrupt any cycle before final size has been reached.

6. When cycle stops automatically, gage final bore size.

WARNING

To avoid personal injury, allow stroker and spindle to come to a complete stop before removing workpiece.

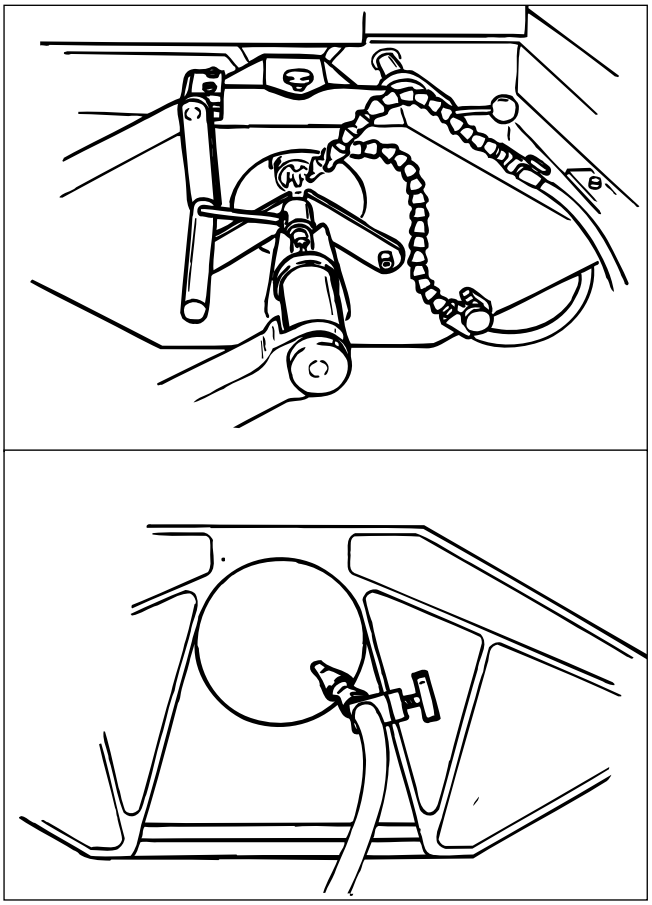


FIGURE 3-2, Coolant Line

7. If you are using ZERO SHUT-OFF for size control, then move STONE FEED dial to adjust size if size is not correct.

NOTE: STONE FEED dial has some backlash. If you must feed down, always feed down beyond and then up to point desired.

CAUTION

Advancing STONE FEED dial while machine is running is not recommended.

8. If you are using ASC, then adjust final bore size by either adjusting screw in sensing tip or by changing number of extra strokes. Large adjustments should be made by adjusting sensing tip. Small adjustments can be quickly and conveniently made by changing number of extra strokes. Over time, as sensing tip wears, size can be adjusted easily with this feature.

The following adjustments may require running several cycles to observe pattern of stonewear, cutting rate, etc.

9. Is finished bore tapered from one end to other, with direction of taper consistent with workpiece's orientation in stroking fixture? If so, loosen Stroker Position Lock and adjust stroke by turning Stroke Position Handwheel slightly to move stroker carriage in direction that workpiece bores are larger.

WARNING

NEVER adjust stroke length or stroke position while machine is running.

10. Is honing rate reasonable? Is cylindricity of finished bore acceptable? Feed forces may have to be adjusted. In general, increase Feed Force if honing is too slow and finished bores are round and straight and of consistent size. Also, in general, decrease Feed Force if bores are not as cylindrical as desired, if size is inconsistent or if stonewear is excessive.

11. To correct other problems with workpiece bores, see Troubleshooting.

NOTES

SECTION 4
ROUTINE MAINTENANCE

GENERAL

The following procedures are given as guides only and are not to be construed as absolute or invariable. Each machine must be maintained individually according to its particular requirements.

WARNING

ALWAYS have power OFF when hoods are open or performing service not requiring power.

CLEANING

Weekly, wipe exterior of machines with a clean, dry cloth. To clean exterior use warm water and a mild detergent or mild industrial liquid. Rinse thoroughly with clean, hot water, and wipe dry.

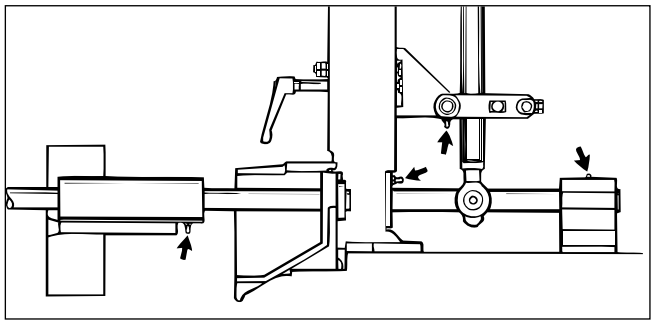


FIGURE 4-1

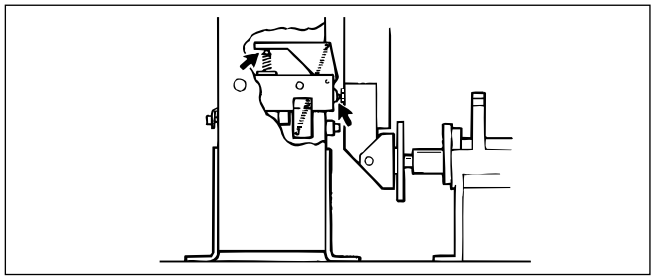


FIGURE 4-2

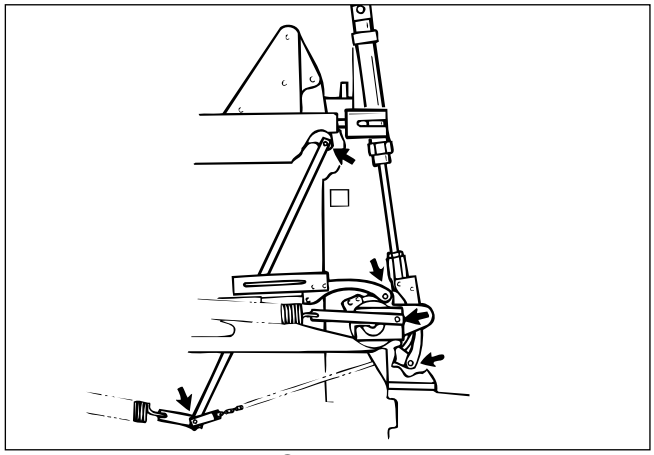


FIGURE 4-3

LUBRICATION

Spindle Only:

Lithium complex base grease
Viscosity: ISO VG 150
NLGI Grade: Moblith AW-Ø or equivalent.
Sunnen SML-110 (1 Gal. Can)

All other lubrication:

Lithium complex base grease
Viscosity: ISO VG 220
NLGI Grade: Moblith AW-1 or equivalent.
Sunnen SML-120 (Cartridge)

Feed Regulator Oil:

ISO VG 150 Oil

ROUTINE MAINTENANCE SCHEDULE

The following procedures and suggested maintenance periods are given as guides only, and are not to be construed as absolute or invariable. Local conditions must always be considered. Each machine must be maintained individually, according to its particular requirements.

Daily:

• Check coolant level (Gage on front of Coolant System), and add coolant as necessary.

CAUTION

DO NOT overfill system.

• If using Sunnen Coolant Concentrate, check concentration and add water or concentrate as necessary.

Every 500 Hours:

CAUTION

Over filling spindle can cause it to run hot.

• Apply two or three pumps of grease to spindle (see Figure 4-1).

• Apply grease to Feed Force Screw Stop Blocks (see Figure 4-1).

• Apply grease all other grease fittings (see Figure 4-1).

• Apply grease to contact points on Indicator Assembly (see Figure 4-2).

• Apply grease (see Figure 4-3) to Cam Assembly Connection Pins.

Every 1000 Hours:

• Clean and repack feed rod thrust bearings.

NOTE: This service period can be stretched to 2000 hours if machine is only used at low speeds (less than 1500 rpm) and low feed forces (less than 6).

• Inspect belts for cracks and excessive wear.

COOLANT SYSTEM

If using optional PF-150 Filtrtion System: Clean side of reservoir will be pumped low when filter in PF-150 gets dirty(see Figure 4-4).
Either decrease flow to workpiece by adjusting valves in work area or replace filter in PF-150. (Follow directions that came with PF-150 to change filter.)

SPINDLE BELT

To replace Spindle Belt:, proceed as follows (see Figure 4-5):

1. Remove two screws holding feed rod thrust bearing cover to thrust bearing housing.

2. Slide feed rod and thrust bearings forward out of thrust bearing housing.

3. Loosen four screws holding spindle motor base plate to deck.

4. Loosen one screw on wedge that bears against motor base plate.

5. Slide spindle motor in toward spindle to loosen belt.

6. Remove and replace belt.

7. It is recommended that feed rod thrust bearings be cleaned and repacked with grease at this time:

• Loosen screw in end of feed rod holding bearing in place.

• Pull bearings off of feed rod. Note back-to-back arrangement of these bearings. (Wide faces of outer races are in contact.)

• Clean and repack.

• Replace bearing keeping same back-to-back arrangement.

NOTE: One bearing takes a much greater load than other. Bearing life will be extended if both bearings held together are reversed when they are replaced so that over time both bearings wear evenly.

---

8. Reverse steps above to reassemble. When tightening two screws fastening cover, alternate between two to seat bearings evenly.

9. Use screw against wedge to tension belt before tightening screws on base plate. Tension belt so that deflection at midway between pulleys is approximately 4mm (.158in) when a 33N (7.4 lb) load is applied.

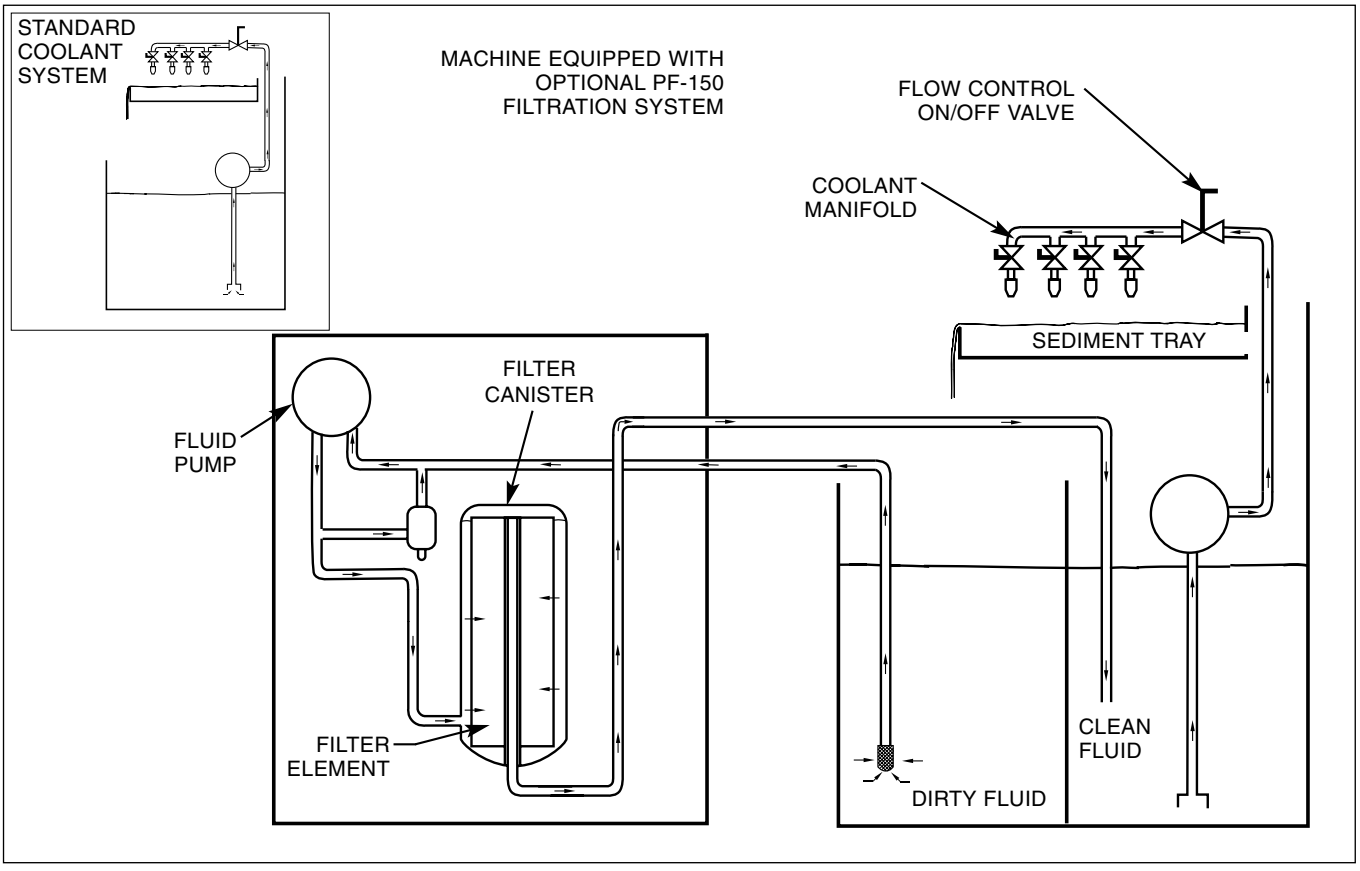


FIGURE 4-4, Coolant System

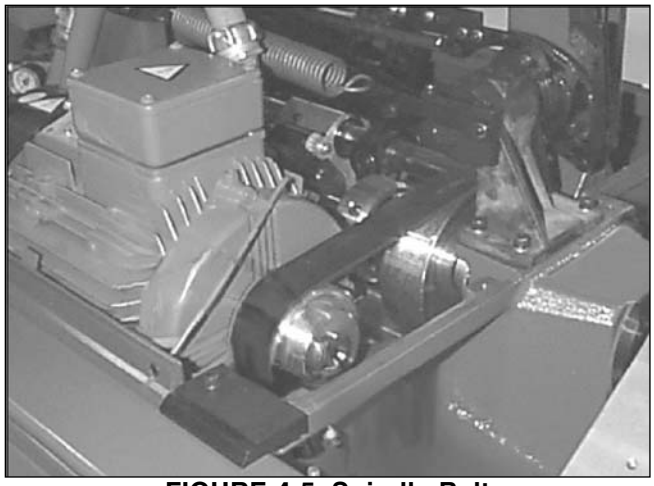


FIGURE 4-5, Spindle Belt

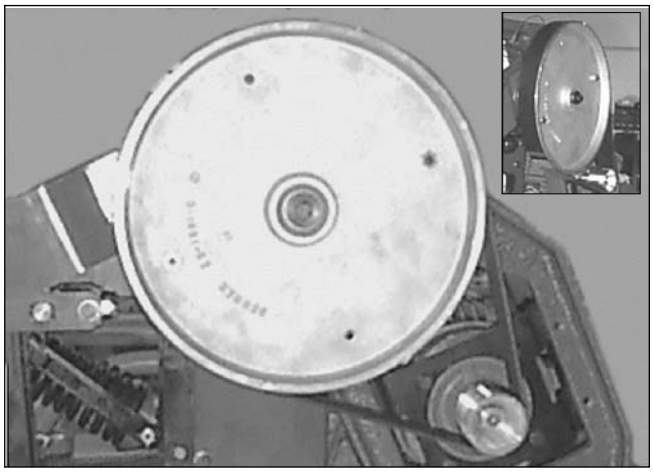


FIGURE 4-6, Stroker Belt

STROKER BELT

To replace Stroker Belt, proceed as follows (see Figure 4-6):

1. Loosen four screws holding stroker motor base plate to stroker frame.

2. Loosen one screw on wedge that bears against motor base plate.

3. Slide stroker motor up to loosen belt.

4. Remove and replace belt.

5. Reverse steps above to reassemble. Use screw against wedge to tension belt before tightening screws on base plate. Tension belt so that deflection at midway between pulleys is approximately 4mm (.158in) when a 33N (7.4 lb) load is applied.

NOTES

SECTION 5
TROUBLESHOOTING

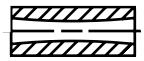
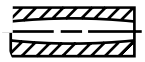
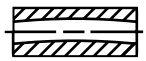
GENERAL

This section contains Troubleshooting information in table form, which should be used when problems occur with your Machine.

OPERATIONAL TROUBLESHOOTING

For suggestions on correcting problems with bore conditions or with honing operation, consult Table 5-1.

TABLE 5-1, Operational Troubleshooting

		Standard Sunnen Tooling and Procedures will satisfy all ordinary honing requirements. If problems are encountered, they can usually be solved by following procedure suggested below. For detailed information on difficult or unusual honing problems contact your local Sunnen Field Engineer or Sunnen Customer Service Department in St. Louis, Missouri, USA.				
CONDITION TO BE CORRECTED		STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
STONE NOT CUTTING (Honing dial needle moves too slowly)	STONE GLAZED* Stone surface looks clean but cutting grains are dulled	Sharpen A or J stone with MAN-700 diamond dresser; use LBN-700 dressing stick on all other stones	Increase cutting pressure	Increase stroking speed	Use a softer stone (one with a lower hardness number)	Check oil to be sure you are using Sunnen Industrial Honing Oil*
	STONE LOADED* Stone surface looks smeared and clogged with chips	Clean stone with LBN-700 dressing stick	Increase stroking pressure	Use a softer stone (one with a lower hardness number)	Use a coarser grit stone (one with a lower grit number)	Check oil to be sure you are using Sunnen Industrial Honing Oil*
SLOW STOCK REMOVAL* (Honing dial needle moves too slowly)		Increase spindle speed	Increase cutting pressure	Check oil to be sure you arc using Sunnen Industrial Honing Oil*	Use a softer stone (one with a Lower hardness number)	Use a coarser grit stone (one with a lower grit number)
POOR STONE LIFE* (Honing dial needle moves too fast)		Decease cutting pressure	Use faster spindle speed	(one with higher hardness number	stone (one with lower grit number)	Check oil to be sure you are using Sunnen Industrial Honing Oil*
BELLMOUTH 		True stone and shoes with truing sleeve If part is short or unbalanced, shorten stroke length	Use softer stone (OK with lower hardness number)	If Bore is LONGER than 2/3 stone length:	Shorten STONE only (or row of stones) slightly on both ends	If bellmouth persists shorten stones still more but do not shorten shoes any further CAUTION: Overcorrection of bellmouth will lead to barrel condition
				If Bore is SHORTER than 2/3 stone length:	Shorten STONES and SHOES equally to 1-1/2 times bore length	
BARREL 		True stone and shoes with truing sleeve	Use finer grit stone (one with higher grit number)	Use longer stone or shorten guide shoes on both ends	Use mandrel with longer stone and shoe	CAUTION: Overcorrection of barrel will lead to bellmouth condition
TAPER IN OPEN HOLE		True stone and shoes with truing sleeve	Change stroke so tight end of bore is stroked over stone further	Reverse work on mandrel more often	If power stroking, make sure spindle and stroker are in alignment	
TAPER IN BLIND HOLE		Shorten stone and shoes to about 3/4 shorten stone more if taper persists	True stone and shoes frequently with truing sleeve	If hole has insufficient or no relief at bottom, use hard tip stone	Provide sufficient relief at bottom of hole	Provide adequate oil flow at bottom of hole to wash cutting out
OUT-OF-ROUND		Make sure honing tool is recommended size for diameter to be honed	Thoroughly true stone and shoes to exact hole diameter	If thin wall part, decrease cutting pressure	If stone stops cutting at decreased pressure use stone with lower hardness number	If power stroking make sure spindle and stroker are in alignment
WAVINESS		Use honing tool with sufficient stone length to bridge waviness (or lands and ports in bore)				
RAINBOW 		Use L, BL, or multi-stone mandrel. Stone length should be at least 1-1/2 times the length of bore for best bow correction		Use shorter stroke length (less overstroke)	Use stone with lower hardness number to avoid part flexing	
FINISH TOO ROUGH*		Decrease cutting pressure	Use finer grit stone (one with higher grit number)	Check oil to be sure you are using Sunnen Industrial Honing Oil*	Thoroughly true shoes to exact hole diameter	For extremely fine finishes in soft or exotic material, use bronze mandrel or bronze shoes
RANDOM SCRATCHES		Decrease cutting pressure	Use finer grit stone (one with higher grit number)	Use softer stone (one with lower hardness number)	If hard steel mandrel is being used, change to soft steel mandrel. If soft steel mandrel or shoes are being used, change to bronze mandrel or shoes	Check oil to be sure you are using Sunnen Industrial Honing Oil*

*Many honing problems, such as poor cutting action, poor stone life, and rough finish are caused by wrong honing oil, insufficient honing oil, dirty honing oil, or contaminated honing oil. Use only clean, full-strength Sunnen Industrial Honing Oil. Make sure that honing oil is neither diluted or "cut" with other oils. Keep solvents and cleaning fluids away from honing machine.

MACHINE OPERATION TROUBLESHOOTING

Error Messages:

ML-2000 has built in error messages that will appear in spindle speed screen to alert operator when machine has stopped due to an error or incorrect setup. The following is a list of errors and directions on how to clear them. Once problem is resolved, pressing "Cycle Stop" button will clear error from display.

Error 1: Unexpected Start Signal.

- When power is turned on, machine verifies that foot pedal/cycle start button is not pressed down to prevent any unexpected start up.

Error 2: Switch Has Changed During a Cycle.

- In order for this error to occur, one of the following switches was changed while machine was honing Expand/Retract, Size Control Mode, Stroker Mode, Finishing Feed Force Mode, or Stroker Enable.

These switches cannot be moved during a honing cycle.

Error 3: Spindle or Stroker Speed Set to Zero.

- A speed must be set for both spindle and stroker before machine can start a cycle.

Error 4: Safety System Was Triggered.

- The safety system determined that an unsafe condition has occurred. I.e. light curtain was broken.

Error 5: Workpiece Oversized.

- The original workpiece was oversized. The ASC probe never stuck workpiece. If ASC is not being used, this error should be bypassed (See Appendix A, "Dip Switch Settings")

Error 6: ASC is Not Aligned Properly.

- Extra Strokes count had decrement by three or more when an additional ASC probe hit was detected.

Error 7: Feed System is Expanded.

- A honing cycle cannot be started with feed system expanded. Place feed selector switch to Retract.

Error 8: Stroker Was Unlatched.

- A honing cycle cannot be started with stroker unlatched. Place stroker mode selector switch to Auto.

Error 9: In Manual Honing Mode.

- A honing cycle cannot be started with stroker mode in manual. Place stroker mode selector switch to Auto.

Error 10: Stroker Enable Key is Off.

- A cycle will not be started when stroker enable key is in OFF position. Turn stroker enable key to ON position.

Error 11: Electrical Fault.

- The machine has had an electrical fault. Check circuit breakers, drives, overloads and motor temperature.

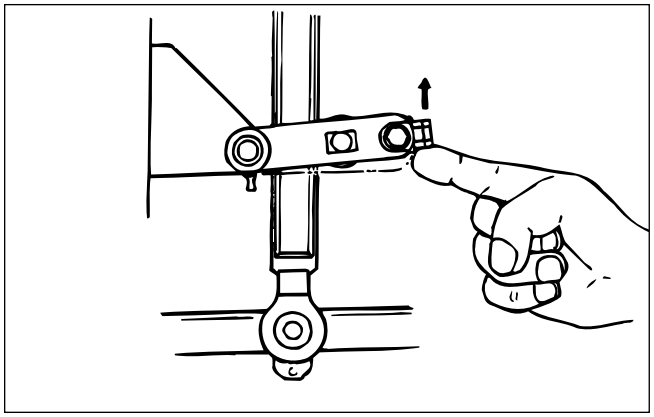


FIGURE 5-1, Stroker Pivot Free Play

Problems / Solutions:

WARNING

Some troubleshooting procedures require examining parts inside machine enclosure. ALWAYS have power OFF when hoods are open. If problem cannot be diagnosed by Power Off inspection, then consult a Sunnen Service Technician.

PROBLEM: Machine does not start when Cycle Start is pressed.

SOLUTIONS:

- Is power on?
- Is FEED selector set to RETRACT?
- Is foot pedal cover in place?
- Is STROKING selector on AUTOMATIC?

For Models ML-2000CE and ML-2000CD only:

- Is STROKER key switch set to ENABLE?
- Is green LED on Light Curtain lit?

If red LED is lit, then something is blocking a light beam.

If yellow LED is lit, then light curtain needs to do its startup self check routine. Put your hand through light beam path and then pull it out again to trigger self check routine.

PROBLEM: One or more of switches on operator panel do not seem to work.

SOLUTION: Some setup functions such as STROKER JOG will not work if other switches are set improperly. Check following:

- Is power on?
- Is FEED selector set to RETRACT?
- Is foot pedal cover in place?
- Is STROKING selector on AUTOMATIC?

For Models ML-2000CE and ML-2000CD only:

- Is STROKER key switch set to ENABLE?
- Is green LED on Light Curtain lit?

If red LED is lit, then something is blocking a light beam.

If yellow LED is lit, then light curtain needs to do its startup self check routine. Put your hand through light beam path and then pull it out again to trigger self check routine.

PROBLEM: Stroke Length slowly changes over time.

SOLUTION: Check Stroke Length Clamp Handle for tightness. If handle is already tight, then stroking load is exceeding capacity of stroking mechanism. Reduce stroking load by one or more of following:

- Reduce Stroker Speed
- Reduce Feed Force
- Reduce weight of fixturing

Also, check Stroker Pivot Assembly free play:

- With power OFF, open right hood.
- Move large stroker pulley by hand until Crossbeam is vertical (see Figure 5-1).
- Lift end of Pivot Assembly lightly with a finger and let go. It should drop between 4 and 10 mm. (Measured at nut.) If drop is greater than 10, loosen jam nut and then loosen nut slightly and retighten jam nut against it. Recheck freeplay.

PROBLEM: Stroker knocks at one or both ends of stroke.

SOLUTIONS:

- Is anything in work area being struck by carriage or fixture? (Press STROKER JOG to check)
- Is stroke length set to a point above 170mm?
- Is Stroke Position Lock tightened? If so, try turning Stroke Position Handwheel. If it turns easily see solution to next listed problem.
- Stroking load may be excessive, see solution above to “Stroke length changes over time”.

PROBLEM: Cannot set stroke speed to anything above 200 SPM.

SOLUTION: Look at stroke length setting. If it is at 90mm or above, machine control will not allow stroke speed to be set over 200 SPM, which would be dangerous to operator and destructive to stroker.

PROBLEM: When setting up to adjust conical and parallel tool runout, stroker carriage cannot be placed in a position where runout indicator can pick up concentric bushing centered on abrasive section of tool.

SOLUTION: Runout indicator can be pulled off of pin that it pivots on, and aluminum base that holds that pin can be turned upside down and rotated so that pin is in a different position when aluminum base is clamped on threaded stroker shaft. If indicator still cannot reach required position, it may be necessary to make a special pin for indicator to pivot on, mounting to front of stroker carriage.

PROBLEM: When attempting to hone a workpiece with only a very small amount of material to remove (1 to 5µ), cycle stops immediately without removing required amount of material.

SOLUTION: Feed System normally feeds up rapidly and there is somewhat of an impact when stone contact workpiece. Sensitive electronic transducer that reads feed rod position will sometimes pick up this vibration and read a position that is less than zero for a fraction of a second, thus ending cycle. To prevent this, turn Feed Regulator Initial Diameter knob on (counterclockwise) about 2-1/2 to 3 turns, and turn Maximum Rate knob to fastest speed (about 9-1/2). This will damp any feed rod vibration without lengthening cycle time and allow even very small amounts of material to be removed accurately.

PROBLEM: Needle on Honing Indicator will not go all way to top of scale when Feed is Retracted.

SOLUTION: Is Indicator Scale / Honing Tool selector set to red “D2” tool family? If so, it is normal for needle to rest about three quarters from bottom of scale when retracted. This will not interfere with honing when using these tools. If selector is not set to red “D2” scale, then Stone Feed dial has been turned back too far. Advance Stone Feed dial (counterclockwise) until needle goes up past maximum scale reading.

PROBLEM: When using Zero Shut-Off, when Feed Force is changed, final bore size is different from previous workpiece.

SOLUTION: This is normal. Components in Feed System compress to a greater degree when feed force is greater. This means anytime you reduce feed force, needle on honing dial will rise, and subsequently final bore size will be greater than previous part. (Assuming stonewear is negligible or properly compensated.) Opposite is true when feed force is increased. Therefore, to avoid making oversized bores, never reduce feed force by more than 0.5 without turning Stone Feed dial back (clockwise) some to compensate for this change in compression.

PROBLEM: Needle on Honing Indicator hangs up (cutting appears to stop) at very low feed force.

SOLUTION: With Feed Regulator off and no workpiece on tool, turn Feed selector to Expand. If needle goes immediately to a position below zero, then there is no machine problem. Feed force selected is probably too low for application, try increasing feed force. If needle stops at some position above zero try following:

- Are you trying to feed up past maximum size of tool you are using?
- Is tool running out? Try adjusting tool runout. Spindle runout can make feed system “stick” at low feed force.
- Lubricate feed rod at grease fitting inside machine.
- Try using a slightly higher feed force.
- If problem persists contact a Sunnen Service Technician (see next problem).

PROBLEM: An application that ran well at a certain feed force, on another ML-2000 or at another time on this machine runs differently now.

SOLUTION: Small differences in honing performance can be attributed to slight differences in individual machines, machine changes over time, or usually to normal variations in cutting performance of abrasive. Machines are calibrated to exact specifications before leaving factory. Over time they may change slightly. It will be easiest to merely adjust feed force to get optimum performance. If you suspect that honing performance has changed significantly or if you find it to be significantly different from another ML-2000 machine, then contact a Sunnen Service Technician to check Feed System calibration.

PROBLEM: Increasing roughing pressure makes no difference in honing rate.

SOLUTION: Is Feed Regulator turned on? If so, increasing pressure may make no difference in honing rate because honing rate is limited by maximum rate selected on Feed Regulator.

- If Feed Regulator is turned off, then check Air Pressure Regulator. Pressure should be 0.55 MPA/ If it is low, then adjust it, by turning knob on top of Regulator.

PROBLEM: When using Feed Regulator at higher feed forces, “Initial Diameter” (where needle begins to slow down on Honing Indicator) appears different during a cycle than it did when it was set by recommended procedure.

SOLUTION: This is normal behavior caused by amount of compression in feed system. However, this indicates that stones are contacting workpiece bore immediately after cycle begins although not at full feed force selected. If this initial contact still seems too rough, then turn Initial Diameter knob counterclockwise some to make Feed Regulator begin at a smaller diameter

PROBLEM: Turning INITIAL DIAMETER knob on FEED REGULATOR smaller (-) does not seem to change point where FEED REGULATOR begins working.

SOLUTION: Damper Cylinder inside machine may be low on oil. Fill cylinder and try again. To fill cylinder without removing it from machine requires a long spout with a flattened tip to fit in fill slot in cylinder.

PROBLEM: Spindle and/or Stroker seems to stall under high honing load.

SOLUTION: Check belt tension. If deflection midway between pulleys is greater than 4mm (.158in) when a 33N (7.4 lb) load is applied, then belts can be tightened. Loosen four bolts holding motor assembly in place. Tighten belt tightening screw against its wedge slightly until appropriate tension is achieved. Retighten mounting bolts.

If belt tension is correct and Spindle Stroker is still stalling, then reduce feed force being used. Continued operation under these loads can be detrimental to machine life.

PROBLEM: Machine stops during or at end of a cycle and power to machine is automatically turned off.

SOLUTIONS:

Are Spindle and Stroker Drives configured for voltage that 18 being supplied to machine? (See “Machine Conversion” in “Installation” section at beginning of this book.)

For Models ML-2000CE and ML-2000CD only:

Did something enter Opto-Electronic Screen during honing cycle? If so, machine will turn its power off so that operator will be aware that workpiece in machine has not been honed to completion.

PROBLEM: No Coolant flow or insufficient coolant flow.

SOLUTIONS: First check coolant level gage for sufficient coolant in reservoir, and check plastic valves in work area to be sure they are open. Pull coolant system out far enough to view it but leave it connected electrically. Open reservoir cover and remove sediment tray to view inside of coolant system. Turn machine power on and set coolant selector to CONSTANT. Refer to Appendix C.

A - SPECIAL TOPICS

FEED REGULATOR

Feed Regulator on ML-2000 is a feed rate limiter. (On earlier model Sunnen Honing Machines this feature was called Stone Saver.)

Without Feed Regulator, at beginning of each cycle machine feeds rapidly until stone contacts work-piece. This high speed contact at full feed force in a rough bore can cause some stone break-down resulting in greater stonewear. Without Feed Regulator, ML-2000 Feed System is a constant force feed system, cutting rate will varying depending on condition of bore (fully or partially cleaned up), hardness of bore, and condition of stone (free cutting or glazing).

Feed Regulator can provide three benefits:

1. Stone Saving: Limiting feed rate just before stone contacts bore can eliminate excessive stone breakdown.

2. Very Low Feed Force Honing: There are practical limitations in applying a very low feed force consistently while tool expands very slowly. In many applications with extremely small mandrels (D2 family) optimum feed force is somewhere less than machine minimum of “1”. Using Feed Regulator set at a very slow speed restrains feed system and effectively delivers less than a feed force of “1” to stone.

3. Elimination of glazing: If stones are glazing, first recommendation is to use a softer stone or to increase feed force. If this is not possible or produces unacceptable results, then setting Feed Regulator to desired cutting rate and increasing feed force significantly will produce cycles of consistent duration without glazing.

Feed Regulator has an adjustable MAXIMUM RATE control and an INITIAL DIAMETER setting knob. INITIAL DIAMETER knob should be set so that feed system feeds rapidly at its normal rate up to some point slightly smaller than smallest bore you expect to encounter. At this initial diameter Feed Regulator takes over, slowing feed to rate that is set with MAXIMUM RATE dial. From that point, feed will continue at that rate or slower if normal cutting rate at selected feed force is slower than maximum rate selected.

For details on setting Feed Regulator see Setup-Power Stroking.

TRUING

Sunnen mandrels, shoes, and stones are manufactured to close tolerances so that in many low to medium precision applications it will not be necessary to true stone and shoes. A proper setup will generate and maintain parallelism between stone and shoes.

If you choose not to true honing unit remember following:

- Hone first workpiece undersize by a fair amount so that you can check straightness of bore. If is not acceptable, you will have to adjust stroke length or stroke position or stop honing cycle frequently and flip part end for end. Continue to hone parts under-sized until bore straightness is acceptable. If bores do not straighten out after a few workpieces, then truing should be considered.

- A new stone, or a used stone placed in an application with a different bore size, will not make full contact with bore until it has worn a radius to match bore. Before it does this, stonewear will be high and cutting rate may be excessively fast. Turn feed force down until stone has worn to where it is making full contact with bore.

NOTE: Truing should NOT be considered optional in following situations:
- Honing bores with keyways or similar interruptions where full contact is required for stones to bridge keyway.
- Very close tolerance work where a high degree of cylindricity is required.
- When stone and shoes have worn grossly out of parallel from continued use of a bad setup.

ASC Unit Notes

1. Disconnecting and Removing

If Automatic Size Control Unit is not necessary for an application, it can be removed from machine if it is in way of fixturing.

- Disconnect electrical cable and two air lines where they enter machine to left of spindle. Air fittings here are self sealing so there is no need to plug ports.

- Loosen Clamp Screw on ASC unit several turns until unit can be lifted free from its guiding rail.

2. Timed honing cycles

For applications where some deburring or polishing is required for just a small amount of time, ML-2000 can be setup to produce cycles of consistent duration. This type of operation is available by placing dip switch B3 in ON position. See Appendix A, "Dip Switch Settings" before making any dip switch changes. Set EXTRA STROKES to:

$$\text{STROKES} = \frac{(\text{Desired cycle time} - 1.5)}{(\text{seconds})} \times \frac{(\text{Stroker Speed})}{(\text{SPM})} \div 60$$

WORKPIECE & FIXTURE WEIGHT LIMITS

On ML-2000, workpiece and fixture is mounted on Stroker Carriage. Because all this has to stroke during honing process, it is desirable to keep weight of fixture to a minimum. If fixture and workpiece weigh too much, stroker speed may have to be reduced. A general rule of thumb is: If combined mass of workpiece and all fixturing mounted to carriage is less than 5 kg (11 lb), then strokes speeds recommended on chart on operator panel will be acceptable. If combined mass of fixture and workpiece is greater than 5 kg (11 lb) then stroke speed recommendations should be reduced by 10% for every kilogram over 5 kg (5% for every pound over 11 lb).

NOTE: For safety always start heavy setups at 60 strokes per minute, then while cycle is running, turn stroke speed up slowly to desired speed. If, at any point, stroker begins to knock, labor, or vibrate excessively then reduce stroke speed to a point that is no more than 80% of that speed.

UNIVERSAL FIXTURES

ML-2000 is equipped with a standard Universal Fixture (see Figure A-1). Universal Fixture is completely adjustable so that virtually all workpieces can be stroked automatically. workpieces are captured axially but not held rigidly so that they can “float” on tool so that tool can follow existing hole without moving its centerline. Fixture includes a torque arm so that a rigid torque absorption point is provided for workpiece or a special workholding fixture to bear against during honing cycle.

Universal Fixture is designed for maximum flexibility. In both configurations fixture can be reversed from left to right to suit operator’s preference. Also Hinge and Latch may be unscrewed from outside of gate piece and reattached on inside for longer workpieces.

NOTE: To mirror fixture from left to right requires removing components from gate, reversing gate and then reattaching components. If entire assembly is simply reversed, then fingers will end up in a position where they are not adequately supported to resist high stroking loads.

ADJUSTING FINGER FIXTURE:

• Set fixed fingers on carriage to contact workpiece as close as possible to tool, leaving enough clearance between tool and fingers so that there is no danger of contact during honing.

• There are two aluminum collars on each fixture support bar backing up Hinge and Latch. Loosen screws holding these collars and move collars out of way.

NOTE: Collars with Hinge have a loose pin spacing them apart.

FIGURE A-1, Universal Fixture

• Move finger fixture assembly on fixture support bars to a position where workpiece will be held with minimal end clearance (approx. 1mm, more if workpiece length is expected to vary widely).

• Move collars to back up both sides of Hinge and Latch and tighten them in place.

TORQUE ARM

Torque arm is shipped assembled to a split collar on left fixture support bar. For very short workpieces there may not be room for this collar. Collar may be removed and torque arm can be attached to top of stroker carriage. An extra screw of appropriate length is provided for that purpose.

HINTS

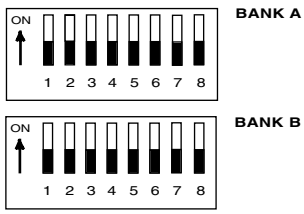
• If you need to hone very long workpieces and standard fixture support bars are not long enough, longer bars are available as an option. (370mm long - Sunnen Part Number: ML-7190).

DIP SWITCH SETTINGS

There are two sets of DIP switches located on PED-2202 console board that select different modes of operation. Do not attempt to change any settings while power is on.

To Change a DIP Switch Setting:

1. Turn main disconnect off.
2. Open console
3. Locate DIP switches.
4. Move switch to desired setting.



5. Close and fasten Console.
6. Turn main disconnect on.

Switches Bank A

A2, A4, A6, & A7: Factory Settings - Those switches should be left in default factory position. DO NOT attempt to change these settings unless specified by a Sunnen Representative.

A1: Slow Extra Strokes - This causes Stroker to run a Jog speed for number of Extra Strokes selected. The program will limit number of Extra Strokes to 10.

A3: ASC Up Before Cycle or Square Honing - The primary use for the A3 DIP switch is for square honing. This activates the solenoid that normally raises the ASC arm 0.5 seconds before the cycle starts. However, for square honing, the ASC arm is not on the machine and the square honing fixture is plugged into these ports instead of the ASC arm and activates regardless of ASC/ZERO SHUTOFF switch position. In this condition, Zero shutoff is desirable as well as activation of the ASC solenoid 0.5 seconds before the start of the cycle to lock the fixture that is now plugged in. The machine must be allowed to keep this fixture locked and run to zero for shut off. Square honing is used often for honing connecting rods.

This also works well for applications using ASC on a job with a very large fixture. The arm rising 0.5 seconds before the beginning of the cycle helps to prevent interference between the arm and fixture, but will still raise if you switch to zero shutoff because of the above description. For this application, put the ASC/ZERO SHUTOFF in the ASC position.

A5: Ignore Oversize Workpiece - In ASC mode, if plunger fails to strike workpiece within first few strokes, machine determines that workpiece is over-size. Turning this switch on will prevent ML from reporting an "Error 5" condition.

Switch Bank B

B1-B2: Factory Settings - These switches should be left in default factory position. DO NOT attempt to change these settings unless specified by a Sunnen Representative.

B3: Stroke Count Honing - Turning this switch on tells ML-2000 to hone for number of strokes set in "Extra Strokes" display. This is useful for deburring or polishing operations. The machine must be in ASC mode of operation for this switch setting to take effect.

B4: Ignore ASC Alignment Error - In ASC mode, if the plunger is struck after 3 misses during extra strokes, the machine determines that the ASC is in misalignment. Turning this switch on will prevent ML-2000 from reporting “Error 6” condition.

B6-B8: Not used - These switches are not currently used by ML-2000. They should be placed in OFF position.

NOTES

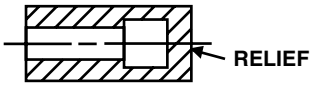
B - GENERAL HONING INFORMATION

GOOD HONING PRACTICES

ALWAYS DEBURR A ROUGH HOLE - If a bore is rough or has burrs prior to honing, a quick deburring operation with a very hard “deburring” stone prevents damage to stock removal or finishing stone, reduces stone costs and speeds up production.

HONE BEFORE HARDENING - When a part is to be hardened, always hone first, leaving only as little stock as necessary to correct heat-treat distortion. When needed, use a deburring stone to remove heat treat scale prior to sizing and finishing operation.

AMOUNT OF STOCK FOR HONING - Previous operation should leave just enough stock so that tool marks can be cleaned up and bore inaccuracies corrected. Less stock allowance is needed for Sunnen honing because Sunnen Honing Units are self-centering in bore. When going from a stock removal to a surface finishing operation leave only enough stock to remove cross-hatch pattern of coarser stone, usually only a few ten-thousandths of an inch.



PROVIDE RELIEF IN BLIND HOLES - Honing of a blind hole can be greatly assisted by providing relief in bottom corner of bore. This allows for at least some overstroking. The relief need be only a few thousandths deep and can even “blend in’’ as hole is honed. The ideal length of relief is 1/3 stone length. Any length of relief is much better than none.

PARTS CAN BE STACKED - Frequently parts with short bores can be ‘’stacked’’ and honed as one long bore. Parts must have flat and parallel faces.

KEEP YOUR HONING TOOLS TRUE - Cutting surface of stone and guide surfaces of shoes must be kept straight and parallel to produce accurate work. Occasional use of a truing sleeve will assist in keeping tools true.

USE ONLY PROPER HONING OIL - Best honing results are obtained only when proper Sunnen Industrial Honing oil is used. Cutting oils, coolants, and other fluids are generally not satisfactory for honing and may result in excessive stone wear or glazing, low stock removal rates and poor surface finish, and frequently cause galling or scoring of part. Sunnen Industrial Honing Oil is especially compounded for honing needs. It keeps stone clean and sharp, reduces stone wear, increases rate of stock removal, and is invaluable in producing fine surface finishes. A free flow of honing oil should be provided, both for Sunnen Honing Machines and for Sunnen Portable Hones. Do not dilute, cut, or change honing oil in any way.

LONGER STONE LIFE - May be obtained by “easing” stone into bore when starting honing operation. When in use, feed regulator does this automatically. When not using feed regulator stone can be damaged by “tramping” on pedal, especially in a rough bore.

KEEP STONE CUTTING PRESSURE LIGHT - Just heavy enough to get good cutting action. Excessive stone pressure will only increase stone wear; it will not make stone cut faster.

UNUSUAL HONING PROBLEMS - Can be referred to Sunnen Honing Laboratory. Be sure to include all data concerning problem, such as tolerances, surface finish requirements, stock removal, type of material, material hardness, and production quantities.

REMOVING WORKPIECE FROM MANDREL - Never begin removing workpiece from mandrel until spindle stops. When pedal is released or automatic shutoff occurs, your spindle should also stop.

HONING DIAL - Each number on dial indicator is equal to a certain amount of stone expansion. To determine this, refer to chart on front of machine.

HONING STONE - Select from Honing Supplies Catalog, from stone cabinet, or from SMOPS Guide.

WORN-OUT MANDRELS - When truing sleeve or workpiece makes contact with any part of mandrel other then shoe, replace mandrel or guide shoes.

TECHNICAL DATA

GUIDE SHOES - INTEGRAL SHOE MANDRELS - Soft shoe mandrels are recommended for all general honing operations. Mandrels with hardened steel shoes can be used for honing carbide, ceramic, or glass; for extremely rough holes; and for some long production jobs. Where extremely fine finishes are required and a 600-grit stone is used, solid bronze mandrels with integral shoes are required. Occasionally unusual specifications do not permit use of honing oils that contain sulfur, and it may be necessary to use bronze mandrels to prevent galling.

GUIDE SHOES - REPLACEABLE SHOE MANDRELS - General purpose guide shoes are supplied as original equipment on mandrels with replaceable shoes. Guide shoes of other materials are available and can frequently be beneficial in certain specific applications.

While it is desirable to provide guide shoes of material with long wearing qualities, they must be soft enough to be trued in for any particular job. Sunnen general purpose shoes meet these requirements.

When work being honed is unusually rough or out-of-round or has burs or wire edges, hardened steel guide shoes are usually more economical. Hardened shoes are also more economical when CBN/ Borazon or diamond honing stones are being used.

When material being honed is very soft or subject to galling or if very fine finish is required, bronze guide shoes are recommended.

Should your particular application require special guide shoes not described in our catalog, please contact Customer Service Department - Industrial Division in St. Louis or your local Field Engineer.

IMPORTANT

Guide shoes of different materials should never be mixed on a multi-stone length mandrel. When shoes are removed from a mandrel to be used later, they should be re assembled in their original position.

WEDGES - Wedges are subject to wear, and to assure best performance they should be replaced when they show signs of wear. Old wedges should be discarded. Wedges supplied with all permanent type mandrels have long life but should be inspected regularly and replaced if showing any wear. This is especially important in AK20, BAL20, AL20, and Y32 honing unit groups.

WEDGE PLATES - High and low wedge plates are supplied with Y (Keyway) mandrels of 35 mm (1.365") size and larger to provide coverage of mandrel diameter range, even with worn guide shoes and stones. Use low wedge plate (e.g., Y56L-W) unless stone cannot be expanded far enough to reach diameter to be honed (within range of honing unit). Use high wedge plate (e.g., Y56H-W) when necessary to reach diameter to be honed.

MANDREL SHIMS - Furnished with all P28 honing units. They are inserted between mandrel body and guide shoe when necessary to reach maximum diameter, especially when guide shoes are worn. They can also be used to help compensate for mandrel runout.

ALTERATION OF HONING UNITS

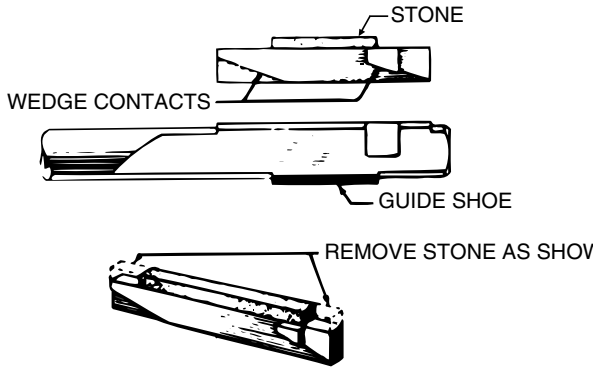
HOW TO ALTER STONES, MANDREL AND SHOES: When alteration of honing stone is necessary, cut through abrasive with an old hacksaw blade and break unwanted section of stone from stoneholder with a pair of pliers. Do not cut into die cast stoneholder (except as described under blind hole alterations). Use a file or bench grinder to shorten guiding surfaces of shoe. Both stone and guide shoe should be altered identically and in same relative position.

ALTERATIONS FOR SHORT OPEN HOLES: Always consider possibility of stacking parts with short bores so that they may be honed as one long bore using standard honing units. Individual parts (if they have at least one flat face) with bore lengths of 1/4 diameter, or less, can also be honed by holding parts flat against face plate of square honing fixture. For precision sizing of short open holes, STONE AND GUIDE SHOE LENGTH SHOULD BE BETWEEN 2/3 and 1-1/2 TIMES BORE LENGTH to be honed.

ALTERATION FOR SHORT OPEN HOLES

COMPLETED ALTERATION FOR SHORT OPEN HOLES

ALTERATION OF HONING STONE



ALTERATION OF INTEGRAL GUIDE SHOE

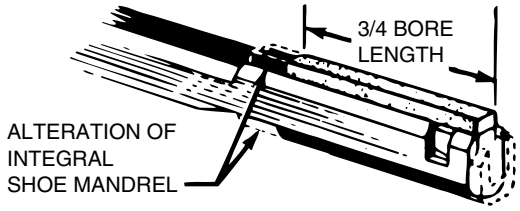
ALTERATION OF REPLACEABLE GUIDE SHOE

When alteration is necessary, both stone and guide shoe must be shortened by same amount. Any alteration of this type should shorten stone and shoe equally from both ends so that honing area remaining is centered over wedge contacts on stoneholder.

If greater accuracy is required than is obtained after alteration, refer to Troubleshooting Chart on page 31. Additional information is provided in Data File 102, “Honing Short Bores”. Write for free copy.

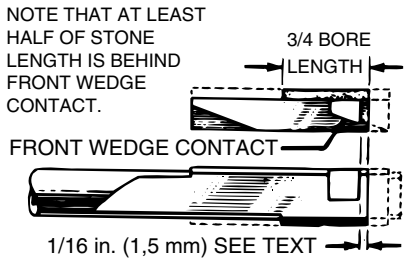
ALTERATIONS FOR BLIND HOLES: If at all possible, provide a relief (undercut) at closed end of hole to permit stone to overstroke honed surface. Relief does not have to be more than a few thousandths deep and can actually blend in with bore when finish honed, but it should be as long as possible, preferably 1/3 length of stone.

Sunnen honing units in K, J-K, AK, J-AK, BL, L, BAL, AL and P28 groups can be utilized for honing bores that have one end closed. In honing blind holes, it is necessary for stone and guide shoe to extend flush with tip of honing unit. If your application utilizes one of P28 group of honing units, install blind hole wedge and R28 honing stones (see Honing Supplies Catalog). Remaining mandrel groups have a tip which extends slightly beyond front end of stone and guide shoe. For all blind hole work this tip must be cut off, as illustrated below. Mandrels which have been altered in this manner can still be used for honing open holes using a full length stone and guide shoe. Blind hole Y mandrels are available on special order, but P20 and D Honing Unit groups are not adaptable for honing blind holes.



ALTERATION FOR BLIND HOLES

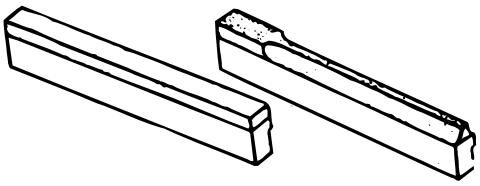
In honing blind holes, STONE AND GUIDE SHOE LENGTH SHOULD BE 2/3 to 3/4 OF BLIND HOLE LENGTH (including relief length). This is necessary to provide for proper stroking. When alteration of stone and shoe length is necessary, remove material only from back end as shown. To maintain stability of stone in mandrel, it is important that at least 50% of stone be behind forward wedge contact on stoneholder. Otherwise stone could rock, causing bore inaccuracies as work is stroked over honing unit. To avoid any chance for stoneholder to “rock” when honing extremely shallow or short blind holes, it may be necessary to cut back die cast stoneholder (as well as abrasive), mandrel, shoes and wedge tip so that only 1.5 mm (1/16") extends beyond front wedge contact. Pressure from wedge is then applied evenly to stoneholder.



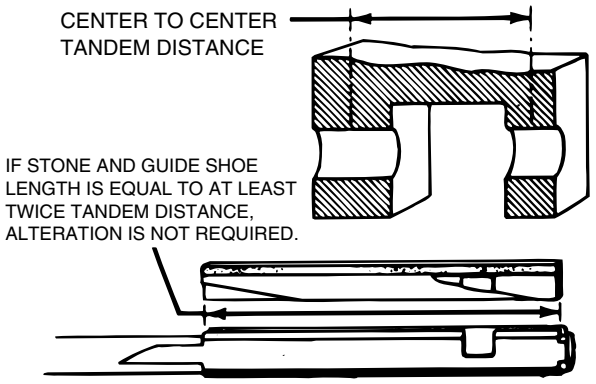
ALTERATION FOR BLIND HOLES (Extremely Short)

Some improvement can be obtained in honing blind holes where no relief is possible at blind end by using a “HARD-TIP” stone. Front section of abrasive has a harder bond than rest of stone. This harder abrasive reduces excessive wear that stone tip is exposed to when no relief is present. We can supply hard-tip stones - in most stone sizes. Minimum order quantity is one standard package of any individual part number. Allow one week for shipment. A “customer made” alteration can achieve same results as a hard-tip stone. Select a stone considerably harder than one normally used for job, and alter as illustrated.

For additional techniques on blind hole honing, refer to “Troubleshooting Guide” and request copies of Sunnen Bore Sizing & Finishing Technology Data Files #102 and #103.



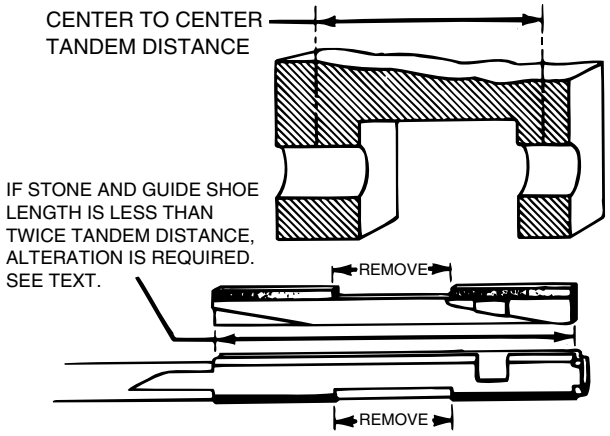
ALTERATIONS FOR TANDEM HOLES: Sunnen honing units can be used to size two or more “in-line” or tandem bores in perfect alignment. Stone and guide shoes must be of proper length so that entire stone surface will contact one or other of bores at some time during honing stroke. To keep honing unit true during operation, STONES AND GUIDE SHOE LENGTH MUST BE AT LEAST TWICE CENTER-TO-CENTER TANDEM DISTANCE OF BORES (see illustration). When honing unit meets this requirement, alteration is not required. It may be necessary to reverse part end for end on honing unit to obtain identical bore sizes. Never stroke either of tandem bores completely off stone and guide shoes.



TOOLING FOR TANDEM BORES

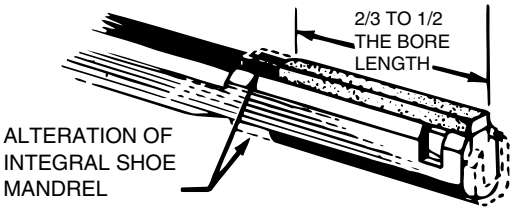
Should stone and guide shoe length be less than twice tandem distance, center area of stone and guide shoe will not wear and a resulting “hump” in honing unit will bellmouth inside ends of both bores of tandem. In some tandem applications, it is necessary to alter honing unit by cutting away area of stone and guide shoe that would become ‘’hump”. Remove from center of both stone and guide shoe, an amount equal to amount stone (and guide shoe) is short of being twice tandem distance. For example, a part having a 2-3/4" tandem spacing would require a 5-1/2" stone and guide shoe, but honing unit has a stone and guide length of only 4-1/2". This honing unit can be used by removing 1" from center of 4-1/2" stone and guide shoe length. Multiple-stone honing units P20 and P28) can sometimes be used by setting up honing unit to leave out center stones and shoes.

Special tandem type mandrels can generally be supplied for those applications which have too long a tandem distance for honing with altered honing units. Contact your Sunnen Field Engineer or factory. Additional discussion on honing tandem and multiple land bores is contained in Data File 106. Write for free copy.



ALTERATION FOR TANDEM BORES

ALTERATIONS FOR SHORT BORES USING AUTOMATIC SIZE CONTROL Always consider possibility of stacking parts with short bores so that they may be honed as one long bore using standard honing units. For precision sizing of open holes, stone and guide shoe length should be between 2/3 and 1-1/2 times bore length to be honed.



Mandrels can be altered as illustrated to hone short bores using automatic size control. Alteration allows sensing tip to be positioned closer to end of honing stone. Alteration is necessary if overstroke of a short bore does not depress sensing tip a sufficient amount to allow automatic size control to work.

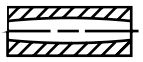
GLOSSARY OF TERMS

ADAPTER - A part used with certain mandrels to adapt them to fit spindle on honing machine.

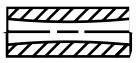
ALTERED STONE - A standard honing stone which has been shortened or otherwise changed for a specific application.

ALUMINUM OXIDE - An abrasive material generally most suitable for fast stock removal in tough materials such as most types of steel. It is designated by letter “A” in Sunnen stone code (example: K17-A57).

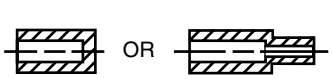
BARREL SHAPE - A condition where extreme ends of a bore are smaller in diameter than middle.



BELLMOUTH - A condition where extreme end or



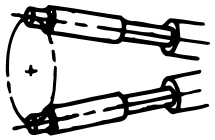
ends of a bore are larger in diameter than middle.



BLIND HOLE - A bore that is constricted or closed at one end.

BOND - Material that holds abrasive grains together in a honing stone.

CBN (Cubic Boron Nitride) - A synthetic abrasive that is second in hardness to, more chemically stable than, and as costly as diamond. CBN is best suited for steels, especially tool steels, high-speed steels and superalloys. General Electric tradename for CBN is Borazon. CBN is designated by letter "N" in Sunnen stone code (example: K12-NR53).



CONICAL RUNOUT - Honing unit not parallel to rotation centerline which causes eccentric motion of one end of workpiece.

CORK BOND - Bonding material for abrasive, composed of powdered cork and a phenolic resin. Cork bonded honing stones are used where extremely fine finishes (say, 2 to 4 microinches) on non-ferrous materials are required.

DEBURRING - Honing process used to remove burrs, sharp edges or similar material from rough bores.

DIAMOND - Hardest abrasive known to man, but chemically not suited for honing materials such as steel. Diamond is only Sunnen abrasive capable of honing very hard materials such as tungsten carbide, ceramics, and glass. It is designated by letter "D" in Sunnen stone code (example: K12-DV57).

DIAMOND STONES - Honing stone made with crushed diamond particles bonded together. It is only abrasive material capable of honing very hard materials such as tungsten carbide, glass, and ceramics.

DIAMOND DRESSER - Diamond abrasive used to dress aluminum oxide and silicon carbide honing stones.

GLAZED STONE - Stone with cutting action impaired because abrasive particles failed to break out of bond when cutting edges wore off. This condition shows up when bond is too hard and/or cutting pressure is too low.

GUIDE SHOES - Part of honing unit that stabilizes bore being honed on tool.

HARDNESS - As applied to honing stone, describes strength of bond that holds abrasive particles together. A hard bond will hold abrasive grains longer; a soft bond will permit stone to "break down" faster, exposing new sharp abrasive grains.

HARD-TIP STONE - Honing stone having a tip or end of harder abrasive than remaining length of stone. Used for honing blind holes where sufficient relief cannot be provided. See "Alterations for Blind Holes'' for how to make hard-tip stones.

HONING - Abrasive machining process primarily used for stock removal, precision sizing and surface finishing of internal and external cylindrical surfaces. Characterized by use of a self-sharpening abrasive stone, a relatively large area of contact with work, and relatively low cutting speeds.

HONING LENGTH - Actual length of surface being honed.

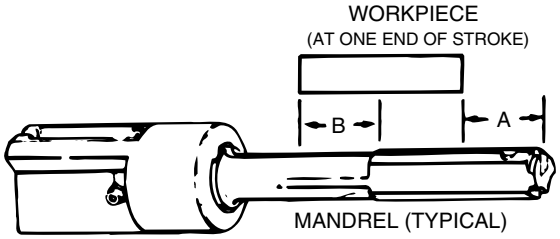
HONING STONE - Abrasive stick consisting of thousands of small abrasive grains bonded together, cemented to metal holder.

HONING UNIT - Complete honing tool consisting of adapter (if required), mandrel and wedge, stone(s), guide shoe(s), truing sleeve, and stone retainer or tension block.

LOADED STONE - Honing stone with cutting action impaired due to cutting surface being partially covered with foreign material, usually material being honed. This condition is sometimes encountered when honing soft materials.

MANDREL - Part of honing unit which holds and positions honing stone and guide shoes in their correct relative positions.

METAL BOND - Metallic bond used with diamond or CBN/Borazon grit to provide a very long lasting honing stone.



A = STONE OVERSTROKE
B = PART OVERSTROKE

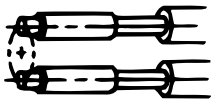
OVERSTROKE - Distance that workpiece is stroked over end of stone; it can also be distance stone extends beyond end of workpiece at end of each stroke. This distance is generally one-half length of stone (or of part, whichever is shortest). If for any reason a shorter stroke is used, the following formulas are useful:

Stone (or shoe) overstroke (on either end) =

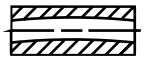
$$\frac{\text{Stroke length + Stone length - Part length}}{2}$$

Part overstroke (on either end) =

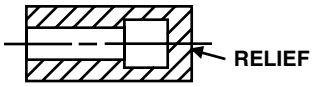
$$\frac{\text{Stroke length + Part length - Stone length}}{2}$$



PARALLEL RUNOUT - Off-center rotation of honing unit which causes eccentric motion of workpiece.



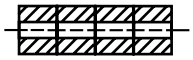
RAINBOW (or bow) - Sometimes called camber or banana shape. Condition where a bore's diameter may be same over its full length but whose axis or center-line is curved.



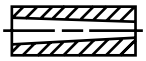
RELIEF - Enlargement of diameter at bottom of blind hole which makes it possible for end of honing stone to pass beyond bottom end of surface being honed.

SILICON CARBIDE - Hard and brittle synthetic abrasive for stock removal in soft materials such as brass, bronze, aluminum. cast iron, etc. and in extremely hard material such as tool steel.

Silicon Carbide is also used for obtaining fine finishes in all materials. It is designated by letter 'J' in Sunnen stone code (example K12-J85).

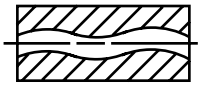


STACKING - Technique for honing short parts. Faces of parts must be square with bore prior to honing. A holding fixture is necessary for aligning and holding parts on a common center.



TAPER - Bore condition where diameter of bore gradually increases from one end of bore to other.

TRUING SLEEVE - Cylinder or workpiece whose purpose is to make guide shoes and stone straight and parallel to each other, and radius to approximate diameter to be honed.

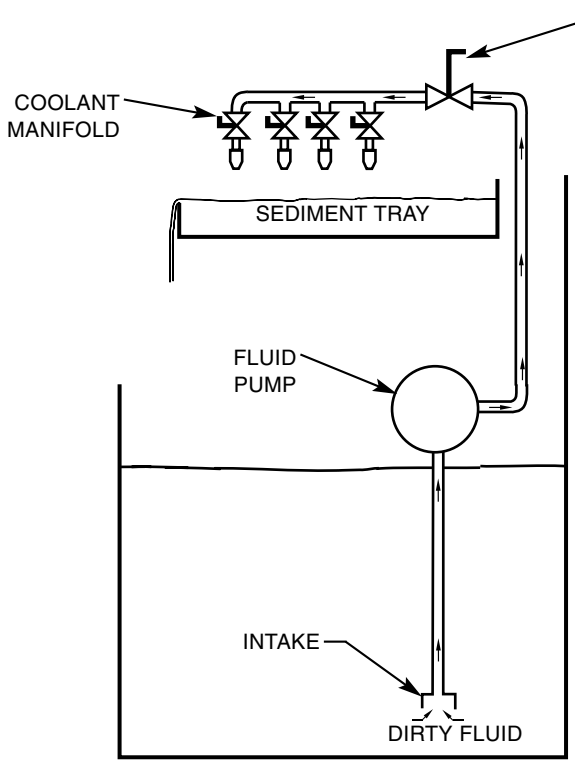


WAVINESS - Longitudinal wave, series of waves or ripple in a bore surface.

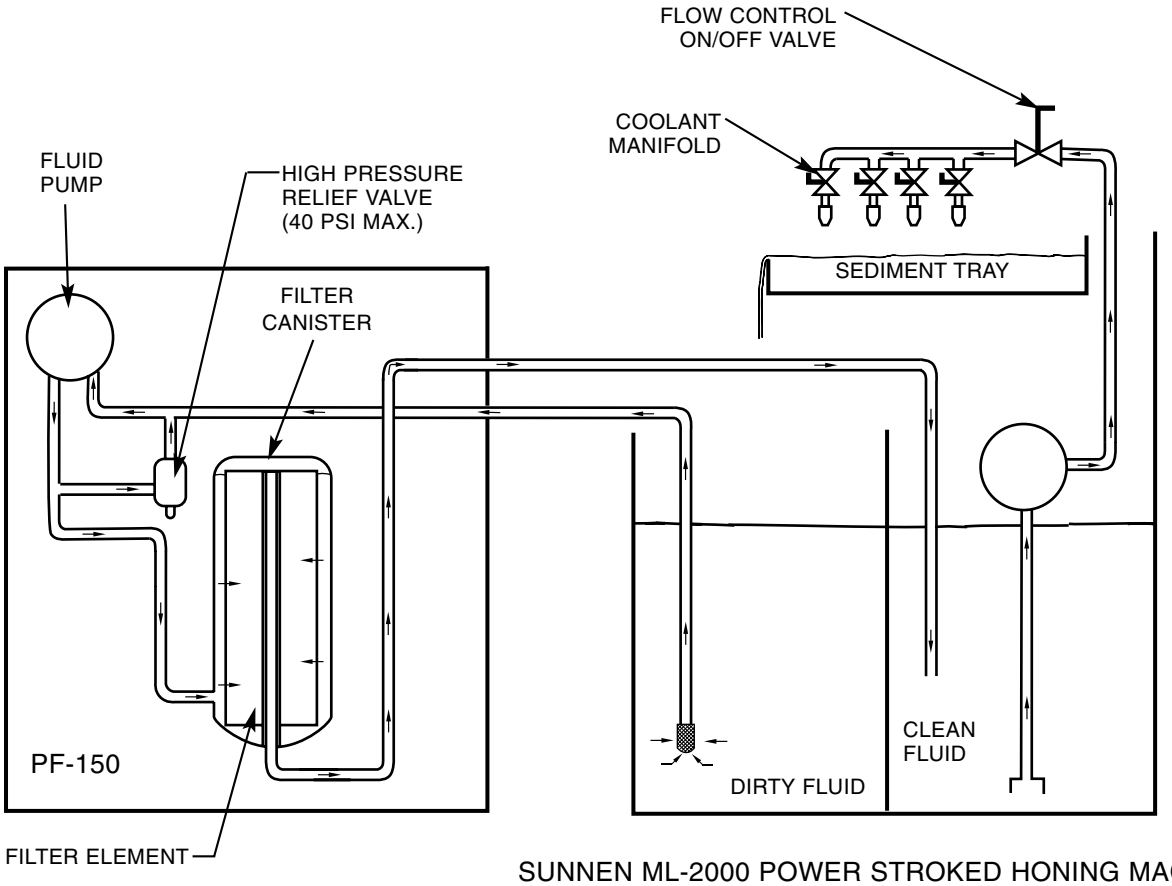
WEDGE - Part of Honing Unit that expands honing stone and applies cutting pressure.

C - COOLANT
SYSTEM FLOW DIAGRAM

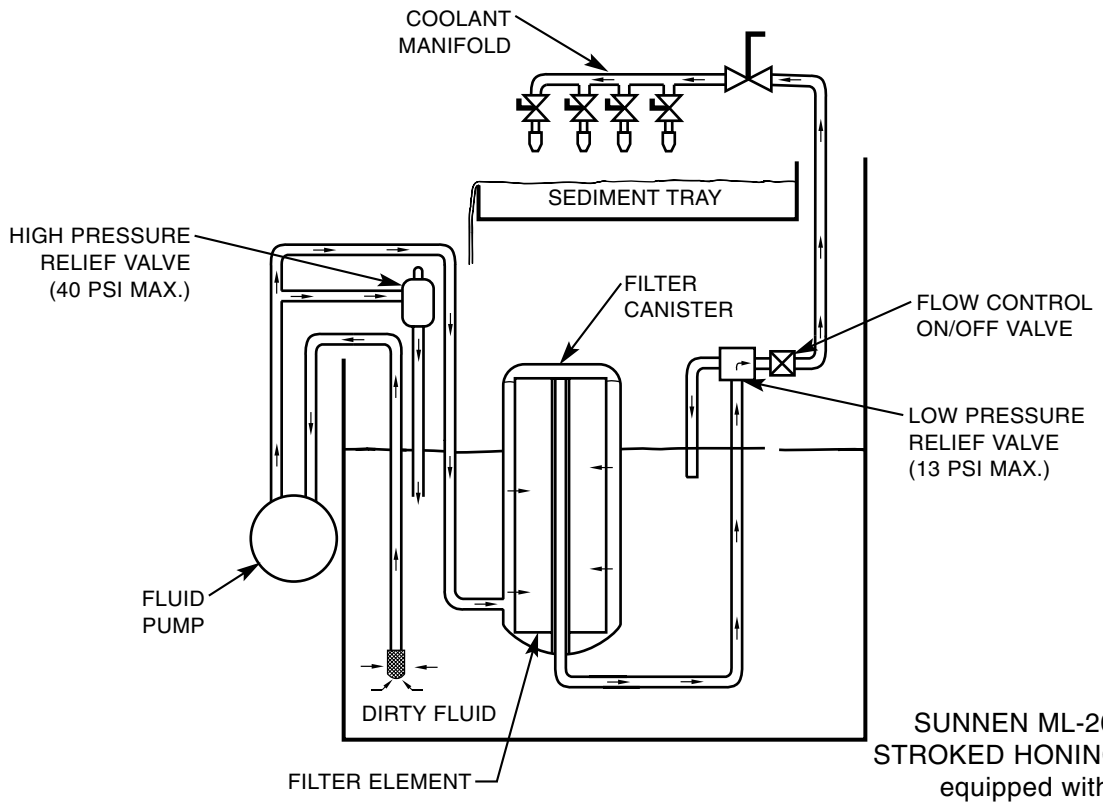
SUNNEN ML-2000 POWER
STROKED HONING MACHINE



SUNNEN ML-2000 POWER
STROKED HONING MACHINE
equipped with STANDARD
ML-3250 RESERVOIR ASSEMBLY

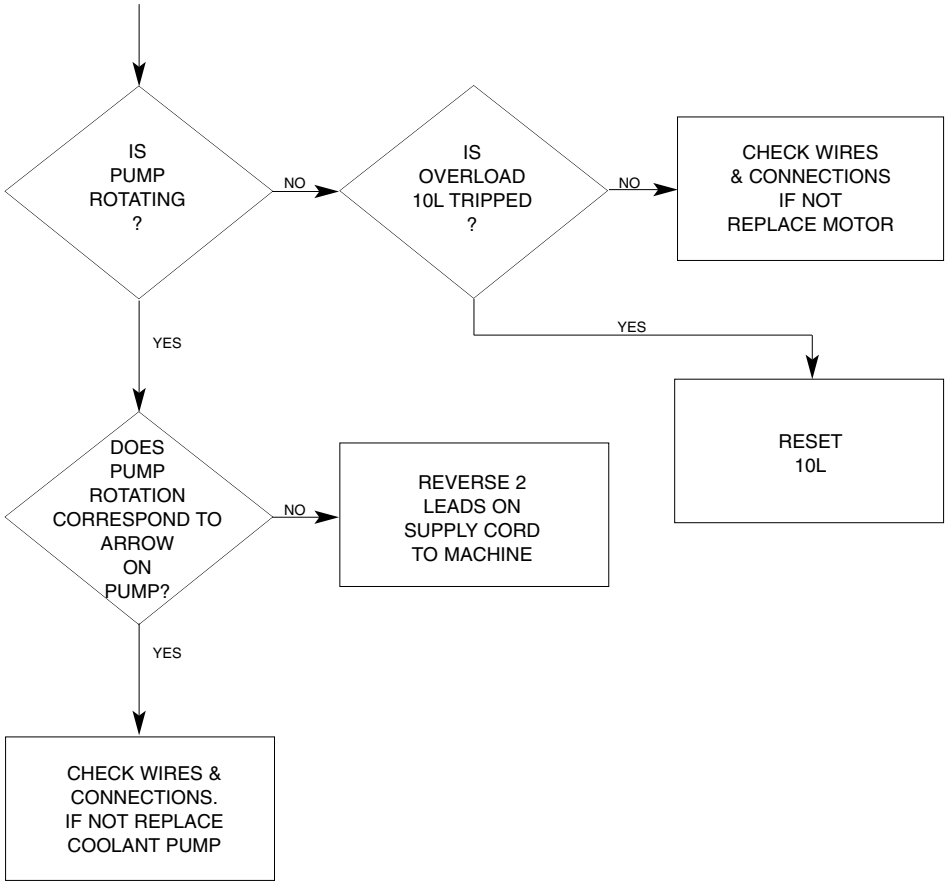


SUNNEN ML-2000 POWER STROKED HONING MACHINE
equipped with OPTIONAL PF-150 GRIT GUARD UNIT FILTRATION SYSTEM



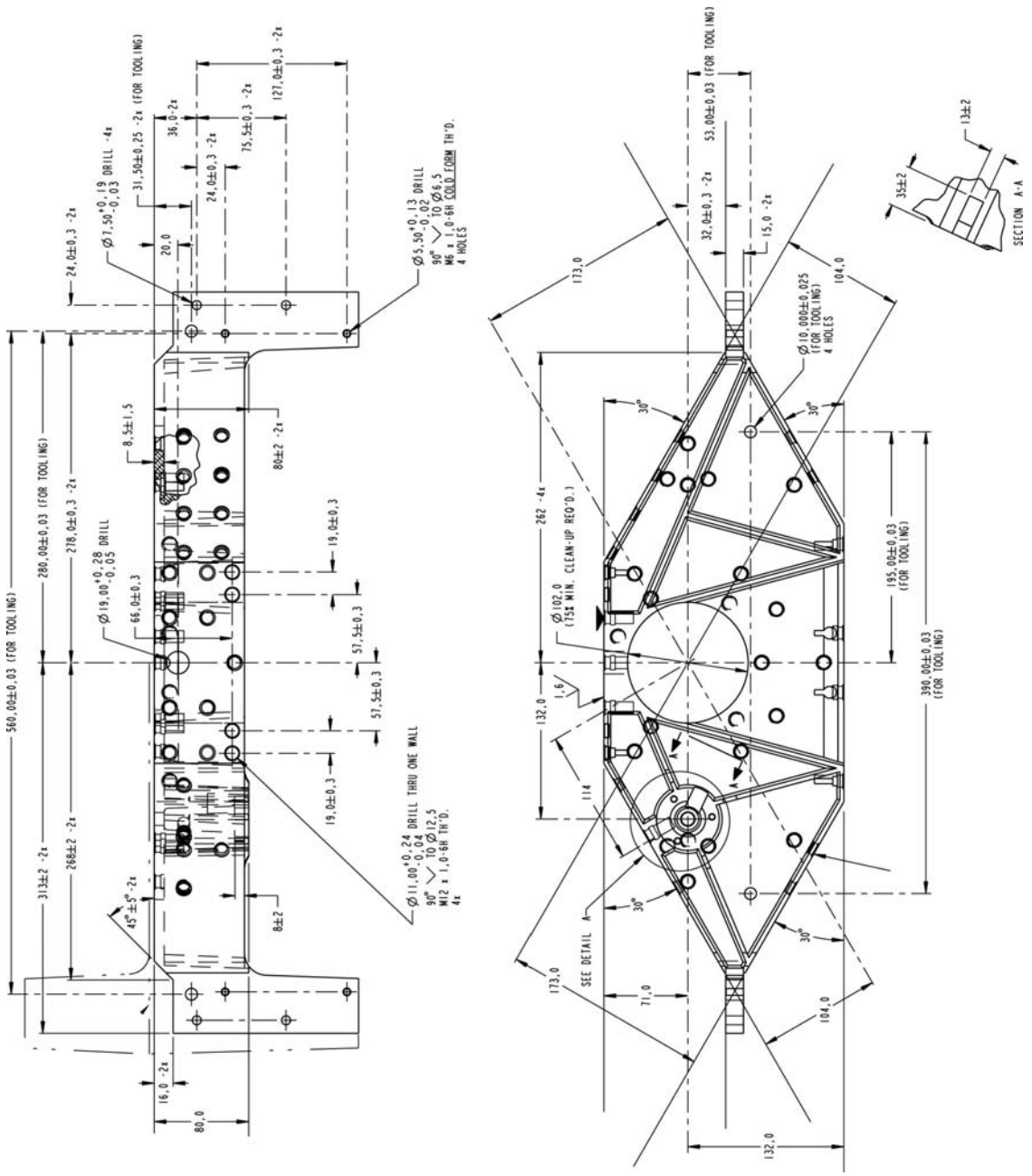
SUNNEN ML-2000 POWER
STROKED HONING MACHINE
equipped with OPTIONAL
ML-3490 COOLANT SYSTEM

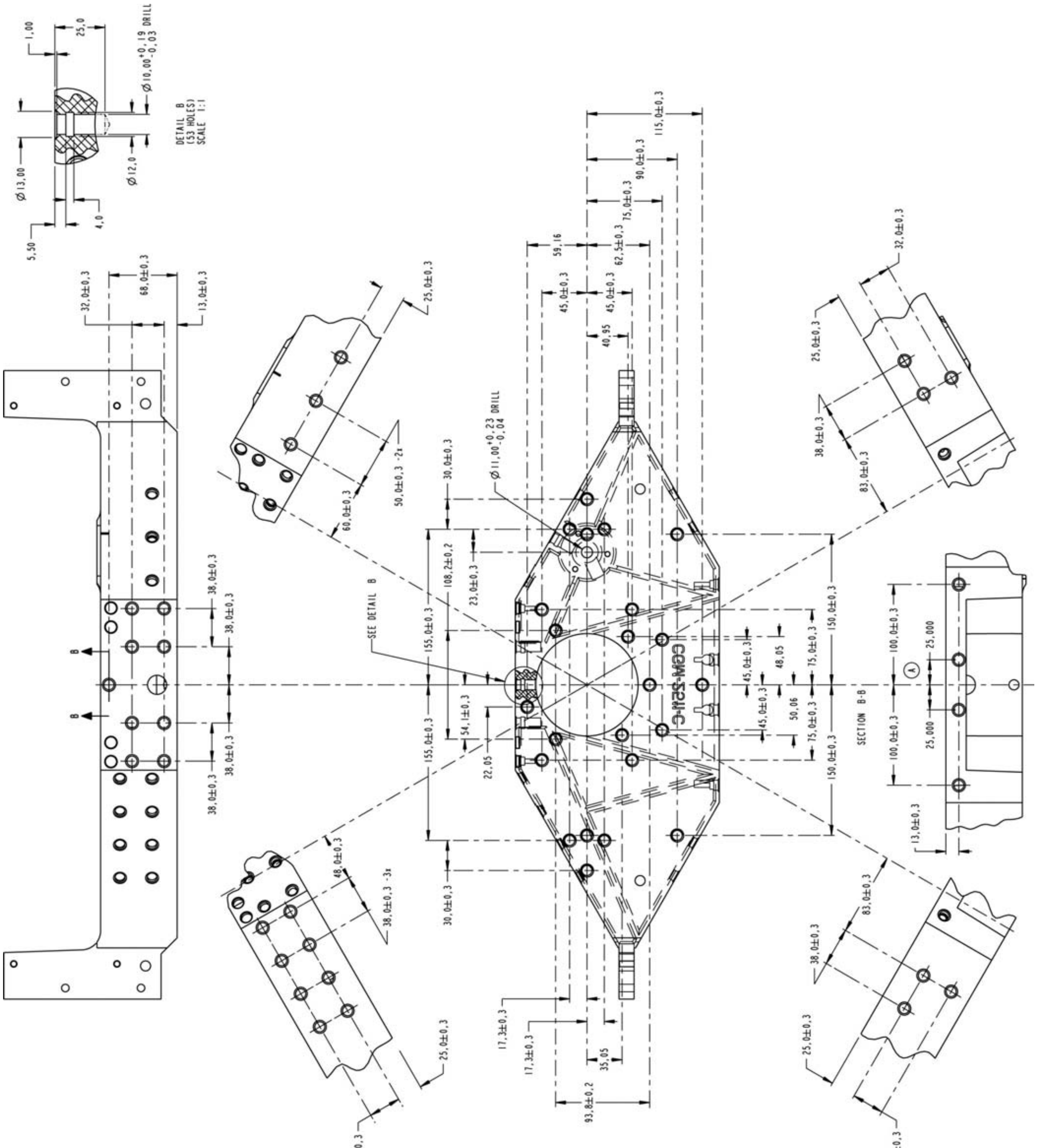
D - COOLANT TROUBLESHOOTING



* NOTE: 4FU AND 5FU MUST BE 1-AMP FUSES. OLDER MACHINES MAY HAVE SMALLER FUSES BUT MUST BE REPLACED WITH 1-AMP FUSES.

E - STROKER CARRTIAGE
HOLE PATTERN





NOTES

Like any machinery, this equipment may be dangerous if used improperly. Be sure to read and follow instructions for operation of equipment.

FRACTION / DECIMAL / MILLIMETER EQUIVALENTS CHART

INCH FRACTION	INCH DECIMAL	MILLIMETER	INCH FRACTION	INCH DECIMAL	MILLIMETER	INCH FRACTION	INCH DECIMAL	MILLIMETER
. . . .	.003937	0,1000	9/32	.281250	7,1438	21/32	.656250	16,6688
. . . .	.007874	0,2000	19/64	.296875	7,5406	. . . .	.669291	17,0000
. . . .	.011811	0,3000	5/16	.312500	7,9375	43/64	.671875	17,0656
1/64	.015625	0,3969	. . . .	.314961	8,0000	11/16	.687500	17,4625
. . . .	.015748	0,4000	21/64	.328125	8,3344	45/64	.703125	17,8594
. . . .	.019685	0,5000	11/32	.343750	8,7313	. . . .	.708661	18,0000
. . . .	.023622	0,6000	. . . .	.354331	9,0000	23/32	.718750	18,2563
. . . .	.027559	0,7000	23/64	.359375	9,1281	47/64	.734375	18,6531
1/32	.031250	0,7938	3/8	.375000	9,5250	. . . .	.748031	19,0000
. . . .	.031496	0,8000	25/64	.390625	9,9219	3/4	.750000	19,0500
. . . .	.035433	0,9000	. . . .	.393701	10,0000	49/64	.765625	19,4469
. . . .	.039370	1,0000	13/32	.406250	10,3188	25/32	.781250	19,8438
3/64	.046875	1,1906	27/64	.421875	10,7156	. . . .	.787402	20,0000
1/16	.062500	1,5875	. . . .	.433071	11,0000	51/64	.796875	20,2406
5/64	.078125	1,9844	7/16	.437500	11,1125	13/16	.812500	20,6375
. . . .	.078740	2,0000	29/64	.453125	11,5094	. . . .	.826772	21,0000
3/32	.093750	2,3813	15/32	.468750	11,9063	53/64	.828125	21,0344
7/64	.109375	2,7781	. . . .	.472441	12,0000	27/32	.843750	21,4313
. . . .	.118110	3,0000	31/64	.484375	12,3031	55/64	.859375	21,8281
1/8	.125000	3,1750	1/2	.500000	12,7000	. . . .	.866142	22,0000
9/64	.140625	3,5719	. . . .	.511811	13,0000	7/8	.875000	22,2250
5/32	.156250	3,9688	33/64	.515625	13,0969	57/64	.890625	22,6219
. . . .	.157480	4,0000	17/32	.531250	13,4938	. . . .	.905512	23,0000
11/64	.171875	4,3656	35/64	.546875	13,8906	29/32	.906250	23,0188
3/16	.187500	4,7625	. . . .	.551181	14,0000	59/64	.921875	23,4156
. . . .	.196850	5,0000	9/16	.562500	14,2875	15/16	.937500	23,8125
13/64	.203125	5,1594	37/64	.578125	14,6844	. . . .	.944882	24,0000
7/32	.218750	5,5563	. . . .	.590551	15,0000	61/64	.953125	24,2094
15/64	.234375	5,9531	19/32	.593750	15,0813	31/32	.968750	24,6063
. . . .	.236220	6,0000	39/64	.609375	15,4781	. . . .	.984252	25,0000
1/4	.250000	6,3500	5/8	.625000	15,8750	63/64	.984375	25,0031
17/64	.265625	6,7469	. . . .	.629921	16,0000	1	1.000000	25,4000
. . . .	.275591	7,0000	41/64	.640625	16,2719	1-1/16	1.062500	26,9880

FORMULAS:

MULTIPLY		BY		TO GET
INCHES (in)	x	25.4	=	MILLIMETERS (mm)
FEET (ft)	x	0.3048	=	METERS (m)

MULTIPLY		BY		TO GET
MILLIMETERS (mm)	x	0.03937	=	INCHES (in)
METERS (m)	x	3.281	=	FEET (ft)

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