OPERATOR'S MANUAL

Metal Working

VARIABLE SPEED VERTICAL MILL

MODEL: VM-942E-1

Book 1 of 2

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THANK YOU & WARRANTY

Thank you for your purchase of a machine from Baileigh Industrial. We hope that you find it productive and useful to you for a long time to come.

Inspection & Acceptance. Buyer shall inspect all Goods within ten (10) days after receipt thereof. Buyer's payment shall constitute final acceptance of the Goods and shall act as a waiver of the Buyer's rights to inspect or reject the goods unless otherwise agreed. If Buyer rejects any merchandise, Buyer must first obtain a Returned Goods Authorization ("RGA") number before returning any goods to Seller. Goods returned without a RGA will be refused. Seller will not be responsible for any freight costs, damages to goods, or any other costs or liabilities pertaining to goods returned without a RGA. Seller shall have the right to substitute a conforming tender. Buyer will be responsible for all freight costs to and from Buyer and repackaging costs, if any, if Buyer refuses to accept shipment. If Goods are returned in unsalable condition, Buyer shall be responsible for full value of the Goods. Buyer may not return any special-order Goods. Any Goods returned hereunder shall be subject to a restocking fee equal to 30% of the invoice price.

Specifications. Seller may, at its option, make changes in the designs, specifications or components of the Goods to improve the safety of such Goods, or if in Seller's judgment, such changes will be beneficial to their operation or use. Buyer may not make any changes in the specifications for the Goods unless Seller approves of such changes in writing, in which event Seller may impose additional charges to implement such changes.

Limited Warranty. Seller warrants to the original end-user that the Goods manufactured or provided by Seller under this Agreement shall be free of defects in material or workmanship for a period of twelve (12) months from the date of purchase, provided that the Goods are installed, used, and maintained in accordance with any instruction manual or technical guidelines provided by the Seller or supplied with the Goods, if applicable. The original end-user must give written notice to Seller of any suspected defect in the Goods prior to the expiration of the warranty period. The original end-user must also obtain a RGA from Seller prior to returning any Goods to Seller for warranty service under this paragraph. Seller will not accept any responsibility for Goods returned without a RGA. The original end-user shall be responsible for all costs and expenses associated with returning the Goods to Seller for warranty service. In the event of a defect, Seller, at its sole option, shall repair or replace the defective Goods or refund to the original end-user the purchase price for such defective Goods. Goods are not eligible for replacement or return after a period of 30 days from date of receipt. The foregoing warranty is Seller's sole obligation, and the original end-user's exclusive remedy, with regard to any defective Goods. This limited warranty does not apply to: (a) die sets, tooling, and saw blades; (b) periodic or routine maintenance and setup, (c) repair or replacement of the Goods due to normal wear and tear, (d) defects or damage to the Goods resulting from misuse, abuse, neglect, or accidents, (f) defects or damage to the Goods resulting from improper or unauthorized alterations, modifications, or changes; and (f) any Goods that has not been installed and/or maintained in accordance with the instruction manual or technical guidelines provided by Seller.

EXCLUSION OF OTHER WARRANTIES. THE FOREGOING LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. ANY AND ALL OTHER EXPRESS, STATUTORY OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE ARE EXPRESSLY DISCLAIMED. NO WARRANTY IS MADE WHICH EXTENDS BEYOND THAT WHICH IS EXPRESSLY CONTAINED HEREIN.

Limitation of Liability. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER OR ANY OTHER PARTY FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR DOWN TIME) ARISING FROM OR IN MANNER CONNECTED WITH THE GOODS, ANY BREACH BY SELLER OR ITS AGENTS OF THIS AGREEMENT, OR ANY OTHER CAUSE WHATSOEVER, WHETHER BASED ON CONTRACT, TORT OR ANY OTHER THEORY OF LIABILITY. BUYER'S REMEDY WITH RESPECT TO ANY CLAIM ARISING UNDER THIS AGREEMENT IS STRICTLY LIMITED TO NO MORE THAN THE AMOUNT PAID BY THE BUYER FOR THE GOODS.

Force Majeure. Seller shall not be responsible for any delay in the delivery of, or failure to deliver, Goods due to causes beyond Seller's reasonable control including, without limitation, acts of God, acts of war or terrorism, enemy actions, hostilities, strikes, labor difficulties, embargoes, non-delivery or late delivery of materials, parts and equipment or transportation delays not caused by the fault of Seller, delays caused by civil authorities, governmental regulations or orders, fire, lightening, natural disasters or any other cause beyond Seller's reasonable control. In the event of any such delay, performance will be postponed by such length of time as may be reasonably necessary to compensate for the delay.

Installation. If Buyer purchases any Goods that require installation, Buyer shall, at its expense, make all arrangements and connections necessary to install and operate the Goods. Buyer shall install the Goods in accordance with any Seller instructions and shall indemnify Seller against any and all damages, demands, suits, causes of action, claims and expenses (including actual attorneys' fees and costs) arising directly or indirectly out of Buyer's failure to properly install the Goods.

Work By Others; Safety Devices. Unless agreed to in writing by Seller, Seller has no responsibility for labor or work performed by Buyer or others, of any nature, relating to design, manufacture, fabrication, use, installation or provision of Goods. Buyer is solely responsible for furnishing, and requiring its employees and customers to use all safety devices, guards and safe operating procedures required by law and/or as set forth in manuals and instruction sheets furnished by Seller. Buyer is responsible for consulting all operator's manuals, ANSI or comparable safety standards, OSHA regulations and other sources of safety standards and regulations applicable to the use and operation of the Goods.

Remedies. Each of the rights and remedies of Seller under this Agreement is cumulative and in addition to any other or further remedies provided under this Agreement or at law or equity.

Attorney's Fees. In the event legal action is necessary to recover monies due from Buyer or to enforce any provision of this Agreement, Buyer shall be liable to Seller for all costs and expenses associated therewith, including Seller's actual attorneys' fees and costs.

Governing Law/Venue. This Agreement shall be construed and governed under the laws of the State of Wisconsin, without application of conflict of law principles. Each party agrees that all actions or proceedings arising out of or in connection with this Agreement shall be commenced, tried, and litigated only in the state courts sitting in Manitowoc County, Wisconsin or the U.S. Federal Court for the Eastern District of Wisconsin. Each party waives any right it may have to assert the doctrine of "forum non conveniens" or to object to venue to the extent that any proceeding is brought in accordance with this section. Each party consents to and waives any objection to the exercise of personal jurisdiction over it by courts described in this section. Each party waives to the fullest extent permitted by applicable law the right to a trial by jury.

Summary of Return Policy.

- 10 Day acceptance period from date of delivery. Damage claims and order discrepancies will not be accepted after this time.
- You must obtain a Baileigh issued RGA number PRIOR to returning any materials.
- Returned materials must be received at Baileigh in new condition and in original packaging.
- Altered items are not eligible for return.
- Buyer is responsible for all shipping charges.
- A 30% re-stocking fee applies to all returns.

Baileigh Industrial makes every effort to ensure that our posted specifications, images, pricing and product availability are as correct and timely as possible. We apologize for any discrepancies that may occur. Baileigh Industrial reserves the right to make any and all changes deemed necessary in the course of business including but not limited to pricing, product specifications, quantities, and product availability.

For Customer Service & Technical Support:
Please contact one of our knowledgeable Sales and Service team members at:
(920) 684-4990 or e-mail us at sales@baileigh.com

INTRODUCTION

The quality and reliability of the components assembled on a Baileigh Industrial machine guarantee near perfect functioning, free from problems, even under the most demanding working conditions. However, if a situation arises, refer to the manual first. If a solution cannot be found, contact the distributor where you purchased our product. Make sure you have the serial number and production year of the machine (stamped on the nameplate). For replacement parts refer to the assembly numbers on the parts list drawings.

Our technical staff will do their best to help you get your machine back in working order.

In this manual you will find: (when applicable)

- Safety procedures
- Correct installation guidelines
- Description of the functional parts of the machine
- Capacity charts
- Setup and start-up instructions
- Machine operation
- Scheduled maintenance
- Parts lists

GENERAL NOTES

After receiving your equipment remove the protective container. Do a complete visual inspection, and if damage is noted, **photograph it for insurance claims** and contact your carrier at once, requesting inspection. Also contact Baileigh Industrial and inform them of the unexpected occurrence. Temporarily suspend installation.

Take necessary precautions while loading / unloading or moving the machine to avoid any injuries.

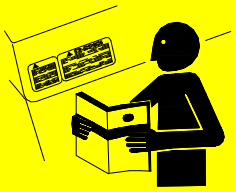
Your machine is designed and manufactured to work smoothly and efficiently. Following proper maintenance instructions will help ensure this. Try and use original spare parts, whenever possible, and most importantly; **DO NOT** overload the machine or make any modifications.

Note: *This symbol refers to useful information throughout the manual.*

IMPORTANT

PLEASE READ THIS OPERATORS MANUAL CAREFULLY

It contains important safety information, instructions, and necessary operating procedures. The continual observance of these procedures will help increase your production and extend the life of the equipment.



SAFETY INSTRUCTIONS

LEARN TO RECOGNIZE SAFETY INFORMATION

This is the safety alert symbol. When you see this symbol on your machine or in this manual, **BE ALERT TO THE POTENTIAL FOR PERSONAL INJURY!**

Follow recommended precautions and safe operating practices.

UNDERSTAND SIGNAL WORDS

A signal word – **DANGER**, **WARNING**, or **CAUTION** – is used with the safety alert symbol. **NOTICE**, which is not related to personal injury, is used without a symbol.

DANGER: Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING: Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

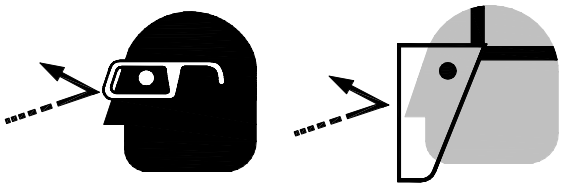
CAUTION: Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE: Indicates a situation which, if not avoided, could result in property damage.

SAVE THESE INSTRUCTIONS.
Refer to them often and use them to instruct others.

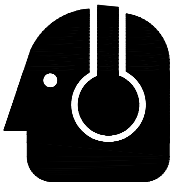
PROTECT EYES

Wear safety glasses or suitable eye protection when working on or around machinery.



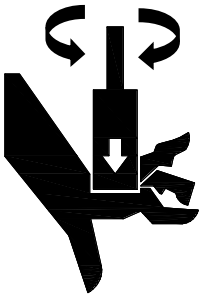
PROTECT AGAINST NOISE

Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear suitable hearing protective devices such as ear muffs or earplugs to protect against objectionable or uncomfortable loud noises.



BEWARE OF PIERCING POINTS AND CUTTING HAZARD

NEVER place hands, fingers, or any part of your body on or near rotating tooling. This tooling can be extremely dangerous if you do not follow proper safety procedures. **Keep hand at least 6" (150mm) from the tooling while operating.**

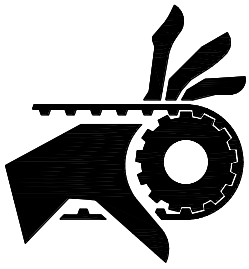


ENTANGLEMENT HAZARD – ROTATING SPINDLE

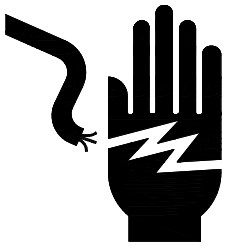
Contain long hair, **DO NOT** wear jewelry or loose-fitting clothing.

BEWARE OF PINCH POINTS

Keep hands and fingers away from the motors, drive belt, and pulleys when performing maintenance. Keep motor guards in place at all times while the machine is running.



HIGH VOLTAGE



USE CAUTION IN HIGH VOLTAGE AREAS. DO NOT assume the power to be off.
FOLLOW PROPER LOCKOUT PROCEDURES.

EMERGENCY STOP BUTTON

In the event of incorrect operation or dangerous conditions, the machine can be stopped immediately by pressing the **E-STOP** button. Twist the emergency stop button clockwise (cw) to reset. Note: Resetting the E-Stop will not start the machine.

SAFETY PRECAUTIONS

Metal working can be dangerous if safe and proper operating procedures are not followed. As with all machinery, there are certain hazards involved with the operation of the product. Using the machine with respect and caution will considerably lessen the possibility of personal injury. However, if normal safety precautions are overlooked or ignored, personal injury to the operator may result.
Safety equipment such as guards, hold-downs, safety glasses, dust masks, and hearing protection can reduce your potential for injury. But even the best guard won't make up for poor judgment, carelessness or inattention. **Always use common sense** and exercise **caution** in the workshop. If a procedure feels dangerous, don't try it.
REMEMBER: Your personal safety is your responsibility.

WARNING: FAILURE TO FOLLOW THESE RULES MAY RESULT IN SERIOUS PERSONAL INJURY

Dear Valued Customer:

- All Baileigh machines should be used only for their intended use.
- Baileigh does not recommend or endorse making any modifications or alterations to a Baileigh machine. Modifications or alterations to a machine may pose a substantial risk of injury to the operator or others and may do substantial damage to the machine.
- Any modifications or alterations to a Baileigh machine will invalidate the machine's warranty.

PLEASE ENJOY YOUR BAILEIGH MACHINE! ....PLEASE ENJOY IT SAFELY!

1. **FOR YOUR OWN SAFETY, READ INSTRUCTION MANUAL BEFORE OPERATING THE MACHINE.** Learn the machine's application and limitations as well as the specific hazards.
2. **Only trained and qualified personnel can operate this machine.**
3. **Make sure guards are in place and in proper working order before operating machinery.**
4. **Remove any adjusting tools.** Before operating the machine, make sure any adjusting tools have been removed.
5. **Keep work area clean.** Cluttered areas invite injuries.
6. **Overloading machine.** By overloading the machine you may cause injury from flying parts. **DO NOT** exceed the specified machine capacities.
7. **Dressing material edges.** Always chamfer and deburr all sharp edges.
8. **Do not force tool.** Your machine will do a better and safer job if used as intended. **DO NOT** use inappropriate attachments in an attempt to exceed the machine's rated capacity.
9. **Use the right tool for the job. DO NOT** attempt to force a small tool or attachment to do the work of a large industrial tool. **DO NOT** use a tool for a purpose for which it was not intended.
10. **Turn off** main power to the machine and wait for the cutting tool to stop turning before removing debris, removing or securing the workpiece, or changing the position of the work table.
11. **Never** expose your hands or limbs to the cutting area while the machine is operating.
12. **Make Sure** drawbar has been tightened before turning vertical mill on.
13. **Never** leave the machine running while unattended. Turn the power OFF. Do not leave the machine until the spindle comes to a complete stop.
14. **Hold** the workpiece firmly against the table. DO NOT attempt to mill a workpiece that does not have a flat surface against the table, or that is not secured by a vise. Prevent the workpiece from rotating by clamping it to the table or by securing it against the column of the mill.
15. **Never** start the machine before clearing the table of all objects (tools, scrap pieces, etc.)
16. **Machines can eject** workpiece towards the operator. Know and avoid the conditions which cause the workpiece to kickback.
17. **Do not stop** the spindle using your hand. Allow the spindle to stop on its own, or in the case of an emergency, use the spindle brake.
18. **Disconnect power** and make sure all moving parts have come to a complete stop before changing cutting tools, starting any inspection, adjustment, or maintenance procedure.

19. **Properly secure** the cutting tool in the spindle before operating the machine.
20. **Do not remove** any safety equipment, such as safety covers, emergency stop buttons, safety mats, railings, light booms, ramps, and warning signs.
21. **Make sure** electrical cables are well protected from damage. Check insulation periodically for wear.
22. **Dress appropriately. DO NOT** wear loose fitting garments, jewelry, neckties, or gloves which may get caught in moving machine parts. Protective clothing and steel toe shoes are recommended when using machinery. Wear a restrictive hair covering to contain long hair.
23. **Use eye and ear protection**. Always wear ISO approved impact safety goggles. Wear a full-face shield if you are producing metal filings.
24. **Stay alert**. Watch what you are doing and use common sense. **DO NOT** operate any tool or machine when you are tired.
25. **Check for damaged parts**. Before using any tool or machine, carefully check any part that appears damaged. Check for alignment and binding of moving parts that may affect proper machine operation.
26. **Do not overreach**. Maintain proper footing and balance at all times. **DO NOT** reach over or across a running machine.
27. **Observe work area conditions**. **DO NOT** use machines or power tools in damp or wet locations. Do not expose to rain. **DO NOT** use electrically powered tools in the presence of flammable gases or liquids.
28. **Keep children away**. Children must never be allowed in the work area. **DO NOT** let them handle machines, tools, or extension cords.
29. **Store idle equipment**. When not in use, tools must be stored in a dry location to inhibit rust. Always lock up tools and keep them out of reach of children.
30. **DO NOT operate machine if under the influence of alcohol or drugs**. Read warning labels on prescriptions. If there is any doubt, **DO NOT** operate the machine.
31. **Turn off** power before checking, cleaning, or replacing any parts.
32. Be sure **all** equipment is properly installed and grounded according to national, state, and local codes.
33. Keep **all** cords dry, free from grease and oil, and protected from sparks and hot metal.
34. Inspect power and control cables periodically. Replace if damaged or bare wires are exposed. **Bare wiring can kill! DO NOT** touch live electrical components or parts.
35. **DO NOT** bypass or defeat any safety interlock systems.
36. Keep visitors a safe distance from the work area.

TECHNICAL SPECIFICATIONS

Table Size	42" x 9" (1067 x 230mm)
T Slots	3 @ .625" (16mm)
Longitudinal Travel	25.25" (641mm)
Cross Travel	12.12" (308mm)
Knee Vertical Travel	14.675" (371.5mm)
Cross Travel of Ram	13.5" (343mm)
Spindle Nose to Table	2.36 ~ 17" (60 ~ 432mm)
Spindle Speeds	8 speeds, 80 to 2760 RPM
Spindle Travel	5" (127mm)
Spindle Diameter	3.34" (85mm)
Spindle Taper	R8
Spindle Feed Per Rev	.003"/.0015"/.006" (.076mm/.038mm/.15mm)
Spindle Head Swivel	45° (F&R), 90° (R&L)
Table Load Capacity	750 lbs. (340kg)
Power Requirement	220V / 1ph, 60hz
Motor Spindle	3 hp, 1ph, 60hz, 18A
Motor Coolant	1/16 hp (40 watt), 220V, 3360 RPM
Coolant Capacity	4gal (15L)
Machine Weight	2,200lbs (1000kg)
Shipping Weight	2,350lbs (1066kg)
Shipping Dimensions	65" x 67" x 79" (1651 x 1701 x 2006mm)

TECHNICAL SUPPORT

Our technical support department can be reached at 920.684.4990, and asking for the support desk for purchased machines. Tech Support handles questions on machine setup, schematics, warranty issues, and individual parts needs: (other than die sets and blades).
For specific application needs or future machine purchases contact the Sales Department at: sales@baileigh.com, Phone: 920.684.4990, or Fax: 920.684.3944.

***Note**: The photos and illustrations used in this manual are representative only and may not depict the actual color, labeling or accessories and may be intended to illustrate technique only.*

***Note**: The specifications and dimensions presented here are subject to change without prior notice due to improvements of our products.*

UNPACKING AND CHECKING CONTENTS

Your Baileigh machine is shipped complete. Separate all parts from the packing material and check each item carefully. Make certain all items are accounted for before discarding any packing material.

WARNING: SUFFOCATION HAZARD! Immediately discard any plastic bags and packing materials to eliminate choking and suffocation hazards to children and animals.
If any parts are missing, DO NOT place the machine into service until the missing parts are obtained and installed correctly.

Cleaning

WARNING: DO NOT USE gasoline or other petroleum products to clean the machine. They have low flash points and can explode or cause fire.

CAUTION: When using cleaning solvents work in a well-ventilated area. Many cleaning solvents are toxic if inhaled.

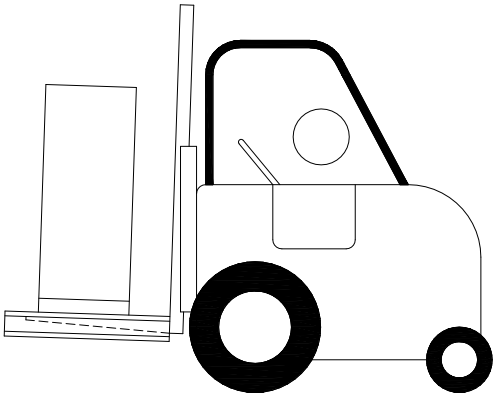
Your machine may be shipped with a rustproof waxy coating and/or grease on the exposed unpainted metal surfaces. Fully and completely remove this protective coating using a degreaser or solvent cleaner. Moving items will need to be moved along their travel path to allow for cleaning the entire surface. For a more thorough cleaning, some parts will occasionally have to be removed. **DO NOT USE** acetone or brake cleaner as they may damage painted surfaces.
Follow manufacturer's label instructions when using any type of cleaning product. After cleaning, wipe unpainted metal surfaces with a light coating of quality oil or grease for protection.

Important: *This waxy coating is **NOT** a lubricant and will cause the machine to stick and lose performance as the coating continues to dry.*

TRANSPORTING AND LIFTING

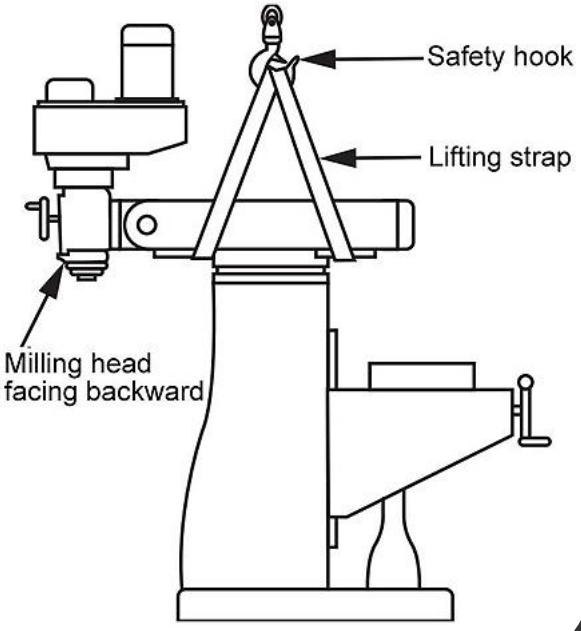
NOTICE: *Lifting and carrying operations should be carried out by skilled workers, such as a truck operator, crane operator, etc. If a crane is used to lift the machine, attach the lifting chain carefully, making sure the machine is well balanced.*

Follow these guidelines when lifting with truck or trolley:



- The lift truck must be able to lift at least 1.5 – 2 times the machine's gross weight.
- Make sure the machine is balanced. While transporting, avoid rough or jerky motion, and maintain a safe clearance zone around the transport area.
- Use a forklift with sufficient lifting capacity and forks that are long enough to reach the complete width of the machine.
- Remove the securing bolts that attach the machine to the pallet.
- Approaching the machine from the side, lift the machine on the frame taking care that there are no cables or pipes in the area of the forks.
- Move the machine to the required position and lower gently to the floor.
- Level the machine so that all the supporting feet are taking the weight of the machine and no rocking is taking place.

Follow these guidelines when lifting with crane:



- Take proper precautions for handling and lifting.
- Use lift equipment such as straps capable of lifting 1.5 – 2 times the weight of the machine.
- Always lift and carry the machine with straps around the ram as shown. It is recommended that the head and ram be rotated 180º to provide the best balance. Move the head in or out as needed to help balance the machine.
- Tighten ram locking bolts. Tighten (4) bolts that hold the ram to the column to 47 ft. lbs. of torque.
- Position the table over the knee lifting leadscrew pedestal.
- Check if the load is properly balanced by lifting it an inch or two.

- Lift the machine, avoiding sudden accelerations or quick changes of direction.
- Locate the machine where it is to be installed, then lower slowly until it touches the floor.

INSTALLATION

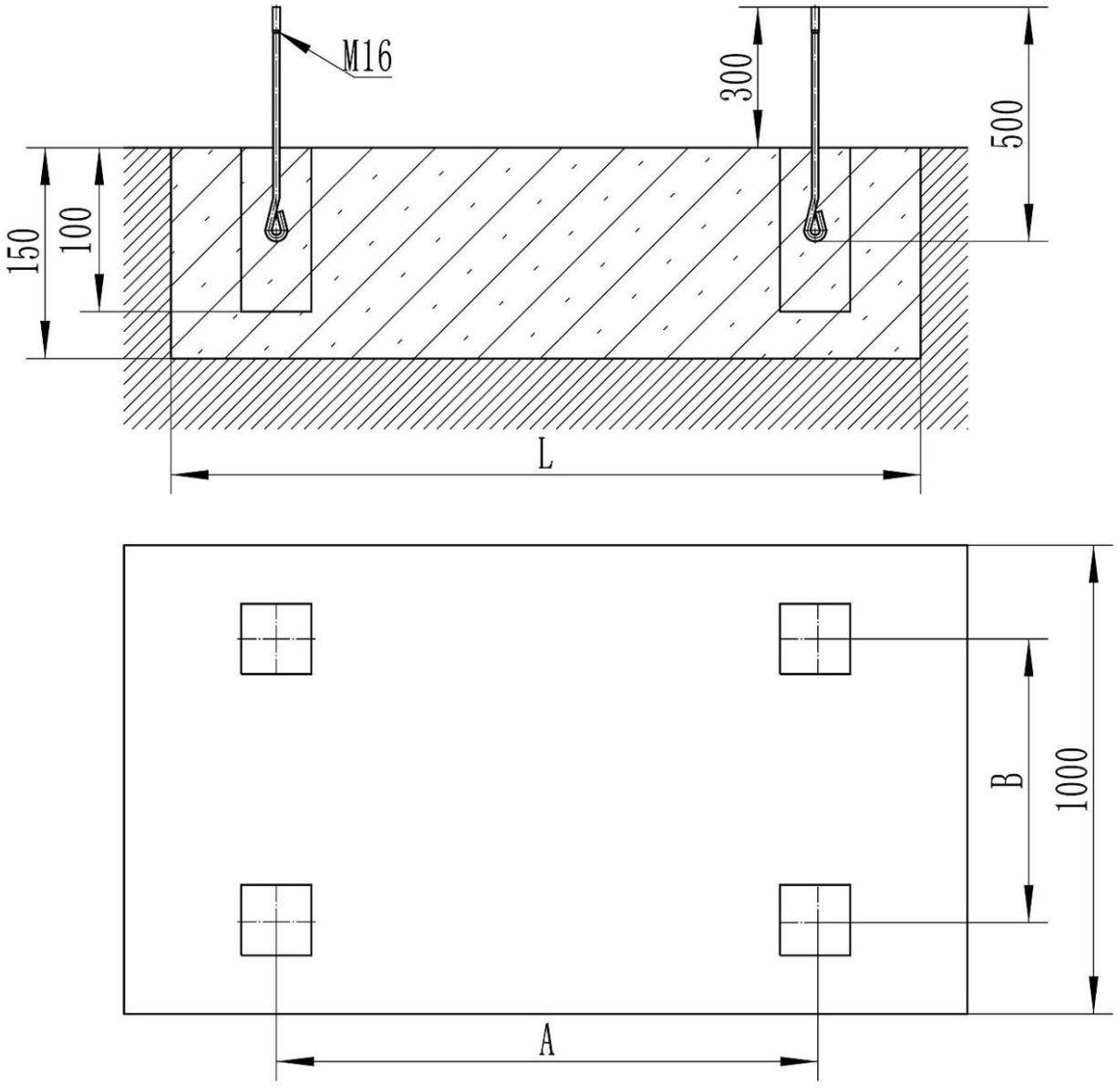
IMPORTANT:

Consider the following when looking for a suitable location to place the machine:

- Overall weight of the machine.
- Weight of material being processed.
- Sizes of material to be processed through the machine.
- Space needed for auxiliary stands, work tables, or other machinery.
- Clearance from walls and other obstacles.
- Maintain an adequate working area around the machine for safety.
- Have the work area well illuminated with proper lighting.
- Keep the floor free of oil and make sure it is not slippery.
- Remove scrap and waste materials regularly, and make sure the work area is free from obstructing objects.
- If long lengths of material are to be fed into the machine, make sure that they will not extend into any aisles.
- **LEVELING:** The machine should be sited on a level, concrete floor. Provisions for securing it should be in position prior to placing the machine. The accuracy of any machine depends on the precise placement of it to the mounting surface.
- **FLOOR:** This machine distributes a large amount of weight over a small area. Make certain that the floor is capable of supporting the weight of the machine, work stock, and the operator. The floor should also be a level surface. If the unit wobbles or rocks once in place, be sure to eliminate by using shims.
- **WORKING CLEARANCES:** Take into consideration the size of the material to be processed. Make sure that you allow enough space for you to operate the machine freely.
- **POWER SUPPLY PLACEMENT:** The power supply should be located close enough to the machine so that the power cord is not in an area where it would cause a tripping hazard. Be sure to observe all electrical codes if installing new circuits and/or outlets.

Anchoring the Machine

- Once positioned, anchor the machine to the floor, as shown in the diagram. Use bolts and expansion plugs or sunken tie rods that connect through and are sized for the holes in the base of the stand.
- This machine requires a solid floor such as concrete at a minimum of 4" (102mm) thick. 6" (152mm) minimum is preferred.

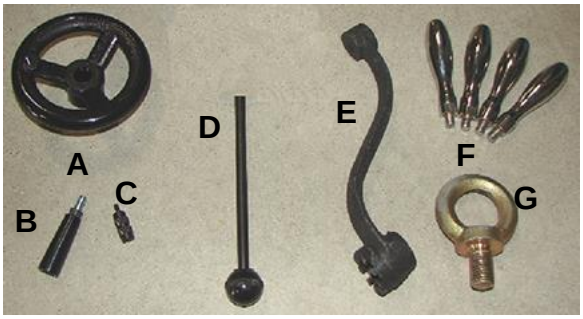


L	59.05” (1500mm)	A	29.13” (740mm)	B	20.47” (520mm)

Contents of Tool Box

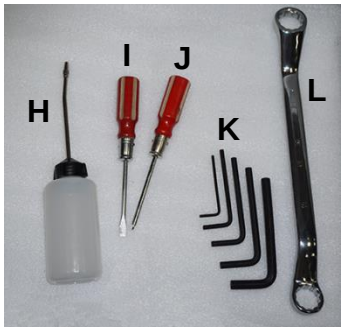
Machine Components

A – (1) Manual feed wheel
B – (1) Feed wheel handle
C – (1) Feed reversing knob
D – (1) Quill feed handle
E – (1) Elevating crank – “Z” axis
F – (4) Ball crank handles
G – (1) Eye bolt



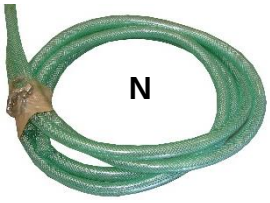
Tools

H – (1) Hand lubrication bottle
I – (1) Flat head screw driver 150x6mm
J – (1) Phillips head screw driver 150x8mm
K – (1 set) Metric allen wrenches
L – (1) Box wrench 19mm, 21mm

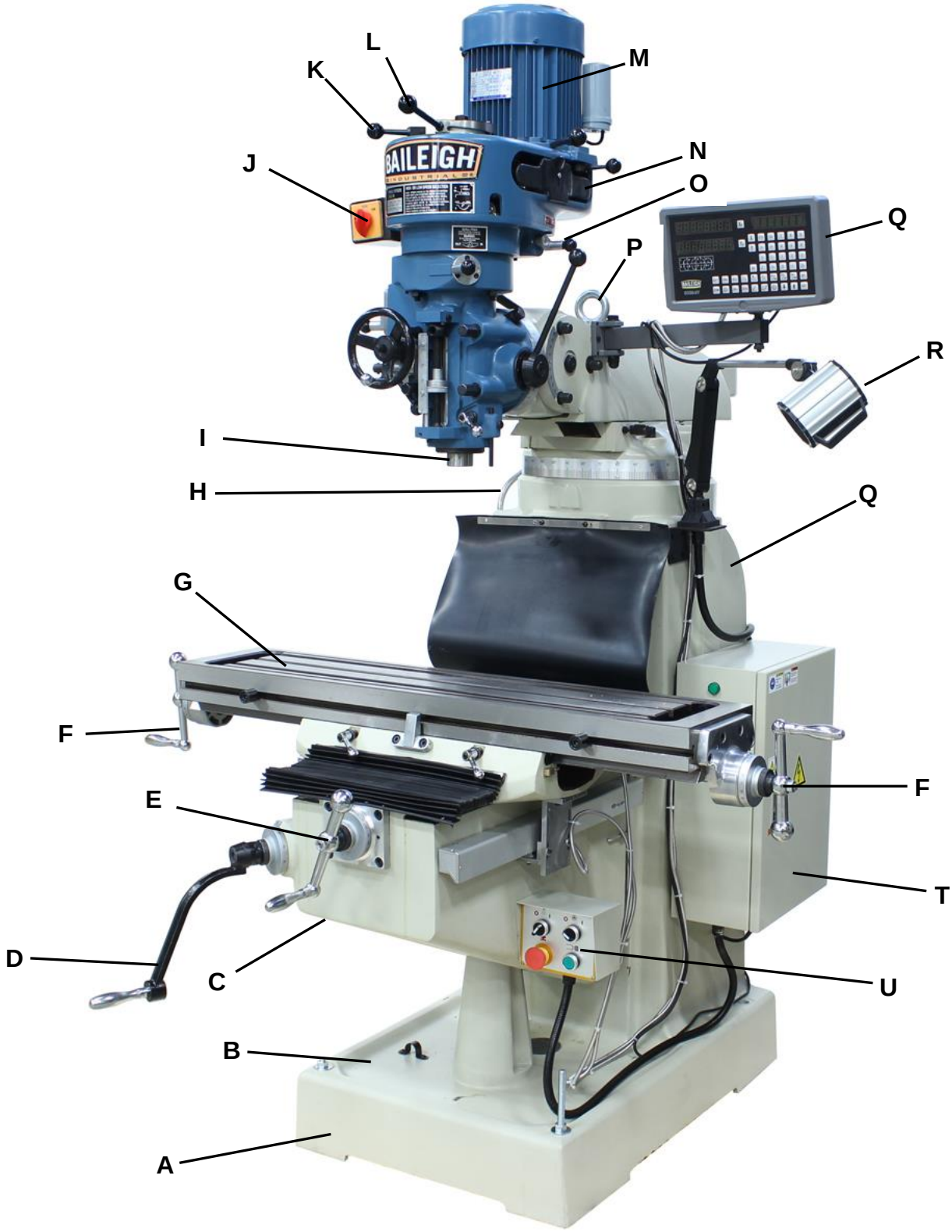


Items Packaged Separately

M – (1) Drip tray
N – (1) Coolant hose w/clamps
O – (1) Draw bar (7/16"-20) *Collet not included.



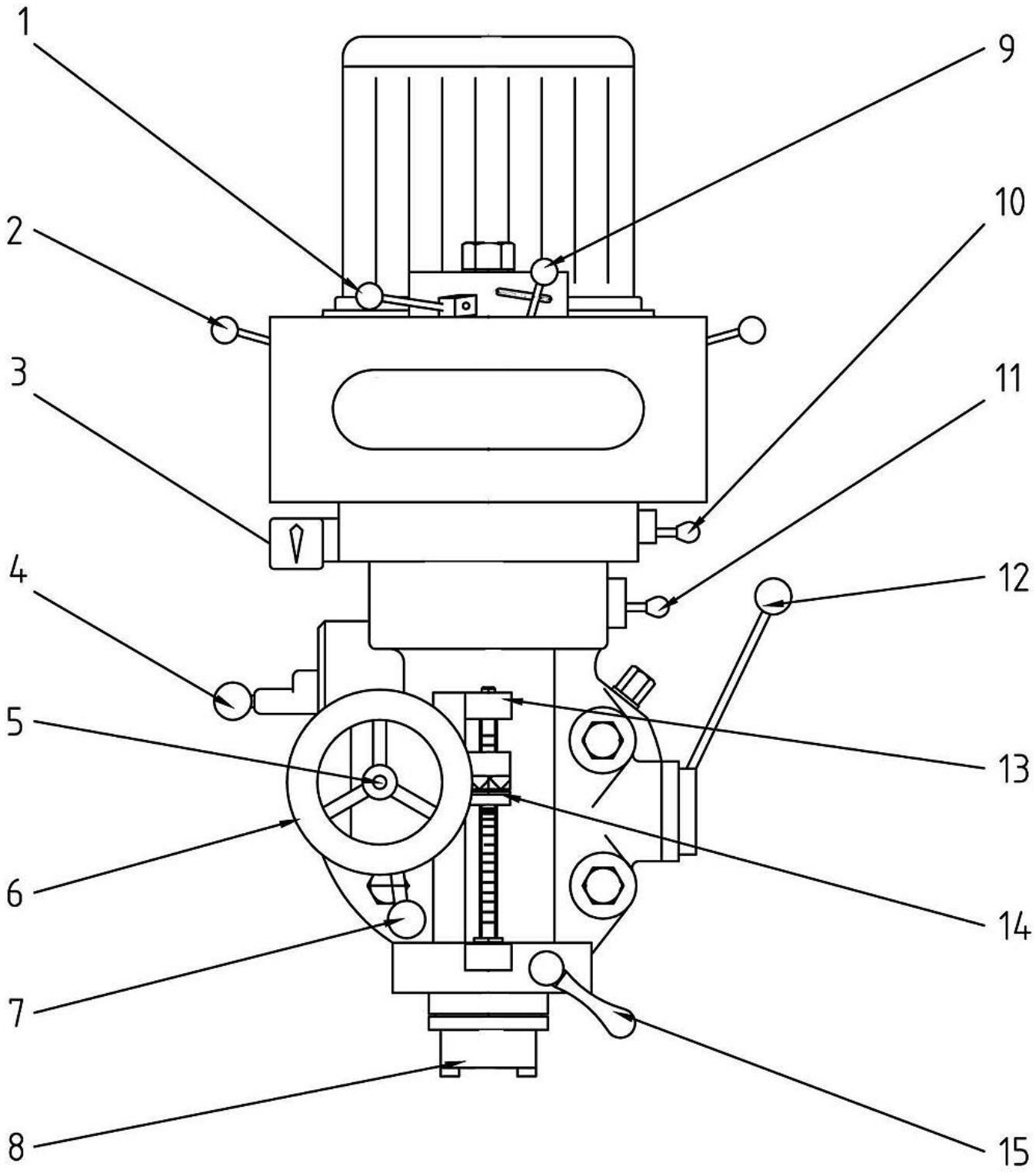
GETTING TO KNOW YOUR MACHINE



The machine is used to process plane surface, oblique plane at any angle, to mill key slots, grooves, and to drill, ream and bore holes. Its milling head can turn by an angle of 90º right or left, 45º forward or backward. The ram can revolve horizontally by an angle of 180º. The spindle can rotate at a high speed with wide ranges.

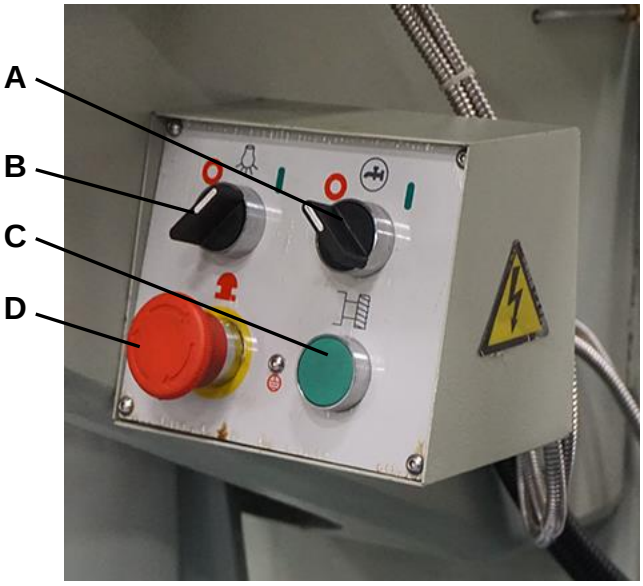
A	Machine Base	Supports milling machine and houses the coolant reservoir
B	Chip and Drip Tray	Collects chips and coolant which returns to tank
C	Oiler	One-shot oiler with sight level glass has manual control lever to distribute lubrication
D	“Z” Axis (Manual)	Turning the handle raises and lowers the knee “Z” axis
E	“Y” Axis (Manual)	Turning the handle controls the table’s Fwd-Back “Y” axis
F	“X” Axis (Manual)	Turning the handle controls the table’s Left-Right “X” axis
G	Table	Holds the workpiece for machining
H	Flexible Coolant Hose	Directs the flow of coolant to the workpiece
I	Spindle	When loaded with a tool, rotates and provides the machining process
J	Fwd - Stop - Rev Switch	3-position switch controls rotation of the spindle
K	Spindle Brake	Moves in either direction to stop the spindle once the power has been turned off
L	High - Low Speed Clutch	Works with speed control lever to change speed range.
M	Drive Motor	Provides power to the spindle
N	Drive Belt Housing	Houses the belt and variable pulley
O	Speed Control Lever	Works with speed clutch to change speed range.
P	Eye Bolt	Provides lifting point during craning operations
Q	Digital Display Meter	Displays positioning functions for machine tool processing
R	Halogen Lamp	Works independently of mill operation to provide additional lighting to the work area
S	Column	Supports the milling machine head
T	Electrical Enclosure	Houses electrical components and wire terminal strips
U	Operation Control Box	Houses the lamp and coolant switches, the Emergency Stop button, and the Power control

Operation Controls



No.	Name	Function
1	Spindle Brake Handle	Make the spindle stop quickly, and holds the spindle during tool changes.
2	Motor Lock Handle	Lock and loosens the motor for changing the belt for speed changes.
3	Power Switch	Power on/off the main motor and direction of rotation.
4	Feed Rate Control Lever	Set quill auto feed rate
5	Feed Reverse Knob	Pull it out or push in to control quill feed direction
6	Fine Feed Handwheel	Realize fine manual feed by the wheel
7	Auto Feed Engage Lever	Pull the lever out to engage auto feed, push it in, auto feed will stop.
8	Spindle	R8
9	H/L Speed Clutch	Cooperate with speed control lever to realize spindle H/L speed change
10	H/L Speed Control Lever	Cooperate with clutch to realize spindle H/L speed change
11	Auto Quill Feed Engage	Make the quill auto feed gear set engage or disjoint
12	Quill Feed Handle	Turn the handle to make quill manual down feed
13	Quill Feed Dog	When the dog touches the adjust Nut, quill auto feed will stop.
14	Quill Feed Adjust Nut	Rotate it to set quill feed depth, and when the dog touch it the auto feed stops
15	Quill Clamping Lever	Tighten the quill to prevent vertical movement.

Operation Control Box



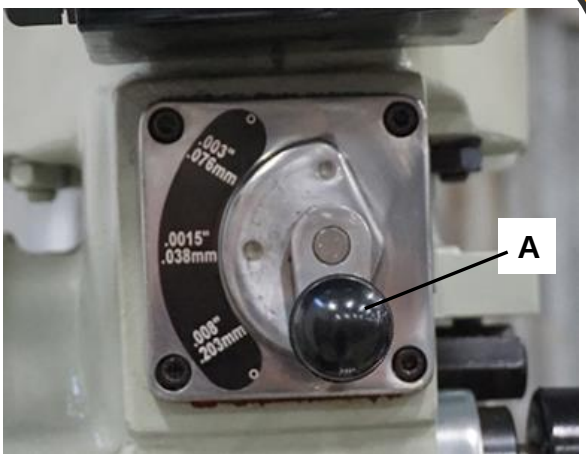
A	Coolant Pump Switch	Turns the coolant pump on or off.
B	Lamp Switch	Turns the light on or off.
C	Power Button	Press to start or stop the main motor.
D	Emergency Stop Button	Press to stop the machine immediately in the event of dangerous conditions or incorrect operation. Twist the emergency stop button clockwise (cw) to reset. Note: Resetting will not start the machine.

Operator Interface

Shown below are the front and rear views of the 2-axis DRO (Digital Readout). The front has a touch pad for operator input and display areas for that information. The rear of the unit has an ON-OFF switch, power cable connector, and input connectors for the “X” and “Y” axes.

Quill Feed Selector

This crank (A) is used to select the feed rate of the quill. It is shifted to different positions by pulling out the knob and turning from one position to another. The feed rates are stamped on the cover near each hole. They are .003", .0015", and .008" (.076mm, .038mm and .203mm). The feed changes are more readily engaged with the spindle running.



Coolant Pump

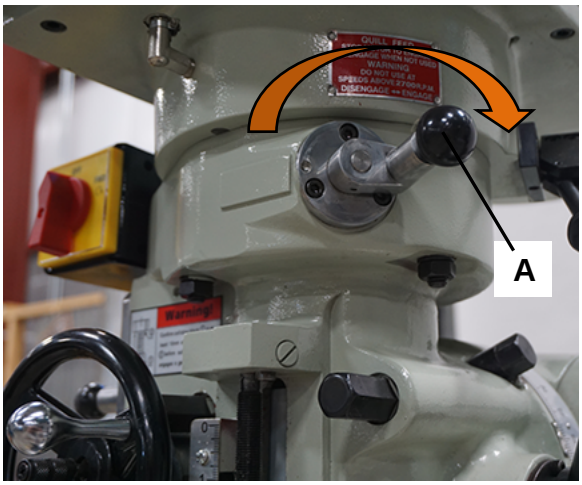
The selector switch (B) turns the pump ON and OFF. Access to the coolant pump is on the back of the column. Remove the (4) screws to allow removal of the access plate. Vacuum out any loose sand and debris from the coolant reservoir. Fill the reservoir with coolant and attach the access plate.

Power Feed Engagement Crank

The power feed crank (A) engages the power feed worm gear when the lever is in the right-hand hole. To disengage, pull the knob out, turn the crank in a clockwise (cw) direction, and move to opposite position.

***Note**: The handle must be moved in clockwise (cw) direction to engage or disengage the power feed. If handle is moved counterclockwise (ccw), no damage will occur, but nothing will happen.*

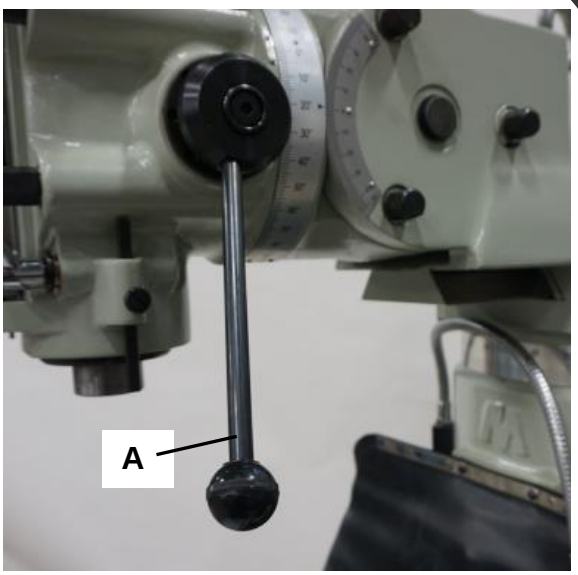
***Note**: It is recommended that the power feed worm gear be disengaged whenever the power feed is not required. This will avoid unnecessary wear on the power feed worm gear.*



***NOTICE:** The power feed worm gear may be engaged while the spindle is rotating. However, it should be engaged gently to avoid damage to the worm gear. The worm gear may be disengaged at any time. Do not use the power feed at speeds above 3000 RPM.*

Quill Feed Handle

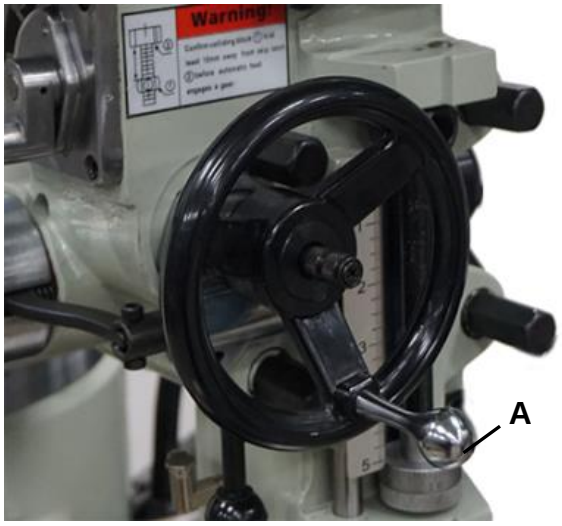
The quill feed handle (A), when turned, either raises or lowers the quill. It can be made freewheeling by pulling the handle out, which disengages the drive pin. This is recommended when using power feed.



Manual Feed Handwheel

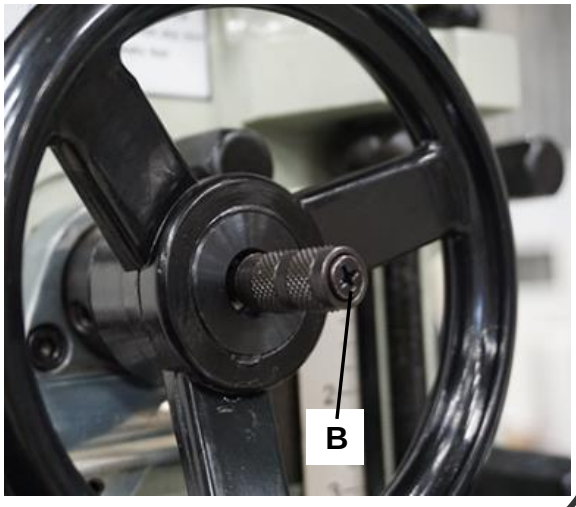
The feed reversing knob should be in neutral position and the feed control lever (B) engaged. Clockwise (cw) rotation of the handwheel (A) moves the quill down. Manual feed handwheel and quill feed handle may be disengaged by pulling them out approximately 1/8" (3mm).

***Note**: The feed control lever must be engaged in order to use manual feed controls. The Quill Feed Handle and Manual Feed Handwheel may be taken off when not in use.*



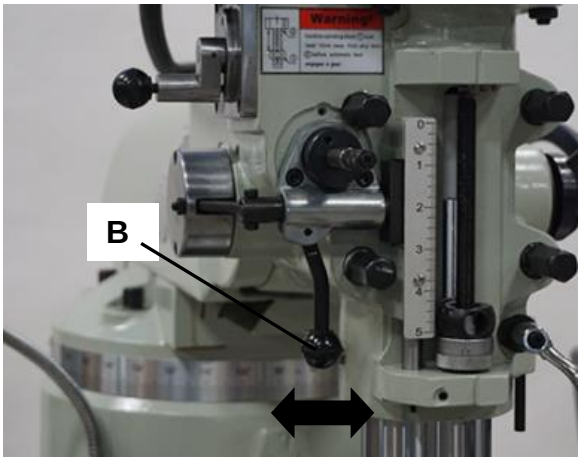
Feed Reverse Knob

Position of the feed reverse knob (B) depends upon direction of spindle rotation. If boring with right-hand cutting tools, pull feed handle towards operator until the clutch engages. Neutral position is between forward and reverse. It is recommended that the handle be left in neutral position when not in use.



Feed Control Lever

The feed control lever (B) engages the overload clutch on the pinion shaft when moved left. It will stay engaged until either the quill stop comes in contact with the micrometer adjusting nut, forcing the feed control lever to disengage automatically, or it is released manually by moving the lever to the right.



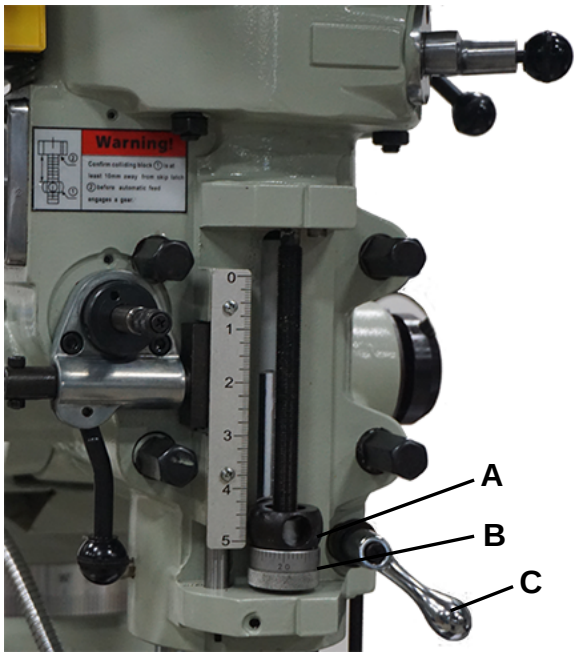
***Note**: The feed control lever is set at the factory to disengage automatically. If it should go out of adjustment, turn the socket setscrew located at the bottom of the tripping rod. When adjusting the socket setscrew, check the automatic disengagement in both directions. The quill stop nut should be against the feed trip lever for the down position and against the reverse trip ball lever for the up position.*

Quill Stop Knob

The quill stop knob (A) is used to disengage power feed in either direction. It also acts as a depth stop when working to a given depth.

Micrometer Nut

This nut (B) is used for the setting of depths. Each graduation on the nut indicates .001" of depth. It reads directly to the scale mounted next to it. Depths may be obtained by setting the micrometer nut in conjunction with the quill stop. Ensure the stop knob is at least 3/8" (10mm) from the nut before engaging.

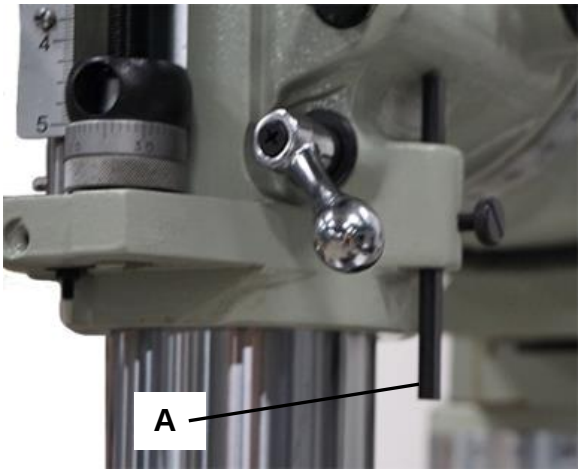


Quill Lock

The quill lock (C) is used to lock the quill in a stationary up or down position when milling or whenever quill movement is not necessary.

Indicator Mounting Rod

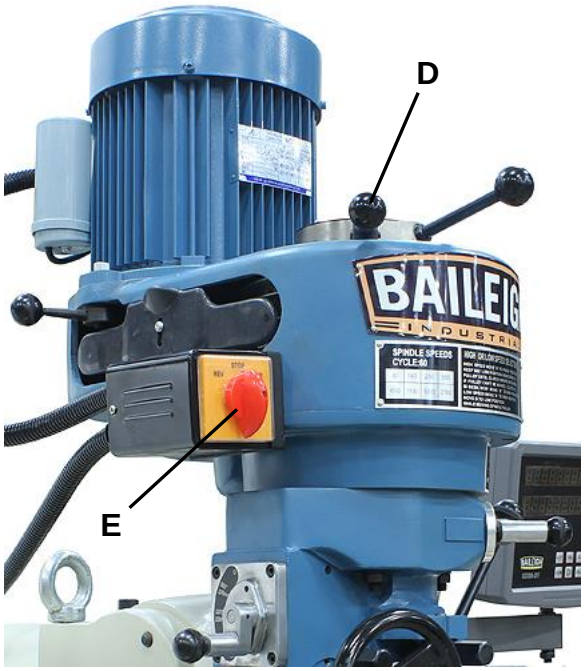
Use this rod (A) to mount a dial indicator when leveling the tool head to the table.



Spindle Brake

The spindle brake handle (D) can be moved up or down to stop the spindle rotation. When locking the spindle, move the lever either left or right and then raise it up. There are no adjustments on the brake, so it must be replaced when worn out.

NOTICE: *Be sure that the spindle brake is released before starting the motor to prevent motor damage.*



Forward – Reverse Switch

This is the motor reversing switch (E) used to obtain clockwise or counterclockwise rotation of the spindle. In the stop position the motor will not be running.

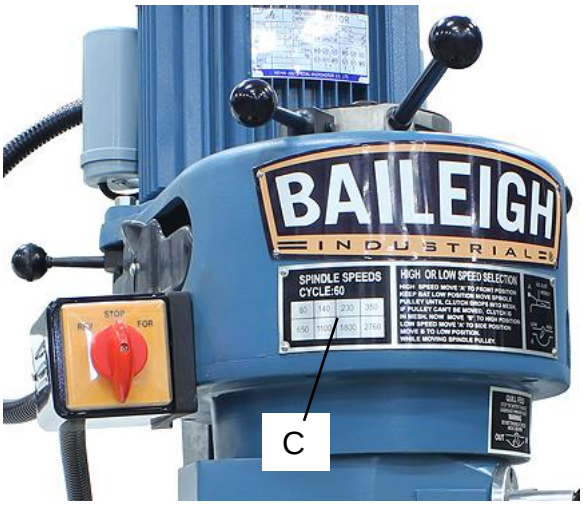
HI – Neutral – LO Lever

DO NOT shift the Hi – Neutral – Lo lever when the motor is running.

***Note**: Changing the speed range WILL change the rotation direction of the spindle. Always verify the spindle rotation direction before machining the work piece.*

Rotate the spindle by hand to facilitate meshing of clutch or gears. Neutral can be found at the mid-way position and is provided to permit free spindle rotation for indicating and set-up.
The 8 different spindle speeds are set by shifting the clutch to either the high or low speed position, and the position of V-belt.
To set spindle speed:

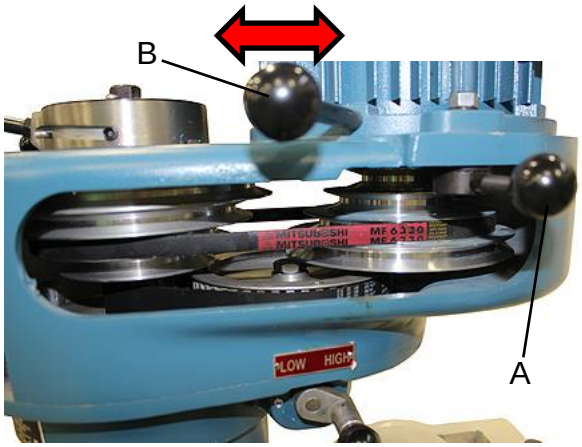
1. DISCONNECT MACHINE FROM POWER! And make sure the spindle is stop.
2. Use the chart and calculation below to find appropriate spindle speed for your operation.
3. Pull H/L speed control lever (A) out, position in HIGH or LOW range, then release lever to seat knob pin in detent.
4. Turn Clutch lever (B) to HIGH or LOW range position. High range position shown.



***Note**: Firmly grasp spindle, then quickly rotate it back and forth until you hear/feel front pulley drop into spindle clutch. If this step was not successful, verify that the machine is disconnected from the power supply. Remove the belt guard and rotate the spindle using the pullies until you are certain that spindle is seated into spindle clutch. Install the belt guard.*

5. Change the belt position as needed to obtain the desired spindle RPM.
6. Refer to spindle speed chart (C) on front of headstock and position V-belt on pulleys for desired spindle speed.

Changing Belt Speeds



1. DISCONNECT POWER TO THE MILL.
2. Open the two covers on the head to expose the belt change cavity.
3. Loosen the lock levers (A) on each side of the head to allow the motor to slide and loosen or tighten the belt.
4. Move the belt tension handle (B) toward the spindle to loosen the belt.
5. Refer to spindle speed chart (C) on front of headstock and position V-belt on pulleys for desired spindle speed.
6. Rotate the belt pulley slowly to help re-position the belt in the correct groove.
7. Pull back on handle (B) to apply proper tension to the belt.
8. Push the center of the belt as shown to check deflection. When properly tensioned the amount of deflection should be approximately 0.5” (13mm).
9. When the belt is at the proper tension, tighten the lock levers (A) on the motor base to secure the tension of the belt.
10. Close the belt access covers.

Calculating Spindle Speed

1. To select the correct spindle speed (RPM) needed for a particular milling operation, first select the type material you will be using from the chart.
2. Then using the formula located below the chart you will be able to calculate what RPM to set the belt configuration to.
3. Measure the diameter of your cutting tool (in inches).

Cutting Speeds for High Speed Steel (HSS) Cutting Tools	
Piece Part Material	Cutting Speed (SFM)
Aluminum and Alloys	300
Bronze and Brass	150
Copper	100
Soft Cast Iron	80
Hard Cast Iron	50
Mild Steel	90
Cast Steel	80
Hard Alloy Steel	40
Tool Steel	50
Stainless Steel	60
Titanium	50
Plastics	300-800
Wood	300-500
Note: For carbide cutting tools, double the cutting speed. These values serve only as a guideline.	

Spindle Speed Example:

For making a surface cut on a piece of mild steel using a 3/8” (0.375”) HSS cutter, do the following:

$$\frac{\text{Cutting Speed (SFM)} \times 4}{\text{Tool Diameter (in inches)}} = \text{RPM}$$

a. From the chart, the recommended cutting speed for mild steel is 90 (SFM).
b. Using the formula, 90 (SFM) x 4 = 360.
c. 360 / 0.375” (diameter of cutter) = **960** RPM.
d. From the speed chart you would then set mill to the High range position with the belt at position (2) for a speed of 1100 rpm.

Using the Drawbar

The drawbar (A) has a 7/16"-20 right-hand thread and should be tightened with normal pressure using the wrench furnished with the machine. To loosen the collet (B), back off the drawbar, and if the collet does not open, give the top of the drawbar a slight tap. The spindle has a non-sticking taper and the collet should release readily. When tightening or loosening the drawbar, it is necessary to lock the spindle. To do this, use the spindle brake which is located on the left side of the belt housing, turning it either left or right until it binds. Make sure the quill feed handle is raised all the way.

One Shot Oiler

The lines running from the oiler pump supply oil to the ways of the table, saddle, and column (knee). (See the Lubrication and Maintenance section.)

ASSEMBLY AND SETUP

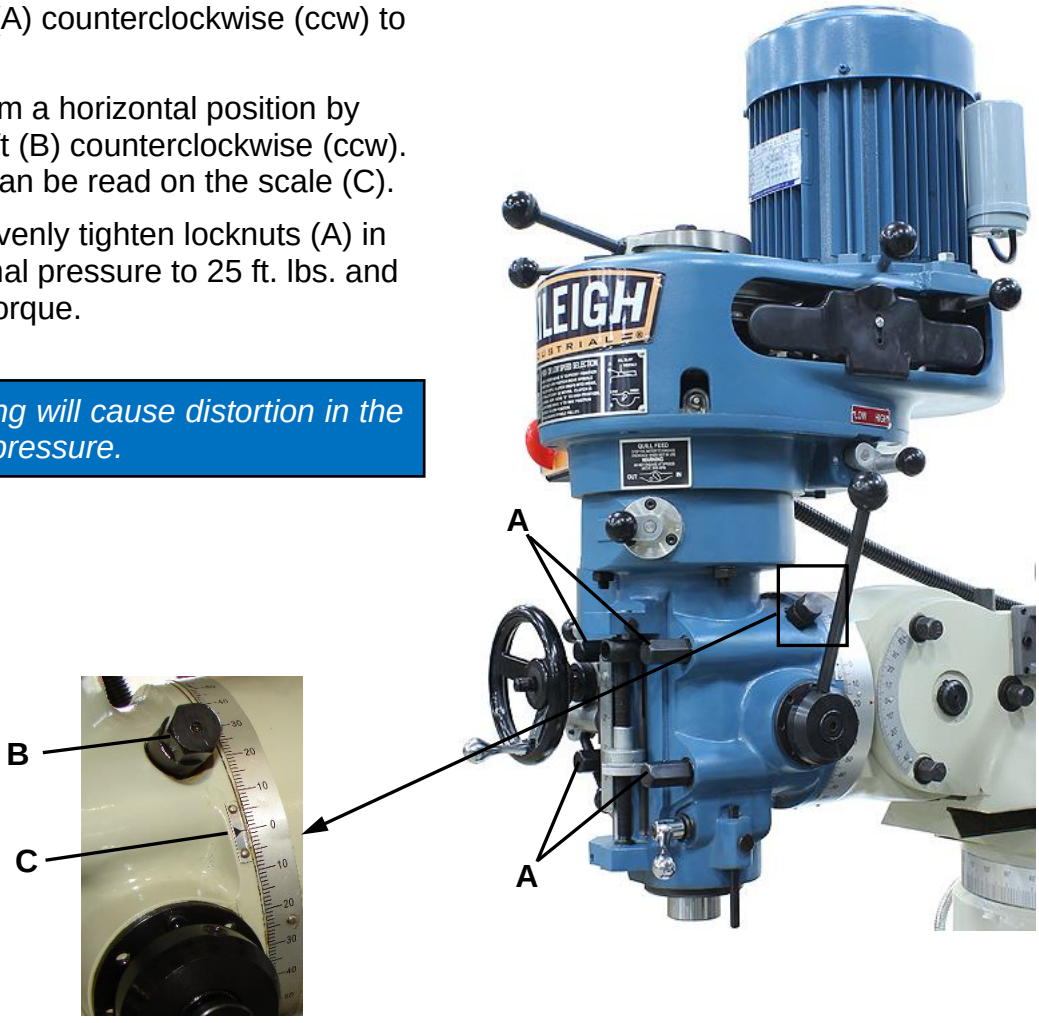
WARNING: For your own safety, DO NOT connect the machine to the power source until the machine is completely assembled and you read and understand the entire instruction manual.

Positioning the Head Upright

NOTICE: *Use and external lifting device to lift and support the head any time that the head is tilted more then 20° in either direction. Failure to use external support will damage the lifting gears.*

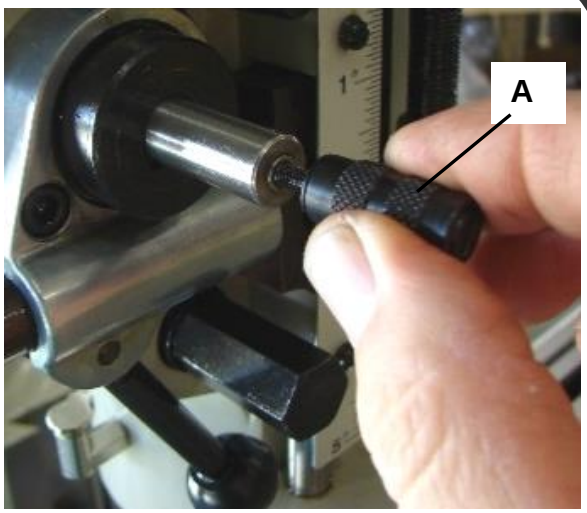
1. Loosen (4) locknuts (A) counterclockwise (ccw) to detent.
2. To raise the head from a horizontal position by turning the crankshaft (B) counterclockwise (ccw). Degrees of rotation can be read on the scale (C).
3. After setting angle, evenly tighten locknuts (A) in two steps using normal pressure to 25 ft. lbs. and then to 50 ft. lbs. of torque.

NOTICE: *Overtightening will cause distortion in the quill. Avoid excessive pressure.*



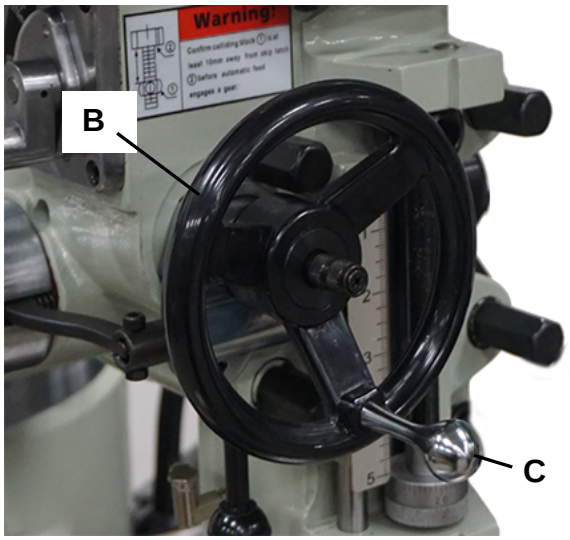
Feed Reverse Knob

1. Attach the feed reverse knob (A) to the end of the shaft.
2. Use a screwdriver to tighten.



Manual Feed Handwheel

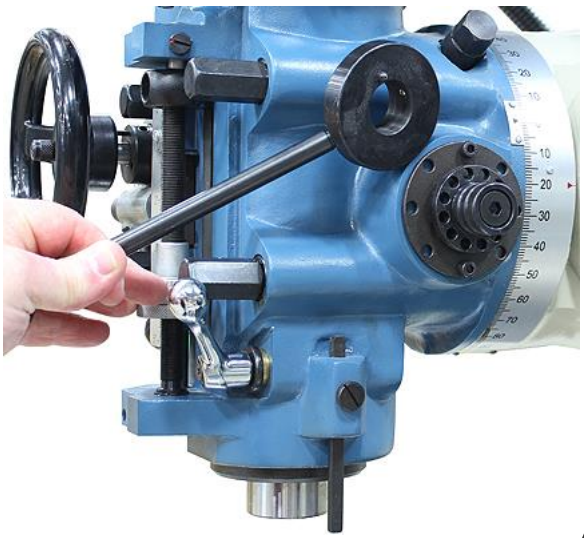
1. Screw the handle (C) onto the handwheel (B).
2. Then slide the handwheel onto the shaft and over the feed reverse knob.
3. To use the handwheel, rotate until the roll pin engages the pilot hole.



Quill Feed Handle

The quill feed handle uses a detent pin and an engagement pin to allow for quick positioning of the feed handle.

1. Align the handle hub over the shaft and carefully press the hub onto the shaft into the first detent.
2. Rotate the handle on the shaft until the handle is at an angle and position that will be safe and comfortable for the operator.
3. Align the engagement pin with the nearest hole and press the hub into the second detent groove to engage the pin and.



Elevating Crank

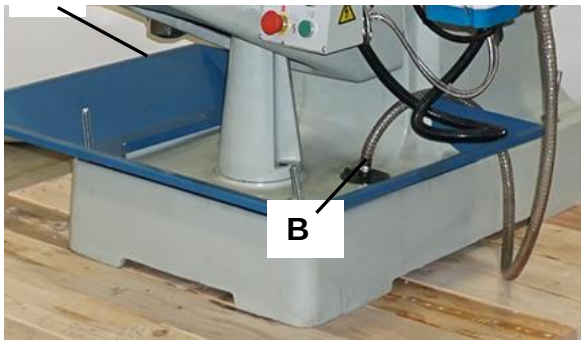
1. The elevating crank simply slides onto the elevation lead screw shaft.
2. To use the handle, engage the teeth, and turn.
3. Place the handle in the freewheeling state when not in use. Clean and lubricate with a general-purpose oil so the crank handle moves free and easy. Check for scratches or burrs. Remove them with a light emery cloth.

Ball Crank Handles

1. Secure the 4 handles to the 4 cranks (X@2, Y, and Z) as shown.

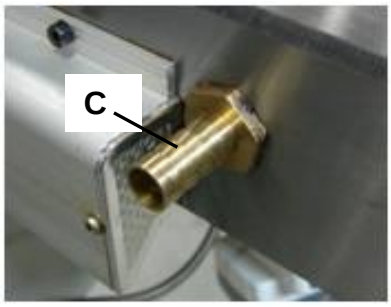
Drip Tray

Set the drip tray (A) into position on the base and secure with (2) capscrews.



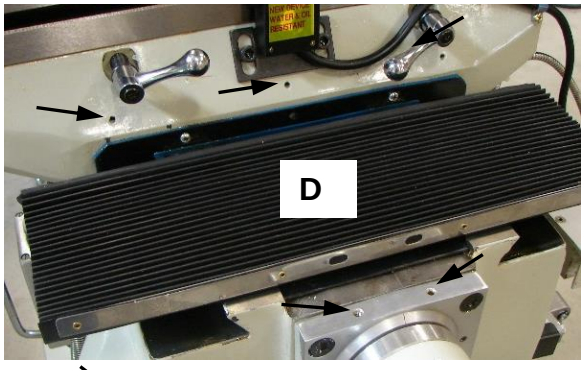
Drain Hose Connection

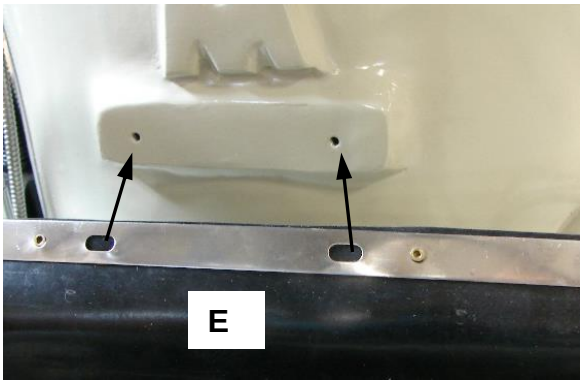
Connect a drain hose to the press-on fitting and secure with a hose clamp. There is a fitting (C) located on each end of the table. Run the other end of the hoses down to the filter screens (B) located on the machine base.



Installing Way Covers

1. Punch holes in the way covers (D) and (E) to line up with tapped holes in machine.
2. Attach the way covers as shown, using the supplied screws through the metal stiffeners.





ELECTRICAL

CAUTION: HAVE ELECTRICAL UTILITIES CONNECTED TO MACHINE BY A CERTIFIED ELECTRICIAN!
Check if the available power supply is the same as listed on the machine nameplate.

WARNING: Make sure the grounding wire (green) is properly connected to avoid electric shock. DO NOT switch the position of the green grounding wire if any electrical plug wires are switched during hookup.

Power Specifications

Your machine is wired for 220 volts, 60hz alternating current. Before connecting the machine to the power source, make sure the power source is OFF.
Before switching on the power, you must check the voltage and frequency of the power to see if they meet with the requirement, the allowed range for the voltage is ±5%, and for the frequency is ±1%.

Considerations

- Observe local electrical codes when connecting the machine.
- The circuit should be protected with a time delay fuse or circuit breaker with an amperage rating slightly higher than the full load current of machine.
- A separate electrical circuit should be used for your machines. Before connecting the motor to the power line, make sure the switch is in the “OFF” position and be sure that the electric current is of the same characteristics as indicated on the machine.
- All line connections should make good contact. Running on low voltage will damage the motor.
- In the event of a malfunction or breakdown, grounding provides a path of least resistance for electric current to reduce the risk of electric shock. This machine is equipped with an electric cord having an equipment-grounding conductor and a grounding plug. The plug must be plugged into a matching outlet that is properly installed and grounded in accordance with all local codes and ordinances.

WARNING: In all cases, make certain the receptacle in question is properly grounded. If you are not sure, have a qualified electrician check the receptacle.

- Improper connection of the equipment-grounding conductor can result in risk of electric shock. The conductor with insulation having an outer surface that is green with or without yellow stripes is the equipment-grounding conductor. If repair or replacement of the electric cord or plug is necessary, do not connect the equipment-grounding conductor to a live terminal.
- Check with a qualified electrician or service personnel if the grounding instructions are not completely understood, or if in doubt as to whether the machine is properly grounded.
- Repair or replace damaged or worn cord immediately.

Power cord connection:

1. Turn the main disconnect switch on the control panel to the OFF position.
2. Unwrap the power cord and route the cord away from the machine toward the power supply.
    a. Route the power cord so that it will NOT become entangled in the machine in any way.
    b. Route the cord to the power supply in a way that does NOT create a trip hazard.
3. Connect the power cord to the power supply and check that the power cord has not been damaged during installation.
4. When the machine is clear of any obstruction, the main power switch may be turned ON to test the operation. Turn the switch OFF when the machine is not in operation.
5. Connect the power feeds and the Digital Readout to the plug receptacles at the back of the electrical enclosure. Unwrap the power cord for each item and route the cord to the power receptacle.
    a. Route the power cord so that it will NOT become entangled in the machine in any way.
    b. Route the cord to the power supply in a way that does NOT create a trip hazard.

***Note**: These outlets are 110V.*

MACHINE ADJUSTMENTS AND OPERATION

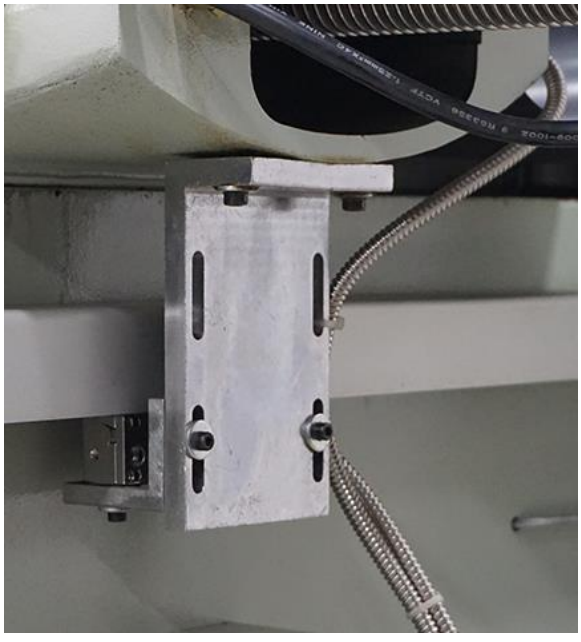
⚠ CAUTION: Always wear proper eye protection with side shields, safety footwear, and leather gloves to protect from burrs and sharp edges.

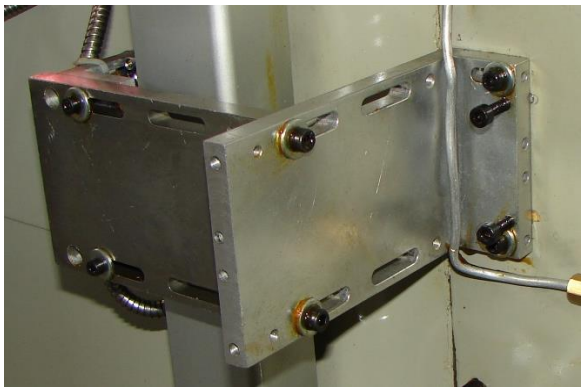
Travel Stops

The longitudinal (X axis) has two adjustable travel stops (A) that determine how much travel is available for the axis. Slide the travel stop in the track and secure with the 12mm hex bolt.

Electronic Ruler Adjustment

The electronic rulers and pickups have been set up and adjusted at the factory. No further adjustments should be required.





Head Alignment

When doing precision work where it is necessary to have the head perfectly square with the table, follow the procedure below:

Y Axis

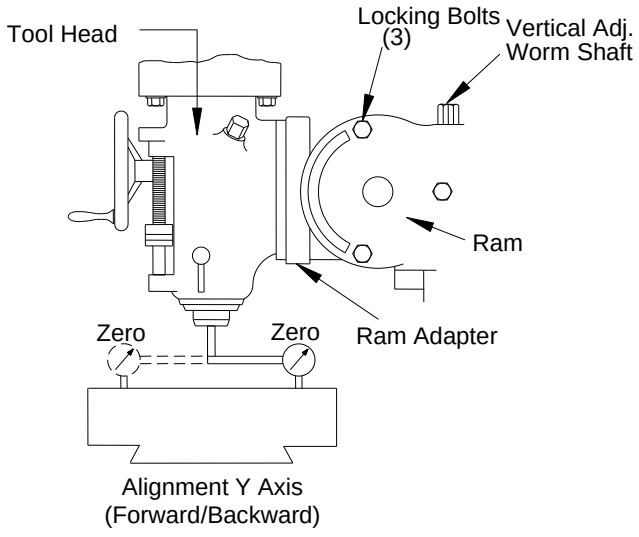
1. Loosen the (3) locking bolts.
2. Mount a surface indicator as shown in left image.
3. Turn the vertical adjustment wormshaft to raise or lower the tool head until the needle on the indicator shows “0” in both directions.

***Note**: The table is fitted to be slightly higher in the front, usually about .0005".*

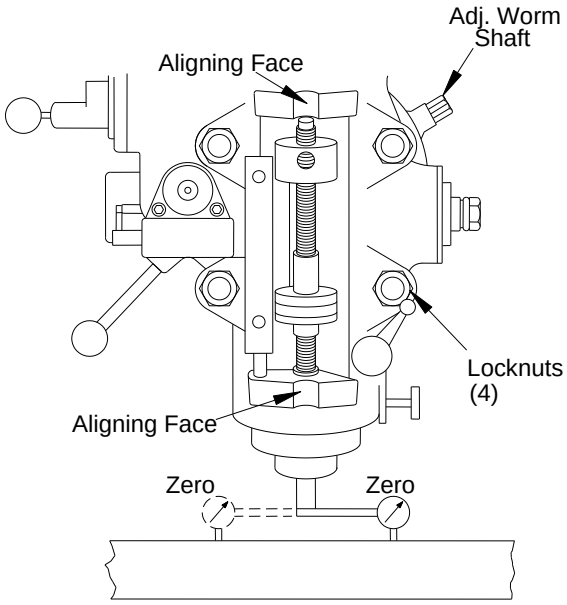
4. Tighten the locking bolts.

X Axis

5. Loosen the (4) locknuts but leave some drag on them for fine adjustment.
6. Mount a surface indicator as shown in right image.
7. Turn the adjustment wormshaft to rotate the tool head until the needle on the indicator shows “0” in both directions.
8. Tighten the locknuts.



Alignment Y Axis (Forward/Backward)



Alignment X Axis (Left/Right)

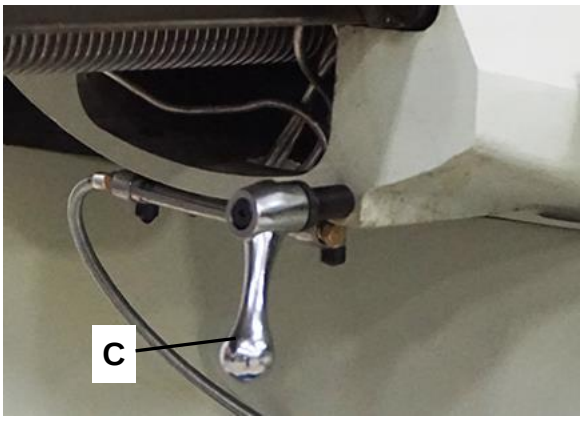
***Note**: The various gibs on your vertical mill help control the accuracy of the table movements along the ways. Tight gibs allow for more accuracy but harder movement. Loose gibs mean less accuracy but easier movement. Proper gib adjustment removes unnecessary sloppiness without causing the ways to bind.*

Clamping the Table, Saddle, and Knee

When milling with longitudinal table feed only, clamp the knee to the column and the saddle to the knee to add rigidity. This will provide for heavier cuts with a minimum of vibration.

X Axis (Table)

The table locking clamp levers (B) are located on the front of the saddle, and should always be clamped when NOT using longitudinal movement.

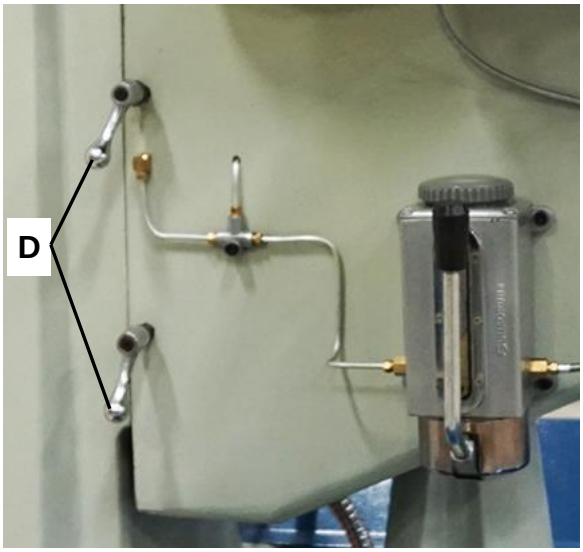


Y Axis (Saddle)

The saddle locking lever (C) is located on the left-hand side of the saddle. Using moderate clamping pressure will hold the saddle sufficiently. Excessive pressure can cause slight table binding.

Z Axis (Knee)

The knee locking clamp levers (D) are on the left side of the knee, alongside the column and are drawn upward to clamp the knee. This is only a tension brake and will not lock the knee completely. The knee clamps should be used at all times that there is no need to change the elevation of the table.

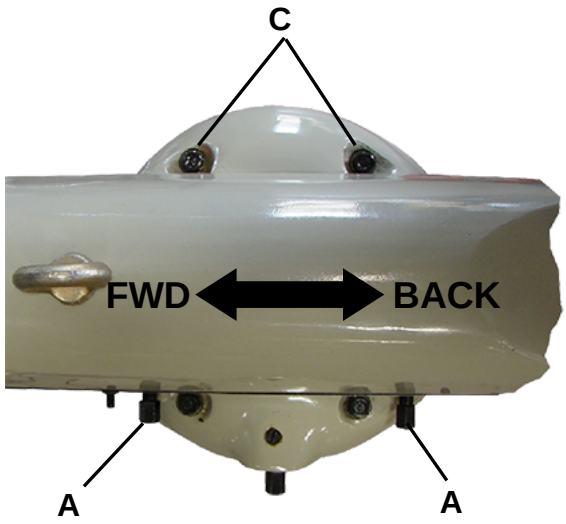


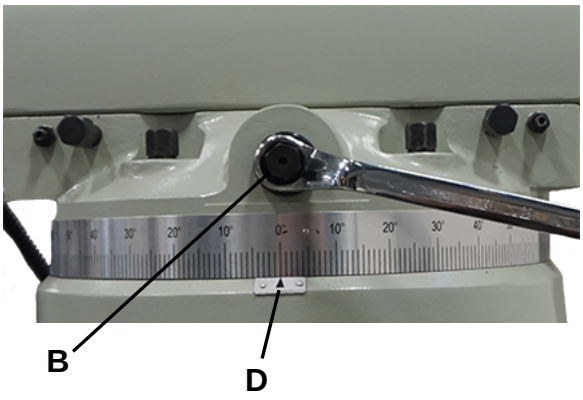
Ram Position

The ram can be moved after loosening the (2) ram lock studs (A).
Rotating crankshaft (B) clockwise (cw) will move the ram back. Counterclockwise (ccw) rotation will move the ram forward.

NOTICE: *Lock the ram securely after moving to prevent machine or workpiece damage.*

Note*: It is recommended that on heavy milling work, the head should be kept as close to the column as possible for maximum rigidity.*





To rotate the ram, unlock the (4) head bolts (C). Manually turn the ram to the desired angle as shown on the degree scale indicator (D). Tighten the head bolts.

Removing the Table

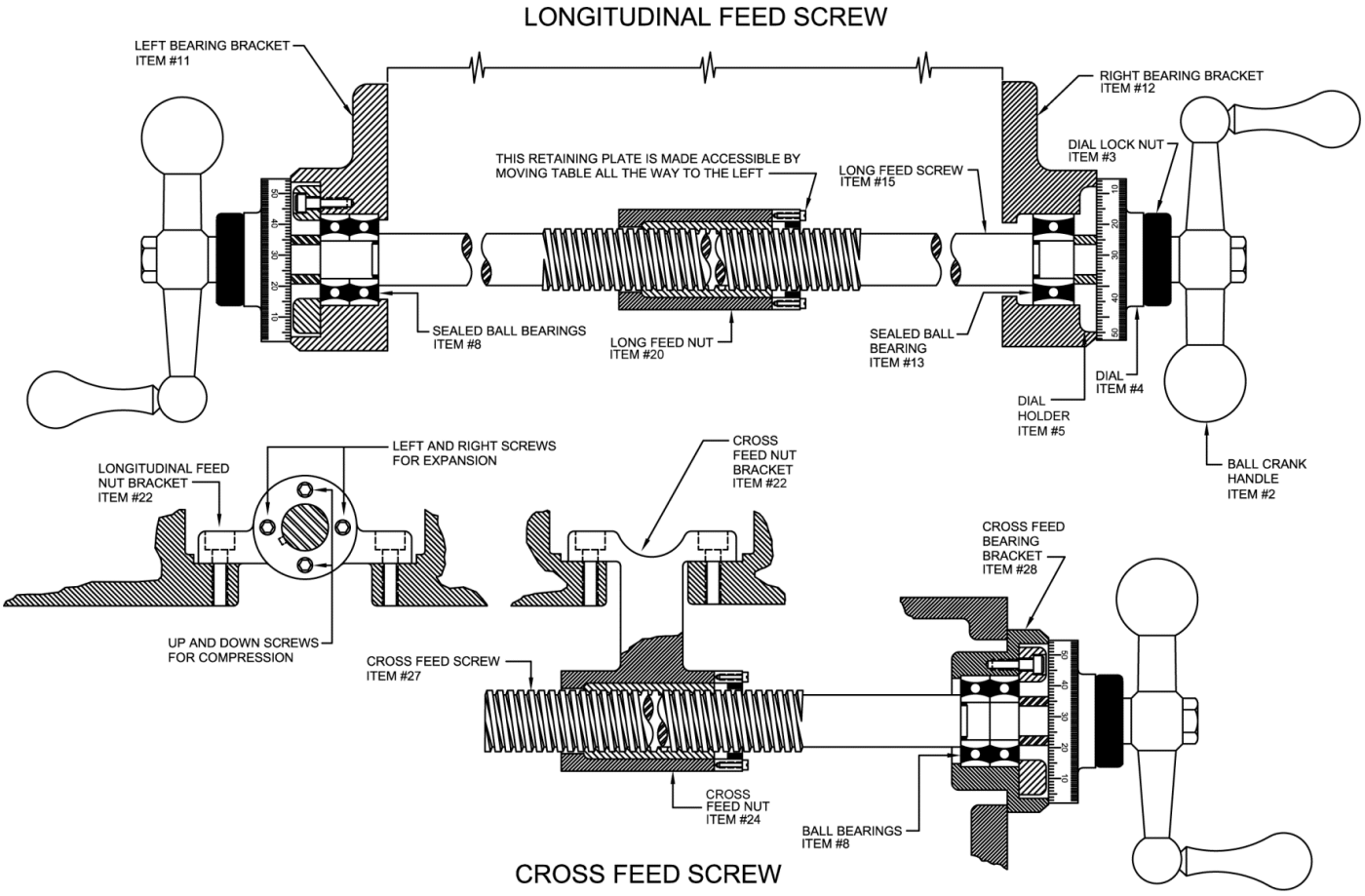
See Longitudinal Feed Screw Figure

1. Remove the ball crank handles, dial holders, and bearing brackets.
2. Turn the lead screw all the way out and slide the table from the saddle.

Removing the Saddle

See Cross Feed Screw Figure

1. Follow the same procedure as removing the table.
2. Remove the cross-feed nut bracket to detach the entire front bracket assembly.
3. Remove the saddle.



Also refer to Leadscrew Identification pages in this manual

GENERAL SPEED RECOMMENDATIONS

Material to be Cut	Feet Per Minute		
	Rough Cut	Rough and Finish	Light and Finish Cut
Cast Iron - Soft (Under 200 Brinnell)	70	80-90	120
Cast Iron - Med. (200-300 Brinnell)	55	60-70	90
Cast Iron - Hard (Over 200 Brinnell)	40	50-60	70
Steel (Chrome Nickel 40-45 Shore)	30	40	50
Steel (Stainless)	60	80	90
Steel (Low Carbon)	80	90	140
Steel (High Carbon)	40	50	70
Bronze (Medium)	90	120	150
Bronze (Hard)	65	90	130
Brass (Hard)	100	150	200
Copper	150	200	300
Duraluminum	400	-----	600
Aluminum	600	-----	1000

TABLE OF CUTTING SPEEDS AND FEEDS

Feet Per Minute	15	20	25	30	40	50	60	70	80	90	100
Diameter Inches	Revolutions Per Minute										
1/16"	917	1222	1528	1833	2445	3056	3667	4278	4889	5500	6112
1/8"	458	611	764	917	1222	1528	1833	2139	2445	2750	3056
3/16"	306	407	509	611	815	1019	1222	1426	1630	1833	2037
1/4"	229	306	382	458	611	764	917	1070	1375	1375	1528
5/16"	183	244	306	367	489	611	733	856	978	1100	1222
3/8"	153	204	255	306	407	509	611	713	815	917	1019
7/16"	131	175	218	262	349	437	524	611	698	786	873
1/2"	115	153	191	229	306	382	458	535	611	688	764
5/8"	91	122	153	183	244	306	367	428	489	550	611
3/4"	76	102	127	153	204	255	306	357	407	458	509
7/8"	65	87	109	131	175	218	262	306	349	393	437
1"	57	76	95	115	153	191	229	267	306	344	382
1 1/8"	50	67	84	102	136	170	204	238	272	306	340
1 1/4"	45	61	76	91	122	153	183	214	244	275	306
1 3/8"	41	55	69	83	111	139	167	194	222	250	278
1 1/2"	38	50	63	76	102	127	153	178	204	229	255
1 5/8"	35	47	58	70	94	118	141	165	188	212	235
1 3/4"	32	43	54	65	87	109	131	153	175	196	218
1 7/8"	30	40	50	61	81	105	122	143	163	183	204
2"	28	38	47	57	76	95	115	134	153	172	191

LUBRICATION AND MAINTENANCE

WARNING: Make sure the electrical disconnect is OFF before working on the machine.
Maintenance should be performed on a regular basis by qualified personnel.
Always follow proper safety precautions when working on or around any machinery.

Daily Maintenance

- Check daily for any unsafe conditions and fix immediately.
- Check that all nuts and bolts are properly tightened.
- Do a general cleaning by removing dust and metal chips from the machine.
- Top off the coolant reservoir. (80% of full tank capacity)
- Clean filter screens located on the machine base.
- Sharpen or replace any worn or damaged tooling.
- Check the sight glass of the one-shot oiler to make sure it is full. Pull once to send lubricant through the lines.
- Lubricate the quill gearing. Do not operate the machine until properly lubricated.

Weekly Maintenance

- On a weekly basis clean the machine and the area around it.
- Lubricate threaded components and sliding devices.
- Apply rust inhibitive lubricant to all non-painted surfaces.
- Thoroughly clean the machine including the coolant reservoir.
- Lubricate the vertical bevel gears.
- Lubricate the 3 leadscrews.

Monthly Maintenance

- Check that all screws and bolts are tight and secure.
- Wipe built-up grime from the vertical mill with a rag and a mild solvent.
- Check for worn or damaged electrical cables.

***Note**: When cleaning chips and debris from the machine, use a brush and a shop vacuum. **DO NOT** blow off the machine with compressed air. The force of the compressed air may force chips into critical mechanisms or may inflict injury to yourself or others.*

Oil Disposal

Used oil products must be disposed of in a proper manner following your local regulations.

Accessing and Cleaning the Coolant System

- Clean the drain screens on the machine base and the drains on the ends of the table.
- Access the coolant pump and reservoir through the back of the main column. Remove the access cover.
- Drain and wash out the dirt and debris from the reservoir.
- Thoroughly clean the pump and pump inlet.
- Fill tank with coolant solution.

Oils for Lubricating Coolant

Any 10:1 (water to coolant) solution will work, however we recommend Baileigh Coolant 20:1 (water to coolant) biodegradable metal cutting fluid. It has excellent cooling and heat transfer characteristics, is non-flammable, and extends tool and machine life. Each gallon of concentrate makes 21 gallons of coolant.

Storing Machine for Extended Period of Time

If this machine is to be inactive for a long period of time, prepare the machine as follows:

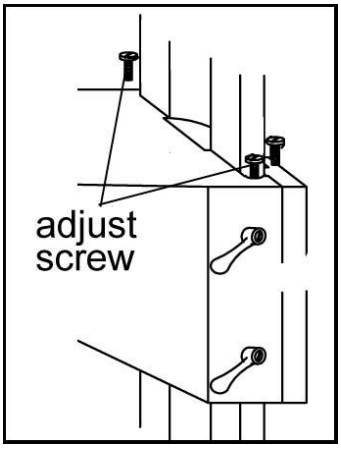
- Disconnect the electrical supply from the power panel.
- Empty and clean the coolant reservoir.
- Clean and grease the machine.
- Cover the machine.

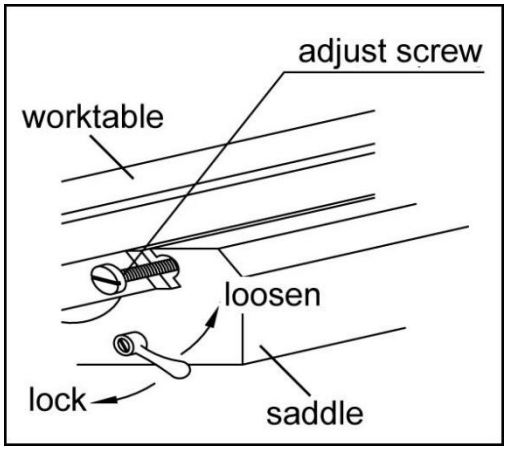
Adjusting Gibs

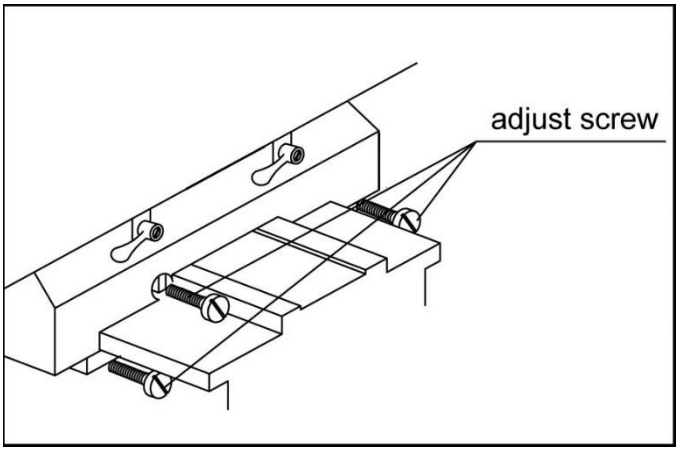
Gibs are tapered lengths of metal that are sandwiched between two moving surfaces. Gibs control the gap between these surfaces and how they slide past one another. Correctly adjusting the gibs is critical to producing good milling results.
Tight gibs make table movement more accurate but stiff. Loose gibs make moving the table sloppy but easier to do. The goal of gib adjustment is to remove unnecessary sloppiness without causing the ways to bind.
Gibs are adjusted with a screw on each end of the gib, that move the tapered gib back-and-forth to increase or decrease the friction pressure between the sliding surfaces. The process of properly adjusting the gibs requires trial-and-error and patience.

To adjust Gib

1. DISCONNECT MACHINE FROM POWER!
2. Make sure all table/knee locks are loose.
3. Loosen one gib adjustment screw, then tighten the other the same amount to move the gib.
4. Use ball handles/crank to move table/knee until you feel a slight drag in the path of movement. repeat Steps 3–4 as necessary.

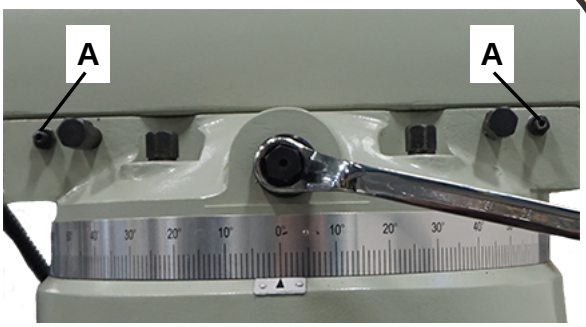






***Note**: It will be necessary to remove small parts, such as way wipers and covers, to access the gib adjustment screws.*

Adjustment of Ram Gib



The column swivel has a long tapered gib and two adjustment screws (A).

1. First back off the jam nut, and then use a flathead screw driver to make the adjustment.
2. Turn the adjusting screws clockwise (cw) until a slight drag is felt when moving the ram manually.
3. Hold the screws in position and tighten the jam nut.

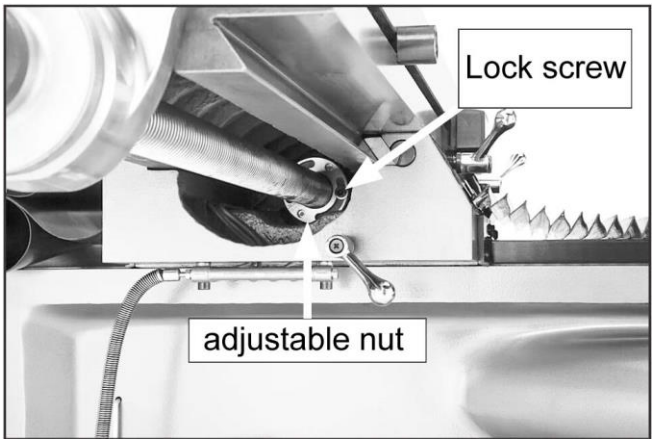
Adjust Leadscrew Backlash

Leadscrew backlash is the amount of motion or "play" in leadscrew rotation before the attached device begins to move. Leadscrews will always have a certain amount of backlash that will increase with normal wear.
Generally, 0.1~0.2mm leadscrew backlash is acceptable to ensure smooth movement and reduce the risk of premature thread wear. However, if you find it necessary to adjust leadscrew backlash, perform the procedures listed below.

Adjust Table Lead Screw Backlash

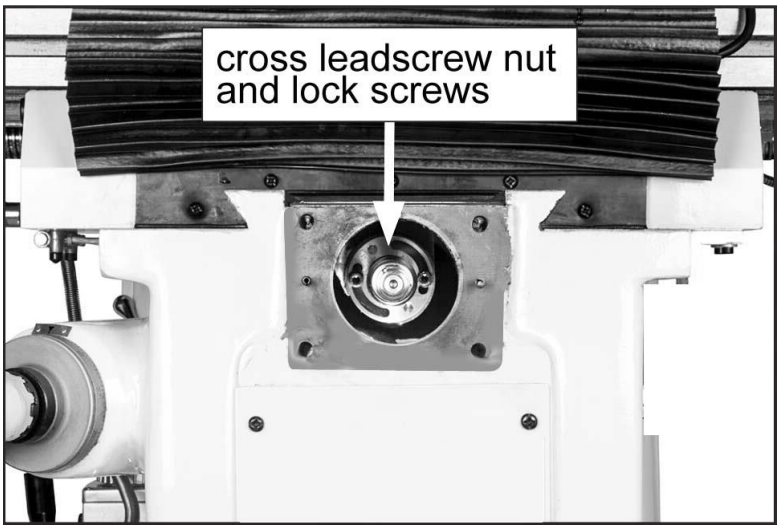
Leadscrew of worktable longitudinal feed is located under the work table, which with two nuts. One is fixed, and another one with ring slot is adjustable.

1. DISCONNECT MACHINE FROM POWER!
2. Move the table to right side and make the leadscrew nut exposed.
3. Loosen lock screws on leadscrew nut accessed from underneath left side of table.
4. Rotate adjustable nut on clockwise in small increments, then check amount of backlash.
5. When you are satisfied with adjustment, retighten lock screw screws.



Adjust Cross Lead Screw Backlash

1. DISCONNECT MACHINE FROM POWER!
2. Move the saddle to front as far as possible.
3. Remove hex nut and ball handle from cross leadscrew.



***Note**: In the next step, take care not to misplace the leadscrew key as you remove the parts.*

4. Unthread and remove knurled retaining ring, graduated dial ring, and leadscrew key.
5. Remove four screws from bearing housing, then slide it off leadscrew.

***Note**: It may be necessary to use a dead blow hammer or rubber mallet on the housing to knock it loose.*

6. Loosen the lock screw for tighten the adjustable lead nut.
7. Re-install key back onto leadscrew so that you can use ball handle in next step.
8. Rotate adjustable leadscrew nut in small increments, slide ball handle onto leadscrew, then check amount of backlash.
9. When you are satisfied with adjustment, retighten two lock screws.
10. Re-install parts previously removed in reverse order.

Lubrication

The machine has numerous moving metal-to-metal contacts that require regular and proper lubrication to ensure efficient and long-lasting operation, and to protect your investment. Other than the lubrication points covered in this section, all other bearings are internally lubricated and sealed at the factory. Simply leave them alone unless they need to be replaced. Before performing any lubrication task, DISCONNECT MACHINE FROM POWER!

Important: *Before adding lubricant, clean the debris and grime from the oil cup or grease fitting and the immediate area to prevent contamination of the new lubricant.*

Use the schedule and information in Figure as a daily guide for lubrication tasks. Follow the referenced sections on the following pages for detailed instructions.

Important: *The following recommended lubrication schedule is based on light to medium mill usage. Keeping in mind that lubrication helps to protect value and operation of mill, you may need to perform lubrication tasks more frequently depending on your usage.*

Lubrication point	Frequency (hours of operation)
Slide way	4~8 Hrs
Ram way	40 Hrs
Knee elevating leadscrew	40Hrs
Quill	4 Hrs
Quill gear	4~8 Hrs
Headstock gear	40 Hrs

Slide Way Lubrication

Oil Type: ISO 68 Equivalent Oil.
Amount: One Pull of Pump Handle
Check/Add Frequency: 4–8 Hrs. of Operation

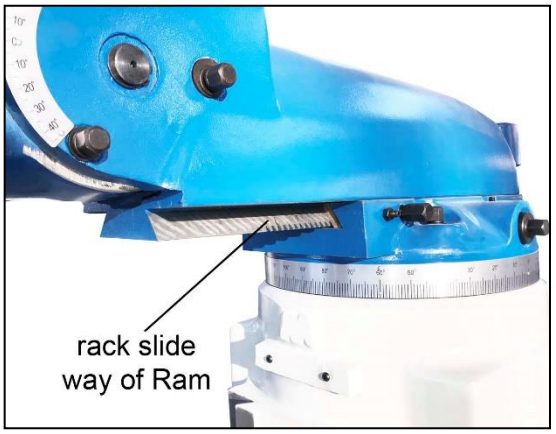
The one-shot oil pump is connected to a series of aluminum tubes that carry the lubricant to wear points on slide ways, cross and longitudinal feed screws. Pull the handle out slowly then release it to send the oil through the tubes then move the table through all paths of movement to evenly distribute the lubricant. Use the sight glass on the side of the oiler to know when to re-fill the reservoir. The oil tank capacity is about 0.5L.

Milling Head Quill Lubrication

Oil Type: ISO 68 Equivalent Oil.
Amount: Oil cup
Check/Add Frequency: 4–8 Hrs. of Operation
Lift oil cup cap and add 5~10 drops of lubricant.

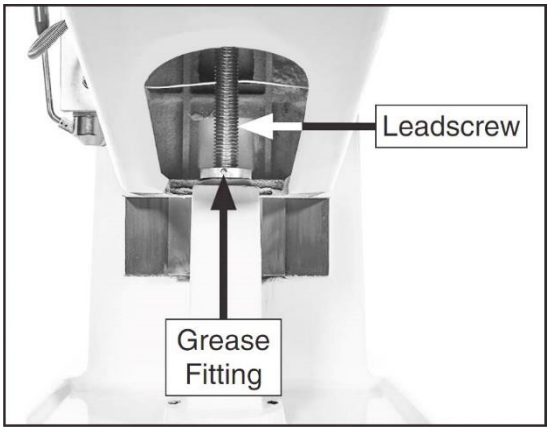
Rack of Ram slide way

Grease Type: ISO 68 or Equivalent.
Amount: Thin coat
Check/Add Frequency: 40 Hrs. of Operation
Move the ram back and forth as necessary to access the full travel of the slide ways. Then use a clean brush to apply a thin coat of lubricant to the ways and racks.



Elevating lead screw lubrication

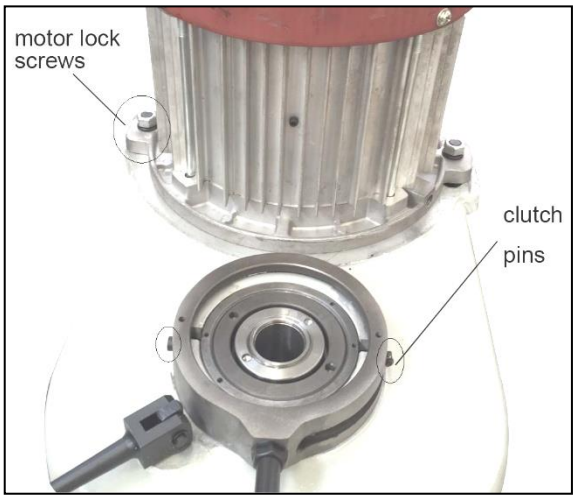
Grease Type: NLGI #2 or Equivalent
Grease Amount: Thin Coat
Check/Add Frequency: 40 Hrs. of Operation
Elevate the table all the way up, then use mineral spirits to clean any debris and built-up grime from the elevation leadscrew threads. Add one pump from a grease gun to the leadscrew grease fitting, then run the Knee up and down to distribute the grease. Repeat this process until the entire leadscrew is well lubricated.



Replace Motor, Belt and Brake Assembly

Replacing a broken belt or the spindle brake assembly requires removing the motor and part of the headstock.
Since the procedure for replacing the spindle brake assembly involves removing many of these same components as in a belt replacement, it is a good idea to check the brake assembly whenever you replace a belt, and replace the shoes if necessary.
The steps of replacing belt and brake assembly:

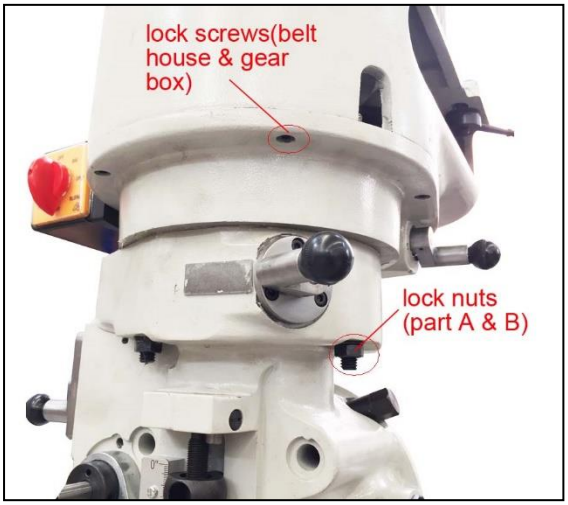
1. DISCONNECT MACHINE FROM POWER!
2. Remove drawbar.
3. Remove motor lock screws, then remove the motor.



***Note**: If V-belt is not broken, be sure to carefully remove it from motor pulley before lifting motor off of headstock.*

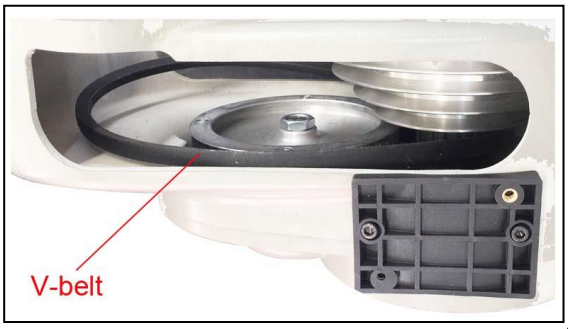
4. Remove the clutch on the top of the headstock.

5. Remove the lock nuts that secure part A to part B.



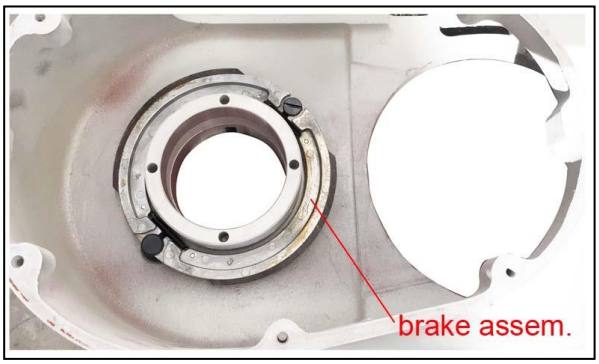
***Note**: The PART A is composed of the belt housing and gear box, which should be separated in next step.*

6. Remove the lock screws and separate gear box and belt housing.
7. Replace the bad belts if necessary.
8. If you want to check and replace brake assembly, go on to the next steps.



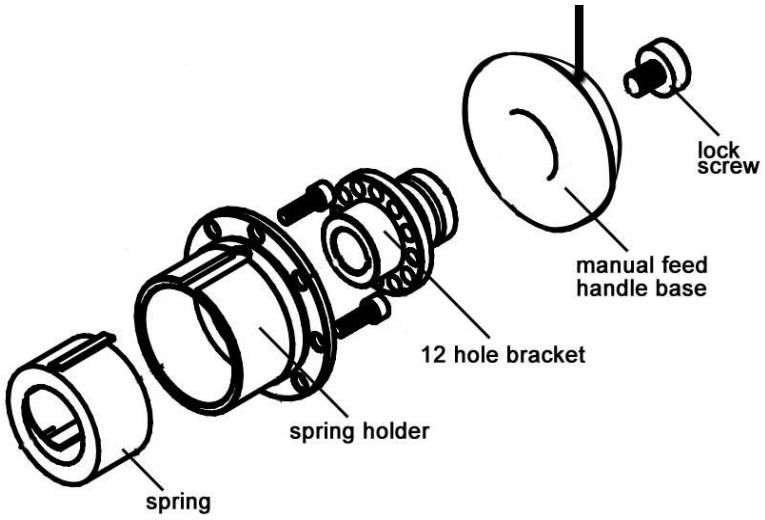
9. Slide motor pulley up to remove it from belt housing, inspect brake assembly for damage or wear, and replace if necessary.

10. Re-assemble milling head in reverse order from Steps 3–8.



Quill reverse Spring Replacement

1. Raise the quill up to top most position, and dismantle manual feed hand base.
2. Remove the bracket with 12 holes.
3. Rotate spring holder on anticlockwise to release spring tension.
4. Remove the spring out of the holder.
5. Install new spring into the holder, and test spring reverse tension as required.
6. Then assemble these parts again.



NOTES

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