

DAD PROS MILL



INSTALLATION MANUAL

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DRO KIT Preparation

Our example covers mounting a 2 axis Milling Machine Digital Readout kit on a SIEG X3 benchtop milling machine. While your particular installation is most likely not going to be on the same exact machine, the concepts and challenges remain mostly the same.

Please take the time to become familiar with the following sections. The life and longevity of your DRO kit may depend on it!

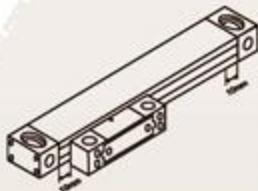
The "Blue Plastic Piece" (BPP)

Secured between the trolley and the scale body is a Blue Plastic Piece (BPP) which helps to protect the reader head during shipping. While the BPP should be removed after the installation is finished, it still remains useful during installation as it helps determine the correct offset, or distance, between the trolley and the scale body.

Note: To give the best protection, the scale should be mounted with the yellow rubber seals (lips) facing down. Note that this is not always possible. The scale performs equally well mounted in any direction. It's just that optimally, the best protection is afforded with the opening facing down, or away, from the cutting tool.

Required Travel

The travel length of the glass grating scale should be longer than the maximum travel of the machine. Optimally, there should be approximately 10mm clearance (approximately 1/2") between the ends of the glass scale and the maximum travel of the machine as shown in the following figure:

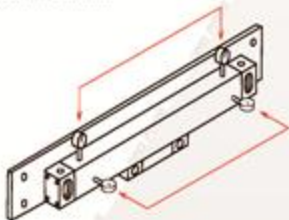


If deemed necessary, less than 10mm clearance can be considered acceptable. Special circumstances would include mounting the scale on the cross-slide of a lathe, where space is extremely limited and minimizing scale overall length is an important consideration. Technically, the minimum travel required is equal to the travel of your machine. How much 'extra' clearance you need is a subjective requirement the end user (you the customer) must determine individually.

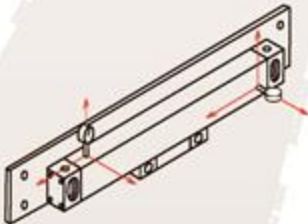
DRO KIT PREPARATION

Scale Alignment

It is very important that the scale body be aligned parallel to the travel of the machine slide. For scale travel less than 950mm, the maximum parallel error between the scale and the machine slide must be less than 0.15mm. For scales longer than 950mm, the maximum alignment parallelism error must be less than 0.1m.



If a dial indicator is used to align the scale, it is important to ensure that the angle between the dial indicator lever tip and the surface measured is less than 3 degrees to avoid a cosine measurement error. If a vertical dial indicator is used as per the following diagram, it is important to ensure that the dial indicator is perpendicular to the measured surface to avoid any error.



DRD KIT PREPARATION

Warnings and Cautions

The opening of the scale must not be installed as to be directly exposed to swarf, oil, water, dust or other foreign products. The provided protectant cover should be installed, space permitting.

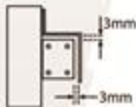


The scales should be installed on a flat, level, machined surface.

The best method for determining the proper mounting distance or clearance between the trolley and the scale body is to use the BPP. For those who insist on measuring, the clearance between the reader head and scale body must be kept between 0.8mm - 1.5mm.

In cases where machined flat surfaces are not available, an installation block or strip should be used to provide a flat datum for the installation.

There must be a clearance of at least 3.0mm between the scale and the scale cover.



All cables should be fixed, but still allow for the maximum amount of machine travel. If fitting the Z axis, the scale should be installed on the side of the column, ensuring that the open side of the scale is away from direct swarf and coolant. The bracket is typically mounted on the knee, and should wrap around the scale to allow for the cover to protect the scale.

DRO KIT PREPARATION

Parts and Pieces

The first thing we recommend is to get familiar with the scales. First, let's go over the parts of a scale. The main housing is referred to as the scale body. The reader or readhead is actually inside of the scale, and is self-guided by five ball bearings running along tracks inside the housing. The outside piece is the "trolley" and simply pushes and pulls the readhead along the length of the scale body. The "joint" between the trolley and the readhead is a metal arm which terminates at the readhead in a kind of ball-and-socket joint. The point is that the readhead is self-aligning, meaning that the outside trolley **does not need** to be in perfect parallel alignment with the scale body.

When looking at a scale for the first time, the first thing that catches most peoples eyes is the BPP between the trolley and the scale body. It is intended to keep the readhead from moving during shipping, but also serves as an excellent tool for determining the offset or distance the trolley should be mounted away from the scale body. At the end of the day, it will be in the trash, but for now, don't discard it.



Readhead

The first task will be to mark the scales in a way that would visually warn us if the readhead is nearing the extreme end of the scale. The arm between the trolley and the readhead is delicate, and if the scale is forcefully run into the end of the scale, it will break.



DRO KIT Preparation - Marking the Scale

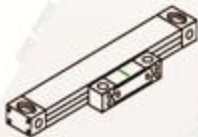
First, remove the two screws holding the blue plastic piece (BPP) to the scale body.



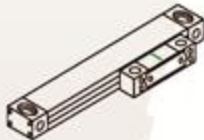
DRO KIT PREPARATION

Now run the trolley back and forth along the scale with the BPP still attached to the trolley. Notice the movement should be smooth and unrestricted.

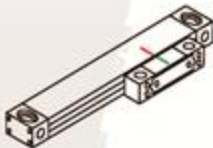
Next, make a mark on the trolley pointing towards the scale body. Exactly where is not important, but most folks choose to mark from the center of the trolley as we did.



Move the trolley to the extreme end of the scale until it 'bottoms out' or hits the end. Don't worry, as long as the readhead is not forcefully struck against the end of the scale, it will not be damaged.

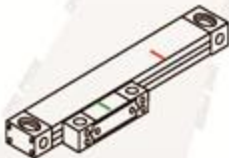


Now make a mark on the scale body opposite the mark on the trolley.

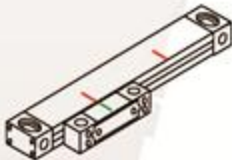


DRO KIT PREPARATION

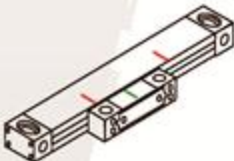
Next, move the trolley to other extreme end of the scale. Note the marks now 'split'.



Once the trolley is bottomed out against the opposite end, make another mark on the scale body opposite the mark on the trolley.



The point of this exercise is that you now have a visual backup of when the reader head would physically hit the end of the scale. After properly mounting your scales, the green mark should always stay between the red marks at all times.



DRO KIT PREPARATION

Mounting Hints

It is best to mount the scale body first. After choosing a flat surface, drill and tap the appropriate size holes. Bolt both ends of the scale into place, leaving one end just loose enough that it can be 'lapped' into parallel. Run a dial indicator along the top surface of the scale, making sure the scale does not rise or fall as the machine moves. **THIS IS IMPORTANT.** Make sure the scale is true **BEFORE** you mount the readhead/trolley assembly.

Next, mount the trolley. It is important to obtain just the right distance or spacing between the underside of the scale and the trolley. This is where the BPP comes in handy. If you mount the trolley such that the blue plastic piece is snug under the trolley, the spacing will be perfect. Note in the picture that the BPP is snug between the trolley and the body of the scale.



Inside the scale, this is what the readhead looks like when the scale is properly mounted. Note the underside of the readhead is not touching or 'bottoming out' on the inside of the scale body.



The following pictures illustrate an **IMPROPERLY** mounted scale where the trolley has been mounted too far away from the scale body. Note the gap between the BPP and the scale body.



BPP KIT PREPARATION

Now while we say the BPP needs to be snug, don't make it too tight. The clearances are great enough here that you really do not need to 'mic it out'. Mount the trolley with the BPP snug and all will be fine. In the photo to the right, you can clearly see the BPP is not even close to snug, it's simply laying there and would easily slide out if the scale were tilted to one end.



Inside the scale, the underside of the readhead is physically dragging along the length of the scale body. Physical failure of the scale will occur almost immediately as the readhead will be physically deformed as it drags the underside of the scale.



The point here, is that there is plenty of room built into the scale for movement and to not get too wrapped up with this. The only real catch here is to make sure the scale body is parallel to the machine's movement, and make sure to mount the trolley so that it doesn't run into the end of the scale.

Note also that most trolleys are a bit wider than the scale on one side, meaning that if you were to mount the scale against a perfectly flat surface, the trolley would be pushed out of alignment. Note in the picture how the trolley is wider on the left side of the scale than it is the right. If the scale were forcefully mounted against a flat surface on the left, the trolley would be forced out of alignment or pushed well to the right. Forcefully pushing the trolley out of position will decrease its' life expectancy greatly!



DRO KIT PREPARATION

Bracket Alignment

For some reason it is extremely common to try and align the brackets with the two large hexagonal openings on the side of the trolley. The brackets are designed, however, to align with the four lipped holes on the underside of the trolley, not the two hexagonal shaped holes on the side. Take a look at the following pictures:



DRO Kit Installation - Installing the Y Scale

Next, we take a look at installing a 2 axis DRO kit on a benchtop milling machine.



DRO KIT PREPARATION

While your particular mill may look altogether different, the basic concepts remain the same. The first step is to determine which scale to mount first, and where to mount it. Today, we've decided to mount the Y scale first as the X scale will pass over the top of the Y scale. Looking at the right side of our machine, we see that the gib adjusting screws and table lock mechanism would present a challenge to mounting a scale on the right side of the mill.



In contrast, the left side of the mill is relatively unobstructed, making it ideal for mounting the scale.



But while the area is relatively unobstructed, the side is not machined square. This will necessitate mounting a backer bar to provide a level surface for the scale to rest on.



INSTALLATION

To compensate for the sloped surface, we'll install a backer bar. On either end of the bar, top and bottom, are grub screws. These screw in or out, as needed, to level the bar.



Mark and drill the mounting holes for the backer bar.



Attach the backer bar using the supplied bolts.



INSTALLATION

Insert the grub screws on the backer bar.



With a dial indicator, ensure the backer bar is square and perpendicular to the machine slides.



Adjust the grub screws as needed until the backer bar is square and perpendicular to the machine slides.

The backer bar is now installed, level and parallel with the movement of the table.



INSTALLATION

Next, fasten the scale to the backer bar.



The scale is now installed!



Next, we'll ensure our scale is parallel with our work surface. First, make sure the mill table is brought all the way to the rear, install a dial indicator so that the indicator tip rests against the top of the scale.



INSTALLATION

Now move the table to the front of the machine.



If there is any movement of the dial indicator, loosen and adjust the scale end bolt as needed. Repeat until the scale is perfectly aligned.



Next, we need to mark the scales in a way that would visually warn us if the readhead is nearing the extreme end of the scale. If you have not done this already, here's how to do it:

Make a mark from the trolley to the scale body. Exactly where is not important, but most folks choose to mark from the center of the trolley as we did.



INSTALLATION

Next, move the trolley to the end of the scale.



Mark the end of the scale above the mark on the trolley.



Next, move the trolley to the other extreme end of the scale. Note how the marks now 'split'.



INSTALLATION

With the trolley touching the opposite end of the scale, make another mark on the scale body opposite the mark on the trolley.



The point of this exercise is that you now have a visual backup of when the trolley would physically hit the end of the scale. After properly mounting your scales, the green mark should always stay between the red marks at all times.



Now place the trolley bracket against the saddle where you intend to mount it.



INSTALLATION

Drill the mounting holes for the trolley bracket.



Next, fasten the bracket against the saddle.



The first trolley bracket is now installed!



INSTALLATION

Next, place the second trolley bracket in place:



Loosely fasten the two bracket bolts:



Insert the trolley bolts through the bracket, into the trolley carriage:



INSTALLATION

Tighten the trolley bolts. Make sure the trolley is not twisted as the bolts are tightened. Adjust the bracket as needed.



Now tighten the bracket bolts. Again, make sure the trolley is not twisted as the bolts are tightened. Adjust the bracket position as required.



All that remains now is to verify the scale runs true with the proper spacing.

Run the table to the back of the machine...



INSTALLATION

As you move the table to the rear, make sure to check the spacing of the BPP. It should be snug, but not overly tight, nor overly loose. Optimally, it should look like the illustration, with no gap between the scale body and the BPP.



At no point should the BPP bind or become loose. A misaligned scale will look like the photo.

Note the gap between the BPP and the scale body. It is imperative to keep the BPP snug along the full travel of the scale.



If the BPP indicates the scale is out of alignment, loosen the scale end bolt and adjust the scale as needed.



INSTALLATION

Next, run the trolley to the other end of the scale. Again, check the BPP alignment both during, and after, the trolley is moved. Loosen and adjust the scale end height as needed.



Congratulations, the scale is installed - now don't forget to remove the "blue plastic piece"!



Scale "Read Direction"

It makes no difference which way the scale initially reads. Scale 'read direction' can be easily changed in the parameters menu after installation. Mount the scale in the position / direction which makes the most sense. In most cases, mount the scale with the cable exiting to the rear of the machine, away from the cutter. Please keep in mind every installation is unique, so there is no one "correct way" to mount scales. Please make sure and reference the Customer installation photos at www.dmgpro.com on the "Installation" page.

Installing the X Scale

Next, we'll install the X axis scale. On the front of the mill, we find the gib adjustment screws and the table lock. Probably not the best choice for mounting a scale. Not to mention a scale is more likely to get banged up at the front of the table when changing vises, moving parts onto the mill, etc.



The back of our mill looks much more accomodating. Plenty of space, and aside from the coolant hole on the right side of the table, definitely our primary choice for mounting our X axis scale.



Initially, we'll just set our scale in place to determine the positioning of the mounting holes. Note the trolley and scale has already been marked to warn of the reader head approaching the end of its' travel limit.



Due to the flat, machined surface, we will not need to use a backer bar. Additionally, the scale will mount to the table, and the trolley to the saddle. This mounting arrangement is opposite of the Y axis scale, where the trolley is mounted to the table, and the scale body is mounted to the base of the machine.

INSTALLATION

Our first step is to drill and tap mounting holes for the scale.



Next, mount the scale to the table. Snug, but do not tighten, the bolts.



It is important to ensure the scale is mounted parallel to the table travel. With the table moved all the way to the stop in one direction, mount a dial indicator to rest against the top of the scale body.



Run the table to the other end of it's travel. Zero out any dial indicator reading by gently "tapping" the scale into alignment. Repeat as necessary to get the scale "true".



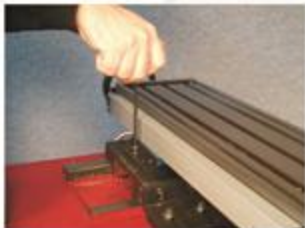
For mounting the trolley we chose to use a 90 degree stock of 1/8" aluminum angle.



After marking the holes, drill and tap. A right angle drill makes this task much, much, easier as the mounting holes are almost always directly underneath the quill.



Install the bolts securing the bracket to the saddle. Make sure the bracket remains flush against the side of the trolley and doesn't "pull away". Adjust as necessary.



Next, install the bolts securing the bracket to the trolley. Make sure the trolley is not "pulled" sideways during this step.



After the trolley bracket has been installed, run the table to either extreme end of its' travels. Make sure the BPP remains snug, but not overly tight, between the trolley and the scale body at all times. Adjust as necessary.



Next, run the table to the other extreme end of its' travel. Again, make sure the BPP remains snug the entire distance. Adjust as necessary.



Once you're satisfied the spacing between the trolley and the scale body is correct, don't forget to remove the BPP!



Position the scale cover over the top of the scale. Make sure a minimum gap of at least 3mm exists between the scale and the cover. Make sure the top "lip" of the cover does not protrude above the top of the table. Mark the appropriate mounting holes.



Drill and tap the holes for the scale cover.



Fasten the scale cover to the back of the mill table with the hex bolts provided.



Congratulations! The scales are now installed!



