Precision Matthews PM-25MV Milling Machine User Manual

Contents

Precision Matthews PM-25MV Milling Machine

OVERVIEW

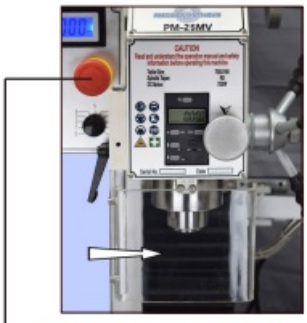
PM-25MV with optional 3-axis DRO

PM-25MV with optional stand/cabinet

PM-25MV

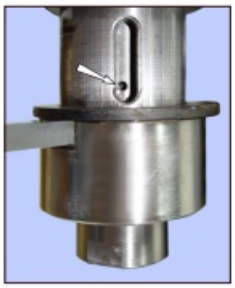
FAQ

My mill doesn't run



120 Vac power connected?
E-Stop button out? (pop it out by twisting firmly to the right.)
Fuse good?

R8 collets won't go into the spindle

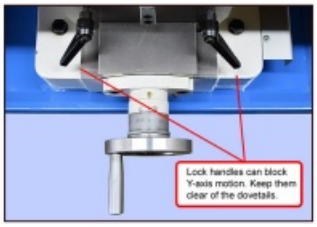


The collet locating screw could be in too far. Back it out a little.

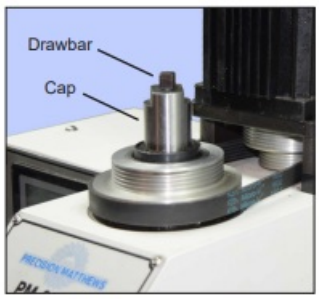
The drawbar doesn't seem to be long enough

Install the drawbar UNDER the drawbar cap, as in the photo (unscrew the cap, insert the drawbar into the spindle, and replace the cap)

The table won't go back to the column



The X-axis (table) lock handles could be the problem. Swing them up to clear.



This manual contains essential safety advice on the proper setup, operation, maintenance, and service of the PM-25MV milling machine. Failure to read, understand and follow the manual may result in property damage or serious personal injury. There are many alternative ways to install and use a mill. As the owner of the mill, you are solely responsible for its proper installation and safe use. Consider the material contained in this manual to be advisory only. Quality Machine Tools, LLC cannot be held liable for injury or property damage during installation or use, or from negligence, improper training, machine modifications, or misuse. This manual describes PM-25MV machines as shipped in February 2016. There may be detailed differences between your specific machine and the information given here (with little or no impact on functionality). Please email us if you have questions about any aspect of the manual or your machine (see our website www.precisionmatthews.com for support addresses). Your feedback is welcomed!

Model PM-25MV Milling Machine

- 1 HP (750W) brushless dc motor, 110 Vac single phase power Quiet belt drive, no gears
- Variable spindle speed from 50 to 2500 pm
- Table size 27-1/2” x 7”
- Quill DRO for precise downfield measurement
- Square column design, heavy cast iron construction Options: steel stand/cabinet, 3-axis DRO
- Weight 275 lb

INSTALLATION

THESE ARE THE MAIN POINTS TO WATCH OUT FOR! But read the following pages for more information

- Handling the mill is at least a two-person job.
- Lower the center of gravity by hand-cranking the headstock down until the spindle nose is just clear of the table.
- Lifting gear – sling, hoist, or forklift – must be rated for at least 500 lb.
- The working location of the mill must allow Full left-right travel of the table, and; Access to the top of the column (for Z-axis leadscrew maintenance).
- Power requirement is 110V, 60Hz, 1φ, 20A circuit protection (spindle motor 14A full load).
- Extension cord not recommended; if no alternative, use 12 AWG not longer than 20 ft.
- Before connecting power for the first time be sure that:

1. The machine is on a firm footing, and adequately secured to a bench or stand.
2. No chuck or collet is installed.
3. There are no clamps or locks on moving parts.
4. The speed control knob is set for the lowest speed.

Setting up the mill
The PM 25MV-BD is shipped in two packing cases, one for the machine and tray (and optional 3-axis DRO), and one for the stand, if ordered. The following procedure makes use of an engine hoist, with a minimum weight rating 500 lb.

1. Prepare the working location, bench, or optional stand. Highly recommended! Bolt the bench or stand firmly on

the floor. Check working clearances, Section 2.

2. Remove the packing case from the pallet, Figure 1-1. Unbolt the machine from the pallet. Install the largest of the four handles on the headstock handwheel (top of the column on right). Install the three smaller handles on the X-axis and Y-axis handwheels.
3. Release the Y and Z axis locks. Check that the mill's center of gravity is as far down and back as possible by cranking both Y and Z handwheels.
4. Tape cloth padding to the underside of the tilt collar.
5. Run a sling under the padding, taking care not to damage the Z-axis locking handle and the cooling fins on the electrical box, Figure 1-2.
6. Hook the sling to the hoist. Slowly lift the mill, controlling any tendency for it to swing as it clears the pallet.
7. Roll the mill into position over the tray, then lower it into place, Figure 1-3.
8. Secure the mill to the bench or stand. If this is a stand

Figure 1-1 **Mill ready for lifting**

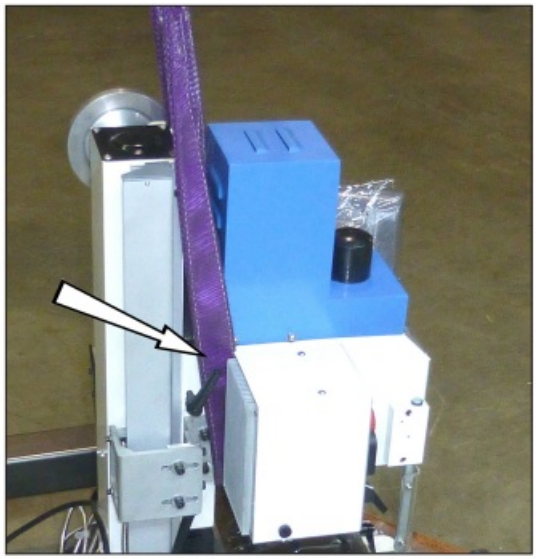


Figure 1-2 **Sling position**

installation, use the four bolts M12 bolts supplied (the bolt locations are threaded.) Use lock + plain wash-ers in all locations.

Assembly and cleanup

Unfinished metal surfaces may be protected in shipping by thick grease and/or paper. Carefully remove these using a plastic paint scraper, disposable rags, and a light oil such as WD-40. Coat bright machined surfaces with a rust preventative such as Rustlick. Level the mill using the table surface for reference, shim-ming under the tray if necessary. Oil the ways and lead screws (Z-axis screw excepted, inaccessible). Initial checks
Read Section 3 if unsure about any item in the following

1. Check that no chuck or collet is installed; there are no clamps or locks on moving parts, and; the speed control knob is at its lowest setting, fully CCW.
2. Remove the blue motor cover. Make sure the belt is set for low speed (belt running on the larger spindle pulley.) If not, re-position the belt, Figure 3-2. Replace the motor cover.
3. Connect 110 Vac power.
4. Be sure the E-Stop (Emergency) button has not been pushed in (it should pop out when twisted firmly clockwise).

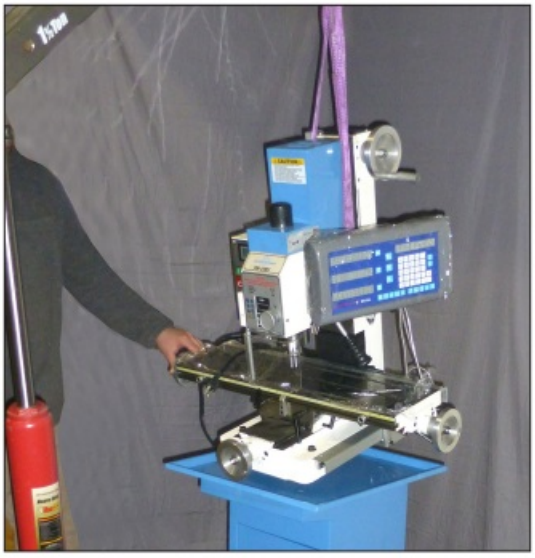


Figure 1-3 **Lowering the mill into position**

5. Press the Power button. The power lamp and the tach display should light.
6. Check the emergency function by pressing the E-Stop button. The power lamp should go out, de-en-energizing the contactor circuit, and disabling all electrics. If this doesn't happen, the E-stop function is defective and needs attention.
7. Restore power by twisting the E-Stop button firmly to the right; this will cause it to pop out.
8. Check that the chip guard switch disconnects power when the guard is swung out.

Test run procedure

DO NOT LEAVE THE MACHINE UNATTENDED DURING THIS PROCEDURE

1. Turn the speed control knob all the way down and to the left, Select Forward (F) spindle direction. The tachometer should display a speed between 50 and 100 rpm.
2. Rotate the speed control knob to the right for a speed of about 200 rpm. Run the spindle at that speed for about 1 minute, then progressively in-crease the speed to the max (about 1250 rpm).
3. Press the E stop button to check it's operation. Ro-tate E stop to the right to reset. The machine should now be ready for normal oper-ations.

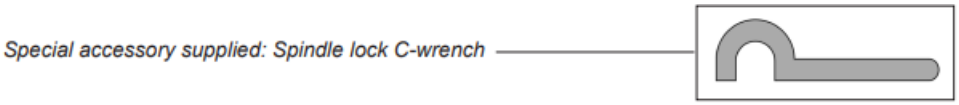
FEATURES & SPECIFICATIONS

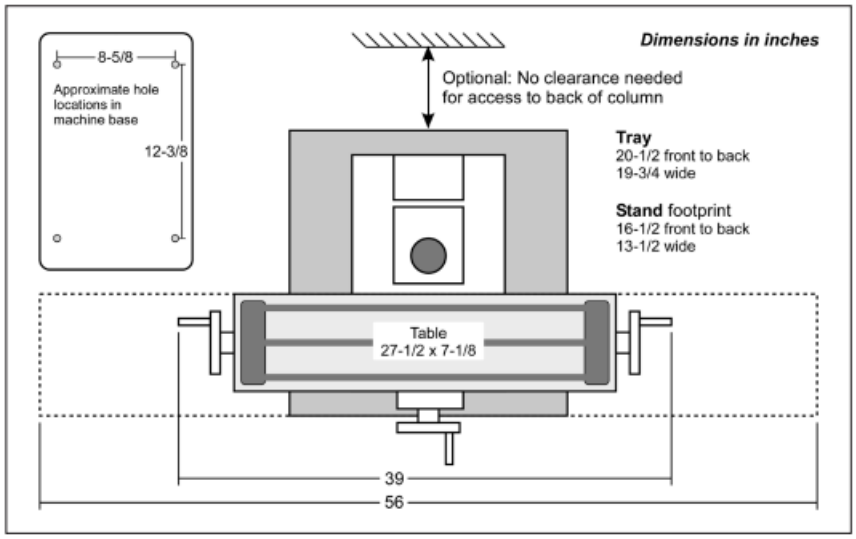
MODEL PM-25MV Milling Machine

General information

The PM-25MV is a robust “square column” mill with R8 spindle and continuously-variable spindle speed up to 2500 rpm. It is designed for day-in, day-out use in the model shop. With a weight of 275 lbs it can handle far more than the typical small machine. For precise control of cutter depth there is a worm-driven quill downfeed with graduated dial and DRO, completely independent of headstock up/down position. The reversible spindle runs in high-quality tapered-roller bearings enclosed in a 2.4” diameter quill with coarse (“drilling”) and fine (“milling”) downfeed options.. It is powered by a 1 HP (750 W) brushless dc motor. Spindle speed is continuously variable from 50 to 1250 rpm, low range, and 100 to 2500 rpm, high range. This is a “gearless” design with two-step pulleys on motor and spindle coupled by a long-life ribbed belt. The headstock can be tilted 90o clockwise and counter-clockwise from the vertical. Precision ground dovetailed ways for table and headstock ensure smooth, precise motion in all three axes: X = left/right motion of table, 20-1/2 in. Y = front/back motion of table, 7 in. Z = headstock up/down, 13 in. Note: Installation of a DRO with external scales may limit these numbers.

Special accessory supplied: Spindle lock C-wrench





Working clearances – space requirements for full motion of the table

PM-25MV SPECIFICATIONS

Dimensions

Approximate weight:

Machine only	275 lb net, 320 lb shipping
Welded steel stand	50 lb net, 54 lb shipping
Size, including stand	W 39 in. x D 20-1/2 in. x H 68-1/2 in.
Stand footprint	W 13-1/2 in. x D 16-1/2 in.
Tray	W 19-3/4 in. x D 20-1/2 in.

Electrical

Power requirement	120V, 60 Hz, single phase
Spindle motor	Brushless dc, 750W (1 HP)
Full load current	14A

Headstock

Vertical travel*	13 in.
Left-right tilt	90 degrees clockwise/counter-clockwise

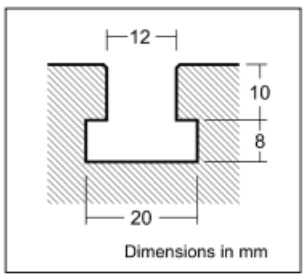
Spindle

Speeds (rpm)	Low range 50 to 1250, High range 100 to 2500
Internal taper	R8
Quill travel	2 in.
Quill diameter	2.36 in.
Spindle nose to table	2 in. min, 12 in. max
Spindle centerline to front face of column	6 in. to pleated cover (uncovered, 7 in.)
Drawbar	Standard 7/16 – 20 thread

Table

Size	W 27-1/2 in. x D 7-1/8 in.
Surface height over the mounting surface	Approx 7 in.
Surface height over the floor, if on stand	Approx 38-1/2 in.
Maximum load	200 lb, table centered, less if overhanging
Leadscrews	Acme, inch pitch, 10 TPI
Left-right travel (X-axis)*	20-1/2 in.
Front-back travel (Y-axis)*	7 in.
T-slots (3)	12 mm wide, 63 mm (2-1/2 in.) centerlines

- DRO installation may limit these numbers



T-slot dimensions

Everyday precautions

- This machine is designed for milling and drilling operations by experienced users familiar with metal-working hazards.
- Untrained or unsupervised operators risk serious injury.
- Wear ANSI-approved full-face or eye protection at all times when using the machine (everyday eyeglasses are not reliable protection against flying particles).
- Wear proper apparel and non-slip footwear – be sure to prevent hair, clothing, or jewelry from becoming entangled in moving parts. Gloves – including tight-fit-ting disposables – can be hazardous!
- Be sure the work area is properly lit.
- Never leave chuck keys, wrenches, or other loose tools on the machine.
- Be sure the workpiece and machine ways are secure before commencing mill-ing or drilling – hold-downs and/or vise fully tightened, X-Y-Z axes locked, cutting tool secured.
- Use moderation: light cuts, low spindle speeds, and slow table motion give better, safer results than “hogging”.
- Don’t try to stop a moving spindle by hand – allow it to stop on its own.
- Disconnect 110V power from the mill before maintenance operations such as oiling or adjustments.
- Maintain the machine with care – check lubrication and adjustments daily before use.
- Clean the machine routinely – remove chips by brush or vacuum, not compressed air (which can force debris into the ways).

No list of precautions can cover everything. You cannot be too careful!

USING THE MILL

MOTOR CONTROLS

Figure 3-1 **Spindle motor controls**
Also shown, arrowed, is the quill locking lever

- Before doing anything, check the installation instructions in Section 1
- Connect the mill to a 110Vac outlet.

- Press and release the green Power ON button to energize the control circuit; the tachometer should light. This is a self-latching circuit – when the ON button is released, a contactor in the electrical box maintains power until released by the red OFF button (also a momentary switch).
- The round orange E-stop button, right, is in series with the OFF button. Like the OFF button, it de-en-energizes the control circuit completely, but it should be used only for its intended purpose – emergency disconnect. Once the E-stop button is pushed in, it stays in until twisted firmly clockwise to release.
  Also in series with the Power and E-stop buttons is a microswitch actuated by the acrylic Chip Guard in front of the spindle. The motor will not run if the chip guard is open.
- The spindle motor is controlled by a three-position switch, Forward/Stop/Reverse, and a continuously-variable speed control knob.

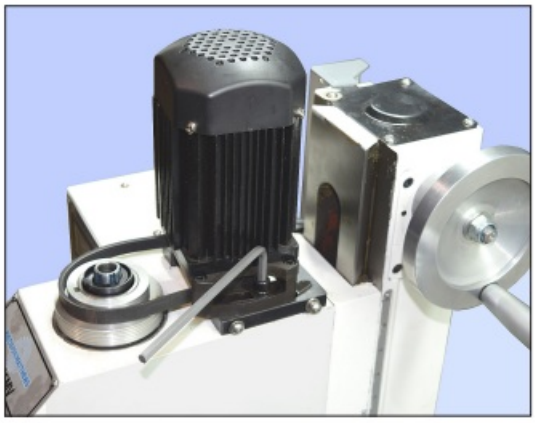


Figure 3-2 **Belt adjustment**

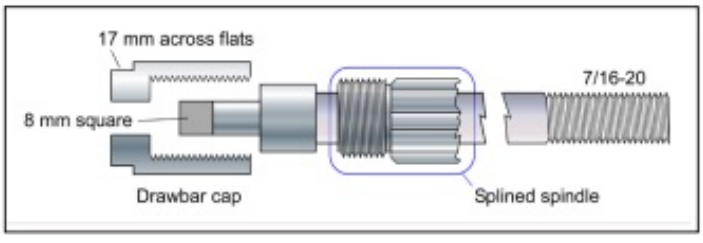
- **F =** Forward (CW, looking down, used for most milling and drilling
- **O =** Stop
- **R =** Reverse (CCW, looking down)

SPINDLE SPEEDS

- The PM-25MV is a belt-driven machine with two-speed ranges, (L) 50-1250 rpm and (H)100-2500 rpm.
- To select a speed range, disconnect the power, then remove the blue motor cover (4 screws). Loosen the socket head screws on each side of the motor, then swing the motor forward to free the belt, Figure 3-2. Make sure that the ribbed belt is properly engaged with the selected pair of grooved pulleys, then re-tighten. Before powering up, rotate the spindle by hand to check the tracking and tightness of the belt. Do not over-tighten – aim for ± ¼" slack between the motor and spindle pulleys.
- Excessive cutter noise, chatter, poor finish, and tool wear are often the result of too high a feed rate, and/or too high a spindle speed. If unsure, go slow!

INSTALLING AND REMOVING TOOLING

The spindle and drawbar are designed for R-8 taper collets, drill chucks, and other arbors with the standard 7/16"-20 internal thread.



Two tools are required to install or remove R8 tooling: an 8 mm wrench for the square drawbar nut, and the supplied C-wrench which engages in flats at the bottom end of the spindle.

Install tooling

Install the R-8 device, then hand-thread the drawbar into it until the shoulder on the drawbar bottoms on the splined spindle, the diagram above (on the machine this is concealed by the drawbar cap, Figure 3-2). Lock the spindle with the special C-wrench, page 5, while at the same fully tightening the drawbar with an 8 mm wrench. [Do NOT try to lock the spindle using the flats on the drawbar cap; this is screwed onto the spindle to secure the return spring cup.] R8 tooling is located in the spindle bore by a set screw. If it is difficult or impossible to insert the R8 device, chances are the set screw is too far. Rotate the spindle by hand to expose the screw, Figure 3-3, then back it out a fraction of a turn using a 2.5 mm hex wrench. The hand rotates the spindle again to check that the screw clears the inside surface of the quill. Remove tooling Protect the table, vise, or workpiece under the spindle with rags or scrap wood. Why? Because they can easily be damaged by falling tools and drill chucks. The cutting tool itself can also be damaged in the same way. Lock the spindle with the C-wrench, loosen the drawbar one-half turn or less, just enough to unseat the taper, then tap the top of the drawbar with brass or dead-blow hammer. Unscrew the drawbar with one hand while supporting the R-8 device with the other hand.

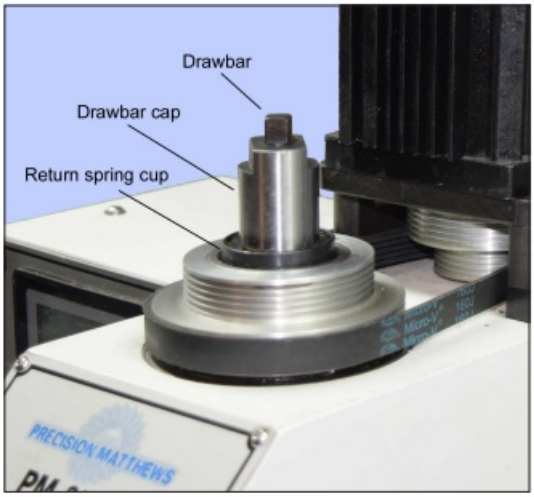


Figure 3-2 **Two-step belt drive**

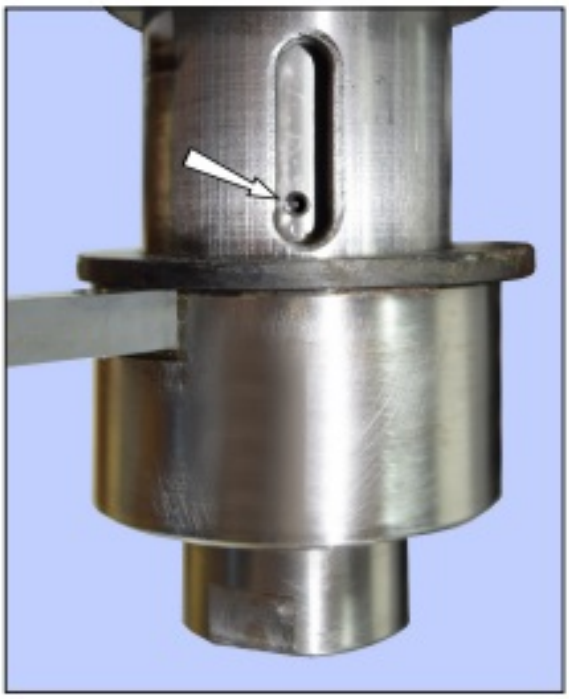


Figure 3-3 **Collet set screw**

Replace the drawbar cap to protect bearings and splines.

MOVING THE TABLE

Conventionally, the left-right movement of the table is said to be along the X-axis (also called “longitudinal travel” or “traversing”). Front-back movement is on the Y-axis, sometimes called “cross travel”. Each axis has a lead screw with a handwheel and graduated dial with 0.001” divisions, 0.1” per revolution. If Figure 3-4 X-axis locks

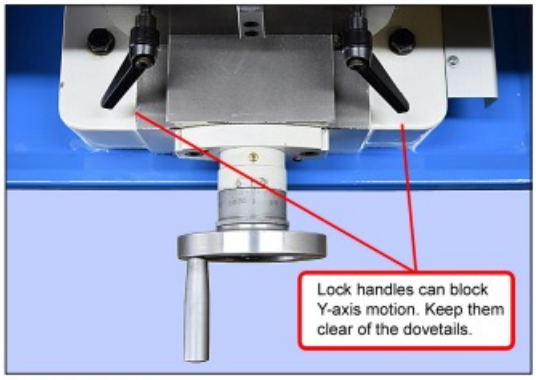


Figure 3-4 **X-axis locks**

RAISING & LOWERING THE HEADSTOCK

The Z-axis crank, Figure 3-6 inset, is at the top right of the column. If the mill has a 3-axis DRO the headstock position is displayed at all times. If not, the headstock can be positioned approximately by reference to a 12” scale on the column. For more precise positioning the crank hub has a graduated dial with 0.001” divisions (be aware of backlash in the bevel gears controlling the Z-axis leadscrew, and also in the leadscrew nut). When the headstock is at the desired height, lock it in place.

- All milling operations should be done with the quill fully retracted into the headstock and locked.
- In operations calling for precise depth control, such as milling, both quill and headstock must be locked to maintain a precise depth of cut. a mill is not equipped with digital readouts (DROs), the table can be accurately positioned by counting whole turns and divisions, keeping leadscrew backlash in mind. This means that table motion must always be in the same direction up to the point of reference, then on to the desired location, see “Positioning by Counting X-Y Divisions”, two pages on.

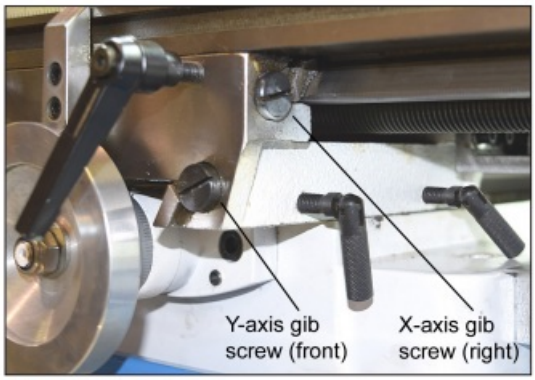


Figure 3-5 **Y-axis locks**

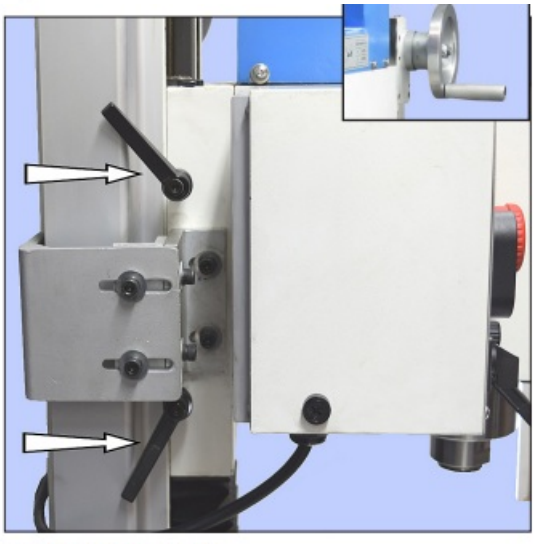


Figure 3-6 **Z-axis locks**

QUILL DOWNFEED

The quill is controlled in two different ways, coarse and fine. In the drilling mode, coarse feed, the mill operates like a standard drill press with a 3-lever hub; lever action low-ers or raises the quill in the usual way by rack and pinion. Return action is assisted by a compression spring within the quill and spindle assembly. For milling operations, the lever hub is not rotated by lever action. Instead, it is locked to a worm wheel, which is turned by the fine control knob. This allows the quill to be driven precisely to any desired position. The fine control knob, because it drives through a worm, cannot be back-driven by return-spring action on the quill (in other words, it stays where it's put). For milling operations, the quill should be locked by the lever on the left of the headstock, Figure 3-1.

Coarse feed (Figure 3-7)

For drilling operations, loosen the knob (4), allowing the lever hub to rotate independently of the sleeve (3).

Fine feed (Figure 3-7)

For milling operations calling for precise, repeatable control of tool depth, tighten knob (4) to engage hub (1) with the internal taper on sleeve (3). Tighten the Z-axis locks, Figure 3-6.

Rotate the fine control knob (2) to raise or lower the quill. Lower the quill by rotating the fine control knob clockwise, positioning it precisely either by counting divisions on the graduated dial or by reference to the digital read-out (DRO), Figure 3-1. Use the locking lever left of the headstock to hold the quill firmly in position. If you are counting downfeed divisions be aware of backlash in the worm drive.

QUILL DRO

The quill DRO is in metric mode when switched on. Press the mm/in button to display inches. Replace the battery by removing the small molded cover on the face of the DRO unit (align the dots). Check the type number and voltage of the installed battery. Replace with an equivalent silver oxide cell available from local retailers.

- Switch off the DRO when not in use!

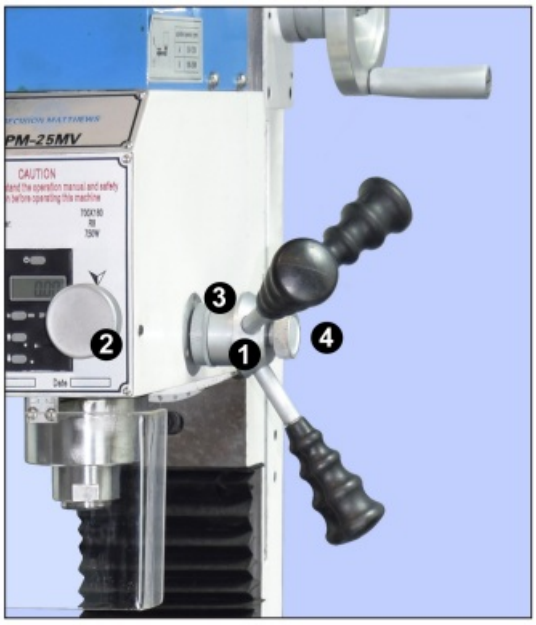


Figure 3-7 **Quill downfeed controls**

Figure 3-7 Quill downfeed controls

The lever hub (1) is connected at all times to the quill pinion, which engages a rack on the back side of the quill. The fine control knob (2) drives sleeve (3) through a worm gear. If clamp knob (4) is unscrewed, both (2) and (3) rotate freely, doing nothing to the quill. Fine feed is engaged by tightening knob (4) to clamp (3) and (1) together. The quill DRO – which has no backlash issues – offers a much less laborious way of setting tool height, but note that the quill is spring-loaded. This calls for care when releasing the quill locking lever. If the fine control knob has been allowed to disengage (backed off counter clockwise), the quill may jump up by 0.01" or more. To avoid this, make sure the fine control has been turned clockwise to apply downward pressure on the quill before the locking lever is released.

POSITIONING BY COUNTING X / Y DIVISIONS

For all spindle positioning operations, with or without DROs, avoid using the quill lock. Why? On practically all vertical mills, including the heavier knee mills, locking the quill may offset the spindle by a few thousandths of an inch. If the edge of the workpiece has been “found” in the quill-locked condition, this will affect the placement of holes drilled thereafter. Instead, lower the quill with the fine down feed control. This is worm driven, so it stays where it’s put without locking.

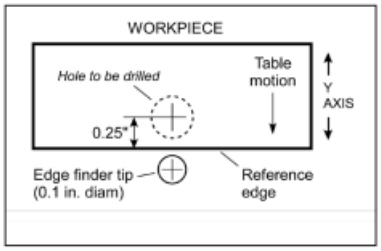


Figure 3-8 **Workpiece positioning example**

In this illustration, a hole is to be drilled exactly 0.25” on the Y-axis relative to the front edge of a workpiece in a

TAPPING OPERATIONS

When threading a drilled hole it is essential to align the threading tap properly in the bore. The mill is often used for this purpose, ideally with a dedicated (non-slip) tap holder or, for production work, an auto-reverse tapping attachment. A drill chuck can be used instead for sizes up to (say) M6 or 1/4”, beyond which the chuck may not grip tightly enough to avoid slippage. Tapping can be done under power, or by hand turning the chuck.

TILTING THE HEADSTOCK

In routine operations the user relies on squareness of the spindle relative to both axes of the table. Front-to-back squareness is set at the factory, and is not adjustable by everyday methods. In the other plane the headstock can be set to any angle up to 90 degrees either side of the normal vertical position. Because re-establishing true vertical (tramming) on any mill is a time consum-ing process, most machinists look first for other ways of vise, or otherwise clamped to the table, Figure 3-8.

1. Install an edge-finder in collet or chuck (a tip diam-eter of 0.2” is assumed).
2. Lock the X-axis (optional).
3. If the reference edge is already to the back the spin-dle centerline, do nothing; if not, rotate the Y-axis handwheel clockwise to send the workpiece back-wards (toward the column).
4. Engage the fine downfeed, Figure 3-7.
5. With the spindle running, lower the quill as neces-sary using the fine downfeed control, then bring the table forward (counter-clockwise), stopping at the point where the edge-finder just makes contact (the tip jumps out of line). Stop the spindle.
6. While holding the Y-axis handwheel to prevent rota-tion, zero the Y dial.
7. Raise the quill, then rotate the handwheel one exact full turn counter-clockwise (0.1”) to bring the refer-ence edge to the spindle centerline.
8. Rotate the handwheel 2-1/2 turns counter-clockwise to bring 50 on the dial opposite the datum; the spin-dle is now 0.25” to the back of the reference edge.

For either method, it is essential to use a tapping fluid. Any cutting oil is better than none, but most users find Castrol’s Moly Dee the most reliable for threading in steel.

If power tapping bear in mind that the spindle does not stop instantaneously, so be careful tapping blind holes. Be sure the quill locking lever is free, and start trial work with the lowest spindle speed.handling a project instead of tilting the head. The headstock is secured by three nuts spaced 120 de-grees apart, one underneath and one either side, Figure 3-9. The headstock is top-heavy, and may swing sud-denly to either side unless a helper is on hand to restrain it. Testing for moveability as you go, carefully loosen the nuts by degrees. Be especially careful if the head has

Figure 3-9 **Headstock nuts**

Figure 3-9 Headstock nuts
not been moved before – the paint seal may let go without warning. (First-time tilting may also call for unusual effort on the wrench.)
Set the headstock to the desired angle by reference to the tilt scale on the headstock base casting, then re-tighten the nuts. The tilt scale is typically good to within ± 1/4o. A more accurate means of angle measurement will be needed if the project calls for greater precision.

REMOVING THE HEADSTOCK

If you wish to remove the headstock be aware that it may — depending on the date of manufacture — be secured to the base casting by set screws in addition to the nuts shown in Figure 3-9. The set screws, if installed, are in a threaded hole on the 3-spoke handle side (right hand) of the headstock casting. The screws are installed in line, with the inner screw seated in a “safety groove” in the base casting, Figure 3-10. The outer screw locks the inner screw.

TRAMMING THE HEADSTOCK

As shipped, the mill is set to zero tilt, squared accurately enough for initial out of the box test drillings, etc. For more demanding project work thereafter, the spindle needs to be set at precisely 90 degrees relative to the table, in other words trammed. “Out of tram” may show up as an offset of a few thousandths between entry and exit of a deep hole, or as a scalloped effect when sur-facing a workpiece with a large-radius fly cutter, greatly exaggerated in Figure 3-11. Tramming is done by fine-tuning the headstock tilt angle. Tram is typically checked by attaching a dial indicator to some form of “sweepable” holder installed in the spindle, the aim being to adjust tilt for the same reading on either side of the X axis. The longer the radius arm, the greater the sensitivity. Figure 3-12 shows a typical shop-made holder; it has a threaded arbor allowing the choice of two radius arms, 6 and 10 inches measured from spindle centerline to indi-cator tip. A collet is used to hold the arbor, in this exam-ple 5/8” diameter. The dimensions are arbitrary, but note that the indicator must be firmly attached, and the arm rock-solid relative to the indicator spring force (which can be considerable on plunger-type indicators).

A suggested procedure for establishing a tram:

1. Disconnect power.
2. Install the dial indicator.

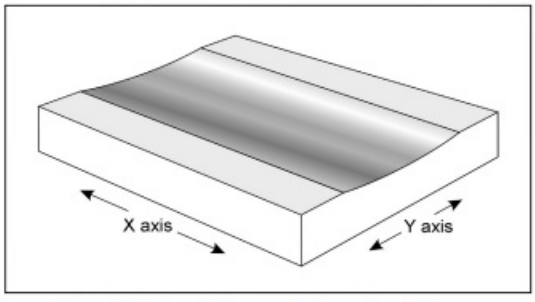


Figure 3-11 **Head tilt can affect surface flatness**

3. If the headstock has been tilted, reset it to the approximate zero-degree position on the tilt scale, then tighten

the three nuts enough to avoid unexpected headstock movement.

4. Remove the vise, if installed, and clean the table surface. If there are noticeable grooves or dings, flatten the surface with a diamond lap or fine-grit stone.
5. Set a 1-2-3 block (or another precision-ground block) on the table under the indicator probe.
6. Switch on the DRO.
7. Using the fine down feed lowers the spindle to give an indicator reading of about half-scale.
8. Note the dial indicator and DRO readings, then back off the fine down feed at least a couple of turns to avoid collision when sweeping.
9. Reposition the 1-2-3 block to the opposite location on the table.
10. Swing the indicator holder to the new location, then lower the spindle – fine downfeed again – to give the same dial indicator reading as in step (8).
11. If the headstock is perfectly trammed – highly unlikely at the first shot – the DRO reading should be as in step (8). If not, loosen the nuts just enough to allow the headstock to be tapped a fraction of a degree in the direction called for, then re-tighten the nuts. The “tap” can be anything from a gentle slap of the hand to a rap with a dead-blow mallet.
12. Repeat steps (7) through (10) until satisfied with the tram, tightening the nuts as you go. This will likely call for several iterations. There is no “right” tram; the acceptable difference in side-to-side readings depends on project specs. As a starting point, aim for ± 0.001” with a sweep radius of 5 or 6 inches.

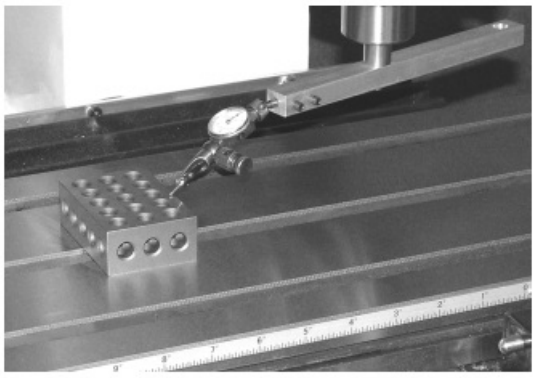


Figure 3-12 **Shop-made indicator holder**

- Tramming calls for patience! Expect to tighten and re-check at least three times (simply tight-ening the bolts can itself affect the tram).
- A similar procedure may be used to check tram in the Y-axis, front to back. The difference here is that there is that Y-axis tram is established in manufacture, and can be adjusted only by these shop methods:

1. Shimming between the dovetailed Z-axis saddle casting and the headstock itself. It is more likely that the headstock is nodding forward rather than leaning backward, so start with (say) a 2 mil shim in line with the underside (central) headstock nut. This is a temporary fix that will need to be checked if the headstock is tilted again.
2. Shimming between the underside of the column and the main base casting. This is a long-term fix. It is a two-person procedure, requiring an engine hoist or some other means of un-weighting the headstock (see Section 1, Installation).

INSTALLING & INDICATING A VISE

For routine milling operations the workpiece is held in a precision vise. For the PM-25MV a 4” vise is most suit-

able. “Indicating” means checking the alignment of the fixed (back) vise jaw relative to the axis of table motion. Install the T-bolts and align the vise by eye. With one of the clamp nuts snug, but not tight, tighten the other one just short of fully-tight (but tight enough so the vise won’t budge without a definite tap from a dead-blow mallet). A typical setup for indicating is shown in Figure 3-13. There is no spindle lock, but you need to make sure that the spindle does not rotate throughout the pro-cedure. Set the indicator tip against the upper edge of a precision reference bar or, if not available, use the front face of the fixed jaw of the vise instead (check for dings, hone if necessary). Adjust the Y-axis to pre-load the indi-cator to mid range at the tightly-clamped side of the vise, then lock the Y-axis. Note the indicator reading, then watch the indicator as you traverse the table slowly toward the loosely clamped side. (Also watch for any sign of spindle rotation.) Ideally, there should be no discrepancy between the in-dicator readings at the two ends — unlikely at the first at-tempt. Return the table to the starting point, then repeat the process, tapping the vise in as you go. Repeat the process as often as necessary for the desired accuracy, progressively tightening the “looser” nut. Now fully tight-en both nuts, and re-check again (tightening a nut can itself introduce significant error). An established routine like this – tight to loose – can save a lot of time.

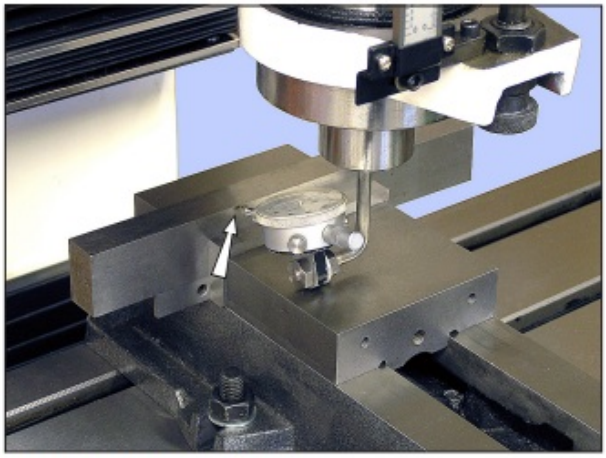


Figure 3-13 **Indicating the vise**
The tip of a standard dial indicator, arrowed, rides along the side face of a ground reference bar (or the front face of the back jaw).

Most users aim for an end-to-end difference of not more than ±0.001” over the width of the vise jaw.

VISE KEYS

Most precision vises come with key slots on the underside machined exactly parallel to the fixed jaw. Key slots, Figure 3-14, can be a great time saver. Properly installed they allow the vise to be removed and replaced routinely, accurately enough for general machining without the need for indicating every time.

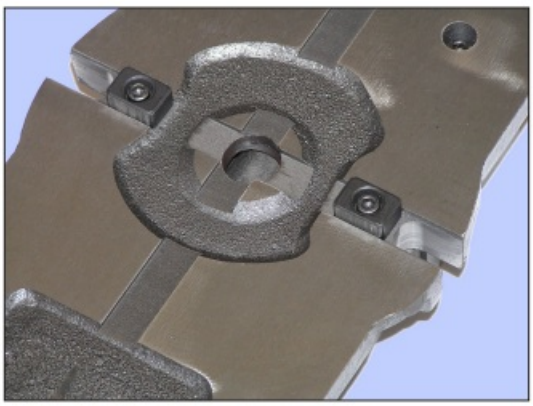


Figure 3-14 **Vise keys installed on X-axis**
On most vises the keys can also be installed on the long axis.

Figure 3-14 Vise keys installed on X-axis

On most vises, the keys can also be installed on the long axis. Most 4” vises have either 14 mm or 16 mm slots, calling for shop-made T-shape adapter keys as Figure 3-15. It is well worth the effort to make these precisely. Aim for a snug fit in both vise and table, but not so tight that it takes more than a reasonable effort to lift the vise clear. Case hardening is recommended, with final fitting using a fine stone or diamond stone.

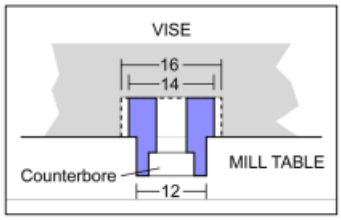


Figure 3-15 **Shop-made vise key**
Dimensions in millimeters

Section 4 MAINTENANCE

Unplug the 120V power cord before any maintenance operation! Remove all machining debris and foreign objects before lubricating ANYTHING! If need be, any oil is better than no oil – but use the recommended lubricants when you can.

RECOMMENDED LUBRICANTS
Ball oilers (X and Y leadscrews): Way Oil, such as Precision Matthews Premium Way Oil
X, Y, and Z axis ways: Way Oil, such as Precision Mat-thews Premium Way Oil
Visible gears such as quill rack and pinion, Z-axis bevel gears: light general purpose grease, NLGI No. 2, or equivalent
X Y, and Z leadscrews: Way Oil, such as Precision Matthews Premium Way Oil
Quill Outer Sliding Surface: Way Oil, such as Precision Matthews Premium Way Oil
Spindle Bearings: High-Speed Spindle Bearing Grease, such as Kluber Isoflex NBU 15

GENERAL OILING

Assuming a clean environment – no abrasive particles or machining debris – lack of proper lubrication is the main cause of premature wear. Rotating parts are easy to lubricate, but sliding parts are not. Gibs are tightened for

GIB ADJUSTMENT
Gibs on the X, Y and Z axes control the fit of the mating dovetailed surfaces. They are gently-tapered lengths of ground cast iron located by opposing screws at each end. Adjusting them is a trial-and-error process that takes time and patience. Aim for the best compromise of rigidity and reasonably free table movement. Too tight means accelerated wear on the ways and leadscrews. Too free means workpiece instability, inaccuracies, and chatter. Both screw heads must be tight against the gib ends. If you loosen one, tighten the other. Remove the way covers for access to the back of the Y gib and the bottom of the Z gib. the best compromise between rigidity and slide ability, which means practically zero gaps between the ways. Take time to understand exactly which are the bearing surfaces on the various dovetail surfaces; this is not obvious – some of the interfaces look like bearing surfaces, but are simply narrow gaps.
Every few hours of operation: 1. Apply the recommended way-oil with a dedicated short-bristle brush such as the type used for applying flux; 2. Use a similar brush to apply oil or grease to the lead screws; 3. Apply oil to the ball oilers, see below.
Ball oilers
Use a pump-type oil can with a tip large enough to more than span the oiler's spring-loaded steel ball. The oil pressure will displace the ball, allowing oil to flow, provided the oil can tip is firmly pressed onto the brass seating. Before oiling check that the ball is not stuck – press it lightly with a probe.
Quill rack and pinion
Lower and lock the quill. Using a stiff flux brush, clean the visible portions of the rack and pinion. Raise and lower the quill to expose the remainder of the working surfaces, locking and cleaning at each setting.
Single bearings
See Servicing Quill and Spindle, two pages on.

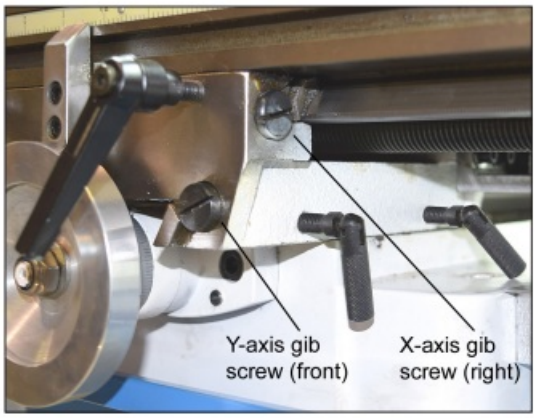


Figure 4-1 **Gib adjustment, X and Y axes**
The back adjustment screw for the Y axis gib is under the solid rubber way cover behind the table. The left adjustment screw for the X axis is in a similar location on the left side of the saddle casting.

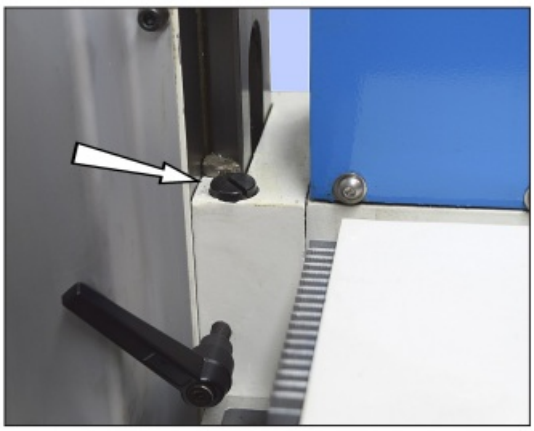


Figure 4-2 **Z-axis gib adjustment, upper screw**
The lower screw is under the pleated way cover.

The lower screw is under the pleated way cover.

LEADSCREW BACKLASH CORRECTION

When alternating between clockwise and counter clock-wise rotation of the X or Y leadscrews, the handwheel moves freely a few degrees but the table stays put. This is backlash, a feature of all leadscrews other than the precision type found on CNC machines. The acceptable amount of lost motion depends on the user, but 0.005” is generally a good compromise. Smaller numbers are possible, but overdoing it can lead to premature wear of leadscrew and nut. Excessive backlash can be corrected by compressing the leadscrew split nut. For the X-axis this is done by tightening the socket head screw in Figure 4-3. A long-handled 4 mm hex wrench is required, ideally one with an extra-thick shank to minimize flexing. The corre-sponding adjustment for the Y-axis is difficult because the split nut and leadscrew are concealed by castings, Figure 4-4. Access to the adjusting screw is possible

DOWNFEED RETURN SPRING

The quill should automatically retract when the coarse downfeed levers are released following a drilling opera-tion. If it does not, check for binding in the quill lock. The return spring, Figure 4-5, is held by a spring cup which is locked to the spindle by a special C-clip beneath the drawbar cap, Figure 3-2. Spring force is not adjustable. only if the entire machine is unbolted from the bench or stand, then: 1. Lifted by sling and engine hoist (see In-stallation, Section 1), or; 2. Tilted backward by pivoting on the back edge of the base casting.

- Both options are two-man procedures

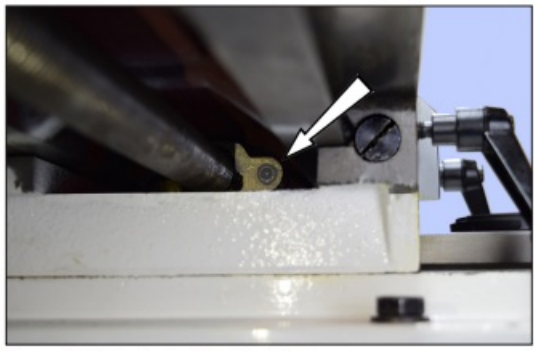
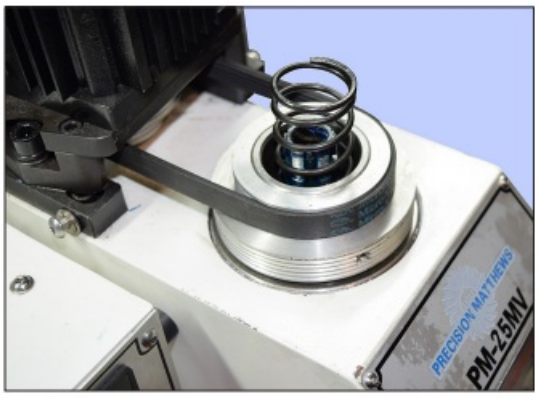


Figure 4-3 **X-axis backlash adjustment**

Figure 4-4 **Y-axis backlash adjustment**



SPINDLE BEARINGS

The spindle runs on grease-lubricated tapered roller bearings. These should be serviced every 500 hours of running time. Thoroughly clean each bearing assembly then repack with a grease such as Kluber Isoflex (wheel bearing grease can be used in low-load, lower rpm op-erations).
Do not over-pack the roller bearings!
Bearing manufacturers recommend that the free volume between inner and outer should be no more than 30% filled with grease. (If smothered with grease, bearings are subject to overheating.)

Especially during the first 10 hours of running time check that the spindle runs smoothly, without excessive heat build-up (the spindle will run warm when used at high speeds over long periods, but should not be uncomfortably hot). Overheating can be due to excessive grease, see above, or an over-tight spanner nut at the upper end of the spindle.

SERVICING QUILL & SPINDLE

In normal use, the quill assembly needs only oiling on its sliding surface. The spindle runs on pre-lubricated roller bearings and needs little attention, see Spindle Bearings, above. If the bearings need to be serviced or replaced, remove the quill/spindle assembly as follows:

1. Remove any installed R8 device from the spindle.

2. Lock the spindle with the C-wrench, then unscrew the drawbar cap (17 mm flats) from the spindle.
3. Remove the drawbar.
4. **IMPORTANT:** Use wood blocks or other means to prevent unexpected downward movement of the quill assembly.
5. Press down on the return spring cup while removing the C-Clip, Figure 4-6.
6. Remove the return spring, Figure 4-5.
7. Using a 2.5 mm hex key remove the two button head screws securing the DRO scale and stand-off block to the quill assembly.
8. Remove the wood blocks (4), then remove the quill assembly from the headstock.

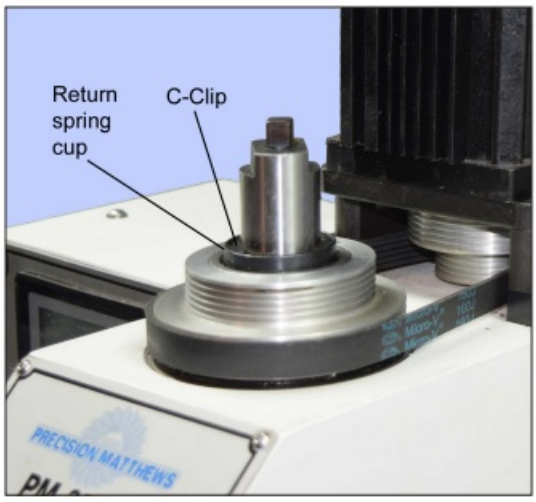


Figure 4-6 **Remove drawbar cap for access to the C-Clip**

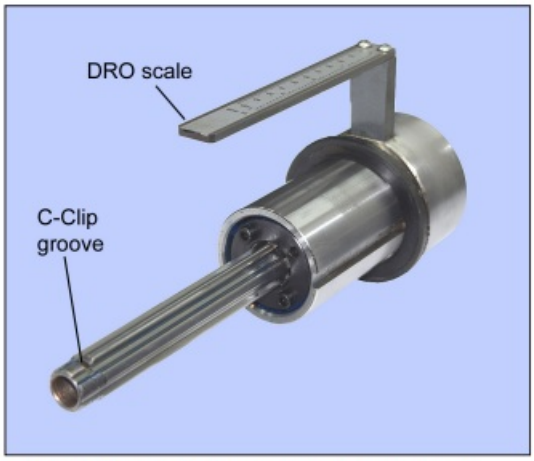
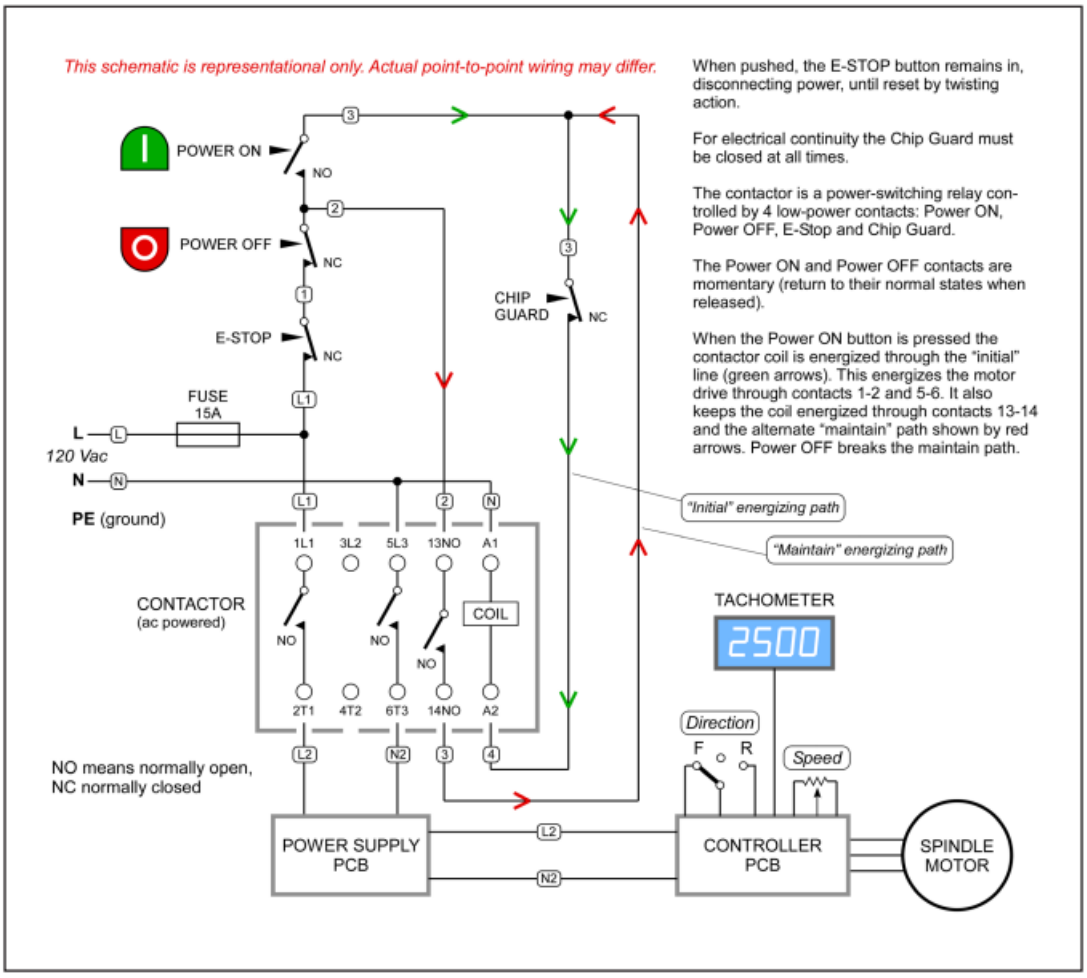


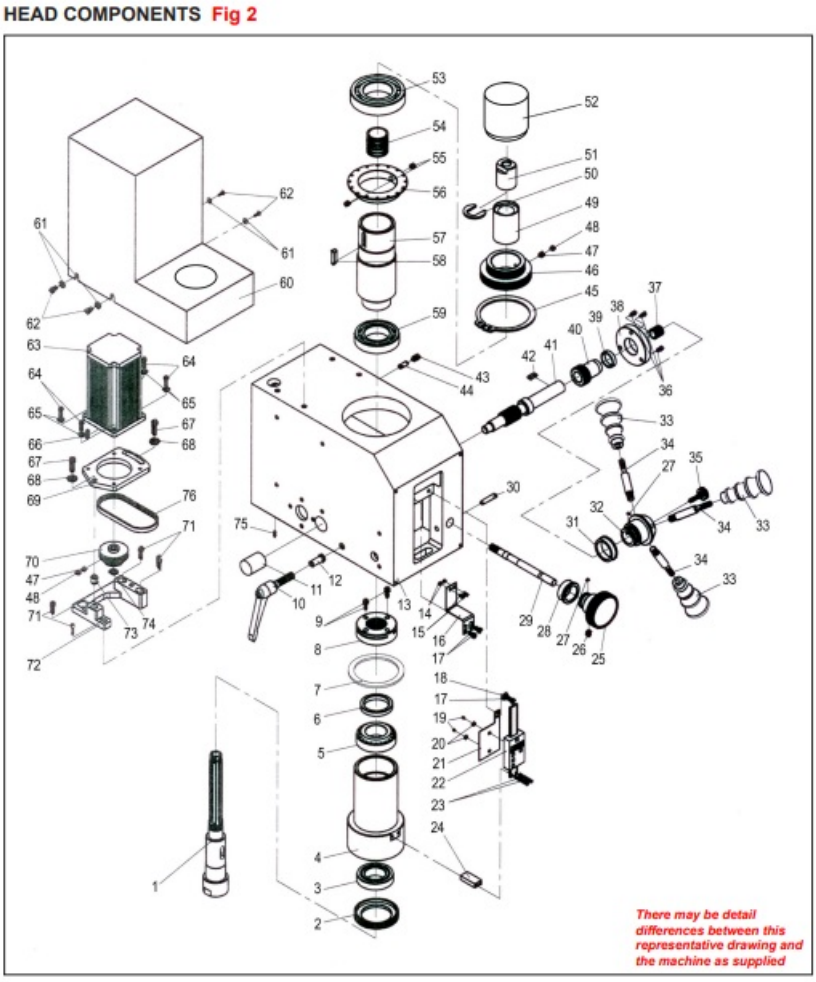
Figure 4-7 **Complete DRO scale and quill assembly**
For illustration only: for servicing operations the scale should be detached from the quill and should remain in the DRO case.

Section 5 PARTS



Model PM25MV-BD ELECTRICAL SCHEMATIC Fig 1

HEAD COMPONENTS Fig 2



HEAD COMPONENTS Fig 2

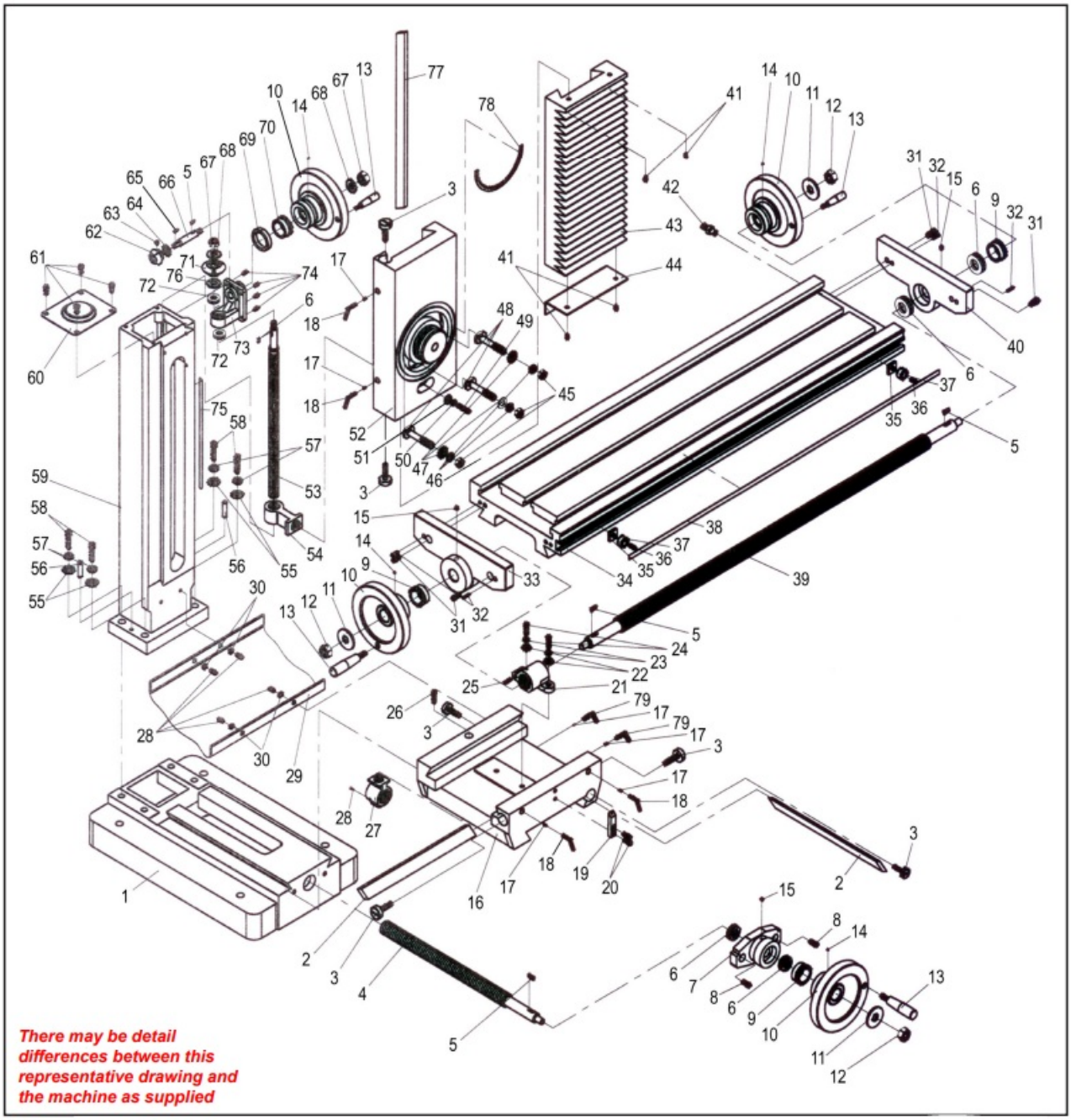
Ref	Description	Part
1	Spindle	Z5209
2	Bearing seal	Z5210
3	Roller bearing 32007	Z5211
4	Quill sleeve	Z5212
5	Roller bearing 32005	Z5213
6	Spacer	Z5214
7	Washer, nitrile	Z5215
9	Screw: M5 x 12 skt hd	Z5217
10	Quill lock handle	Z5218
11	Casting plug	Z5219
12	Quill guide pin	Z5220
13	Headstock	Z5221
14	Nut: M3	Z5222
15	Screw: M3 x 8 pan hd	Z5223

16	DRO bracket	Z5224
17	Screw: M4 x 10 pan hd	Z5225
18	Washer: flat, M4	Z5226
19	Screw: M4 x 6 pan HD	Z5227
20	Washer: flat, M4, large	Z5228
21	DRO backplate	Z5229
22	DRO assembly	Z5230
23	Screw: M4 x 55 pan HD	Z5231
24	DRO connector block	Z5232
25	Fine feed knob	Z5233
26	Screw: M5 x 8, set	Z5234
27	Leaf spring	Z5235
28	Graduated dial, fine	Z5236
29	Worm spindle	Z5237
30	Pin: taper, 8 x 30	Z5238
31	Graduated dial, coarse	Z5239
32	Coarse feed hub	Z5240
33	Coarse feed handle	Z5241
34	Coarse feed spoke	Z5242
35	Clamp knob	Z5243
36	Screw: M4 x 10 skt hd	Z5244
37	Compression spring	Z5245
38	Pinion shaft flange	Z5246

Ref	**Description**	**Part**
39	Sleeve	Z5247
40	Worm gear	Z5248
41	Pinion shaft	Z5249
42	Key: 4 x 12	Z5250
43	Screw: M6 x 12, set	Z5251
44	Pin: 5 x 10	Z5252
45	Retaining ring: 45, ext	Z5253
46	2-step spindle pulley	Z5254

47	Screw: M6 x 8, set	Z5255
48	Screw: M6 x 6, set	Z5256
49	Return spring cup	Z5257
50	C-clip, spring retainer	Z5258
51	Drawbar cap	Z5259
52	Drawbar cover	Z5260
53	Ball bearing: 6209	Z5261
54	Spring, quill return	Z5262
55	Screw: M6 x 8, cone pt	Z5263
56	Tach sensor coil	Z5264
57	Splined sleeve	Z5265
58	Key: 6 x 25	Z5266
59	Ball bearing: 6007-2Z	Z5267
60	Motor cover	Z5268
61	Washer: flat, M4	Z5269
62	Screw: M4 x 10 pan hd	Z5270
63	Motor, DC ,Main Motor	Z5271
64	Screw: M5 x 20 skt hd	Z5272
65	Washer: flat, M5	Z5273
66	Key: 6 x 16	Z5274
67	Screw: M8 x 30 skt hd	Z5275
68	Washer: flat, M8	Z5276
69	Motor mount, lower	Z5277
70	2-step motor pulley	Z5278
71	Screw: M6 x 20 skt hd	Z5279
72	Motor mount, upper	Z5280
73	Bushing	Z5281
76	Ribbed belt	Z5284

TABLE, COLUMN, & BASE COMPONENTS Fig 3



TABLE, COLUMN, & BASE COMPONENTS Fig 3

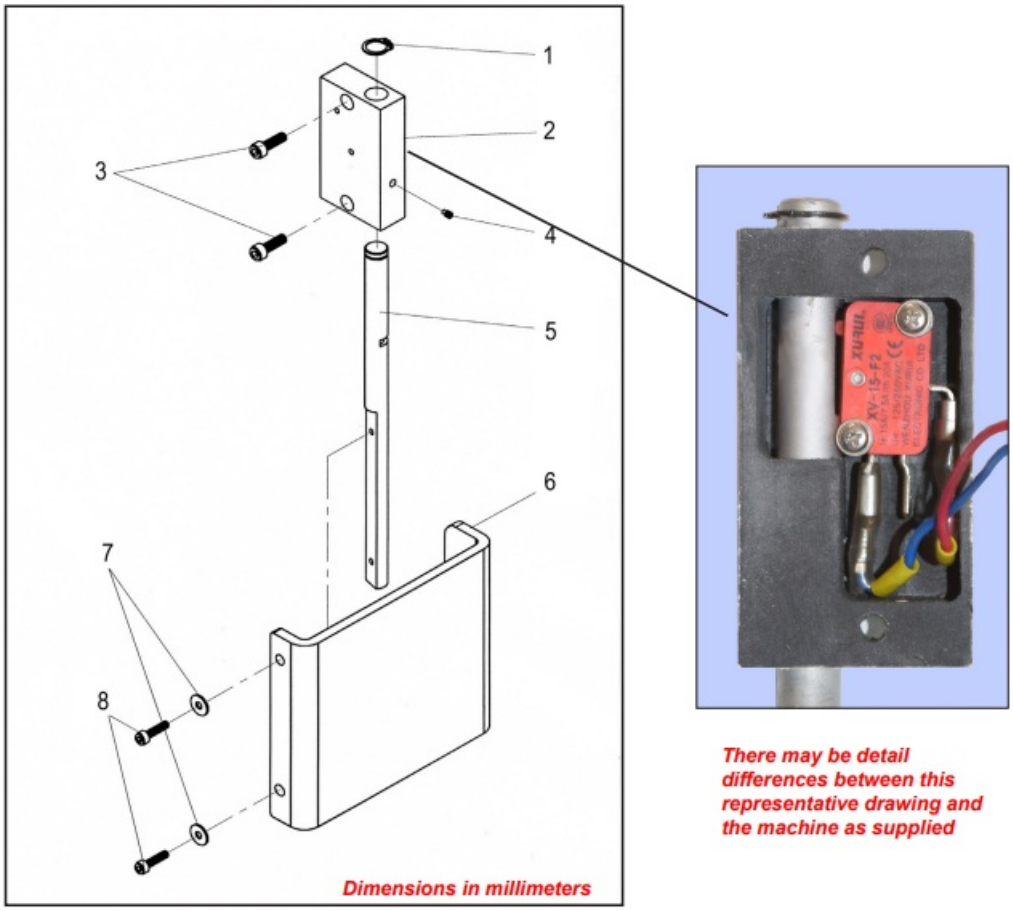
Ref	Description	Part
1	Base	Z5285
2	Gib, Y-axis	Z5286
3	Gib adjust screw	Z5287
4	Y-axis leadscrew	Z5288
5	Key: flat, 5 x 16	Z5289
6	Ball bearing: 51103	Z5290
7	Y-axis support flange	Z5291

8	Screw: M8 x 20 skt hd	Z5292
9	Graduated dial	Z5293
10	Handwheel	Z5294
11	Washer: flat, M10	Z5295
12	Locknut: M10	Z5296
13	Handle	Z5297
14	Leaf spring	Z5298
15	Oiler: 6	Z5299
16	Saddle, X-Y	Z5300
17	Friction pin	Z5301
18	Lock handle: M8 thread	Z5302
19	Stop/indicator block	Z5303
20	Screw: M5 x 12 skt hd	Z5304
21	X-axis leadscrew nut	Z5305
22	Washer: flat, M6	Z5306
23	Washer: lock, M6	Z5307
24	Screw: M6 x 20 skt hd	Z5308
25	Screw: M5 x 20 skt hd	Z5309
26	Screw: M6 x 40 skt hd	Z5310
27	Y-axis leadscrew nut	Z5311
28	Screw: M5 x 16 skt hd	Z5312
29	Y-axis cover stiffener	Z5313
30	Washer: flat, M5	Z5314
31	Screw: M6 x 16 skt hd	Z5315
32	Pin: taper, 6 x 25	Z5316
33	X-axis support flange: L	Z5317
34	Table	Z5318
35	Nut: square M6	Z5319
36	Screw: M6 x 12 skt hd	Z5320
37	Stop collar	Z5321
38	Table scale	Z5322
39	X-axis leadscrew	Z5323
40	X-axis support flange: R	Z5324

Ref	Description	Part
41	Screw: M5 x 8 skt hd	Z5325
42	Hose fitting (coolant)	Z5326
43	Z-axis pleated cover	Z5327
44	Support bracket	Z5328
45	Nut: M10	Z5329
46	Washer: lock, M10	Z5330
47	Washer: plain, M10	Z5331
48	T-bolt: M10 x 60	Z5332
49	Screw: M8 x 35	Z5333
50	Washer: lock, M 8	Z5334
51	Washer: plain, M 8	Z5335
52	Saddle, Z-axis	Z5336
53	Z-axis leadscrew	Z5337
54	Z-axis leadscrew nut	Z5338
55	Washer: plain, M 12	Z5339
56	Pin: taper, 6 x 35	Z5340
57	Washer: lock, M 12	Z5341
58	Screw: M12 x 60	Z5342
59	Column	Z5343
60	Column cap	Z5344
61	Screw: M5 x 8 skt hd	Z5345
62	Bevel gear A	Z5346
63	Screw: M6 x 8, set	Z5347
64	Pad	Z5348
65	Key: flat, 4 x 16	Z5349
66	Lifting gear shaft	Z5350
67	Locknut: M12	Z5351
68	Washer: plain, M 12	Z5352
69	Collar	Z5353
70	Graduated dial	Z5354
71	Bevel gear B	Z5355
72	Ball bearing: 51102	Z5356

73	Z leadscrew bracket	Z5357
74	Screw: M5 x 14	Z5358
75	Z-axis scale	Z5359
76	Washer	Z5360
77	Gib, Z-axis	Z5361
78	Tilt scale	Z5362
79	Lock handle: swivel, M8	Z5363
80	Chip Tray (Not Pictured)	Z7728

CHIP GUARD Fig 4



There may be detail differences between this representative drawing and the machine as supplied

Ref	Description	Part
1	Circlip	Z5364
2	Switch box	Z5365
3	Screw: M5 x 16 skt hd	Z5366
4	Screw: M4 x 8, set, spc'l	Z5367
5	D-shape shaft	Z5368
6	Shield	Z5369
7	Washer: flat, M4	Z5370
8	Screw: M4 x 14 skt hd	Z5371

Documents / Resources

	Precision Matthews PM-25MV Milling Machine [pdf] User Manual PM-25MV Milling Machine, PM-25MV, Milling Machine, Machine

References

- Precision Matthews Machinery Co. – Precision is our first name