

Equipois Inc.
zeroG² Arm
Set-up Manual
Revision D

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Safety Icon



Warning: Risk of personal injury.

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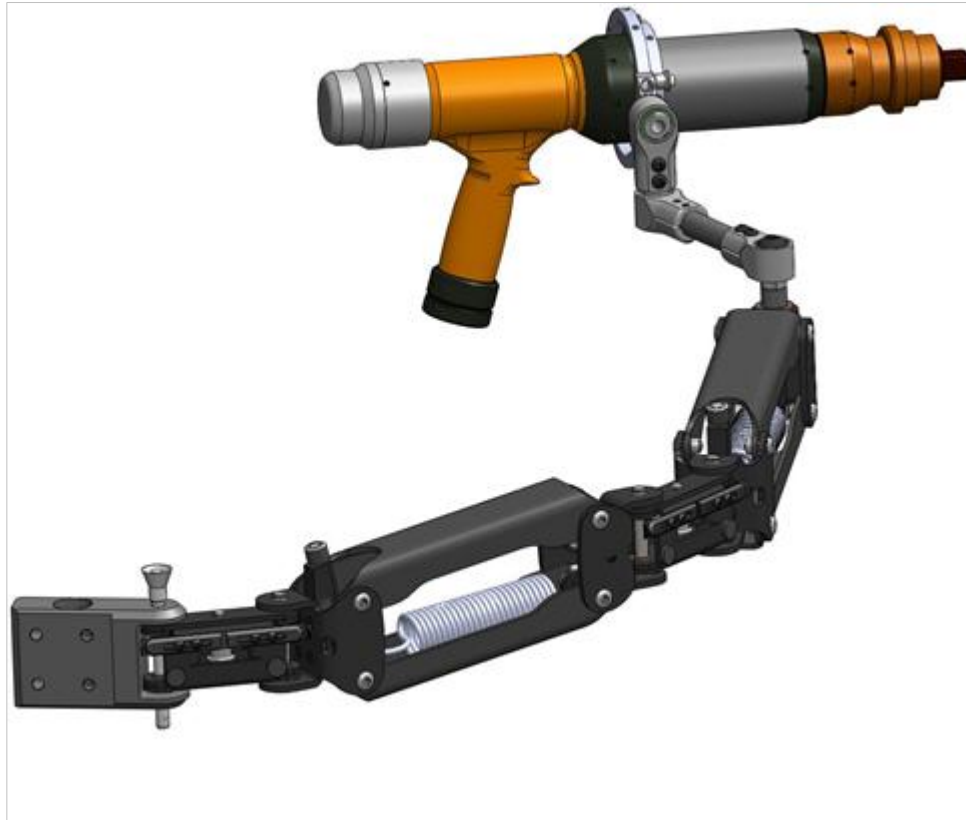
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Glossary

Italicized terms in the definitions have their own glossary entries.

clevis pin—The quick-release pin that attached the shoulder hinge block to the mounting interface block.

cord—See *tensioner*.

centering—The movement of the arm to a horizontal rest position when the tool is released.

dock—A mechanism for fastening the zeroG[®] arm in a folded, out-of-the-way position.

end block—One of several pieces that connect the upper and lower assemblies of a *link* and contain the sockets for connecting the link variously to the hinge block, *mounting interface block*, or the *gimbal post*.

gimbal—The mechanism that holds the tool* while allowing it to rotate freely. The gimbaling mechanism includes the *yoke* and is attached to the arm, often by a *post*.

hinge block—See *link*.

hinge stop—An optional attachment to the *hinge block* that limits the angle between the *link* and the hinge block.

iso-elasticity—The zeroG arm's property of requiring virtually the same force to move the *tool** up and down over the vertical range of motion. As iso-elasticity is decreased, the range of iso-elastic motion becomes narrower, and the force required to move the tool increases more quickly as it is moved toward the top and bottom of the range.

lift—The upward force with which the arm supports the *payload*.

link—A segment of the arm. The arm's links are termed the distal (or forearm) link and the proximal

(or upper arm) link. The shoulder hinge block connects the proximal link to the *mounting interface block*, and the elbow hinge block connects the distal link to the proximal link. Installations that require minimal vertical range use one dynamic link and one static link, which has no spring and adjusters.

mounting interface block—The connector that is fastened to the *mounting system* and includes the socket to which the shoulder *hinge block* of the zeroG arm is attached.

mounting system—The structure that supports or transports the arm within range of the *work*.

payload—The assembly supported by the arm, including the tool* *-gimbal-post* assembly, air-hose, power cord, etc.

post—An extension to the *yoke's* tail that is inserted into the arm socket.

tensioner—Any tensile member, such as a bungee cord (or shock cord), that pulls a hinge back to a preset position.

top-mounted—Refers to a method of mounting the tool* on the arm so the tool is above the arm; with the tool mounted by inserting the post into the arm socket from the top.

underslung—Refers to a method of mounting the tool* on the arm so the tool is below the arm; with the tool mounted by inserting the post into the arm socket from the bottom.

work—The point or area where the tool* is applied or employed.

work envelope—The vertical and lateral ranges within which the tool* contacts the *work*.

yoke—A U- or L-shaped bracket that allows the tool* to rotate; it is the innermost part of the *gimbal-ing* mechanism. The *gimbal-post* assembly varies with the tool* and work situation.

Getting started

In this chapter, you assemble the tools, material, and information you need to install the *zeroG*® arm, and do the analysis and make the decisions required for the setup.

Unpacking

1. Open the factory shipping carton and take out the bill of materials.
2. Ensure that you have the details of your *zeroG* arm's customization. These affect the installation of the gimbal-and-post assembly that holds the tool* and attaches it to the arm. They should be in either:
 - _ The original Equipois application summary that was provided with your proposal or any assembly drawings included with your system. Contact Equipois or your authorized representative if you are unable to find any documentation related to your specific customizations.
 - _ Or the packing list in the shipping box.
3. Inventory the contents of the shipping carton against the packing list.
4. If the contents do not match the packing list, report the discrepancy to Equipois.
5. Check the customization documentation and the contents of the shipping carton for these items. If you have them, they have to be installed during the initial setup.
 - _ a docking kit
 - _ arm centering kit
 - _ combination cord/docking anchor (“combo anchor”)

Verify the mounting system

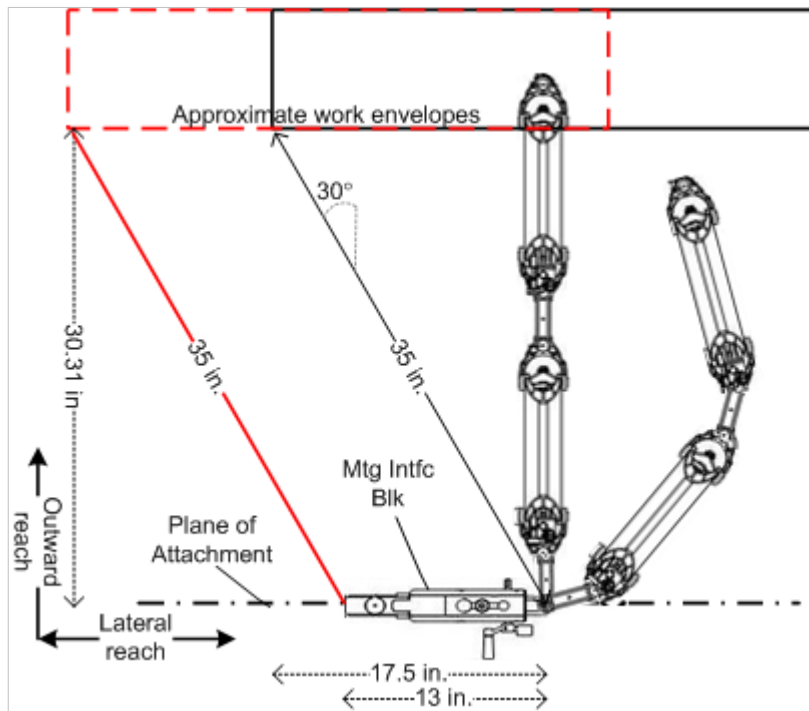


Figure 1 Outward and lateral reach

The mounting system must anchor the *zeroG* arm so the tool floats in the work envelope, which is the vertical and lateral range within which the tool contacts the work. If the work envelope requires the operator to move laterally beyond the reach of his arm, the mounting interface block can be placed on a moveable support, such as a sliding rail, crane arm, or cart. The mounting point, where the mounting interface block is attached to the mounting system, can be above or below the level of the work area.

To ensure that the mounting system will let you place the mounting interface block so the tool naturally floats in the work envelope:

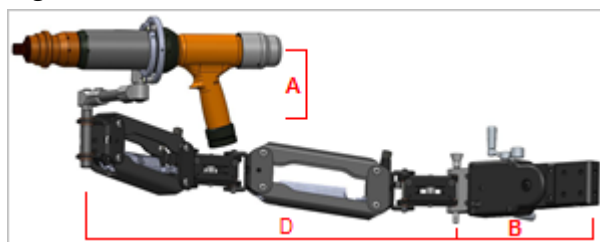


Figure 2 Spans A, B, and D

1. Measure the vertical reach of the post and gimbal (span A, Figure 2). _____
2. Note any additional vertical reach contributed by the tool during operation. _____
3. Add 1 and 2 for the total vertical reach. _____
4. Measure the distance from the mounting point to the work area perpendicular to the plane of attachment (see Figure 1). _____
5. Measure the horizontal offset from the mounting point provided by the mounting interface block and other mounting apparatus (span B, Figure 2 and Figure 4). _____ As Figure 1 shows, this doesn't affect the outward reach much if it is less than 15 in., but a shorter offset can be significant if the work envelope is fairly wide, in which case you may need a moveable mounting system.
6. Note the horizontal reach of the tool, gimbal, and post assembly (span C, Figure 3). _____
7. Now, verify that the proposed mounting point satisfies these criteria:

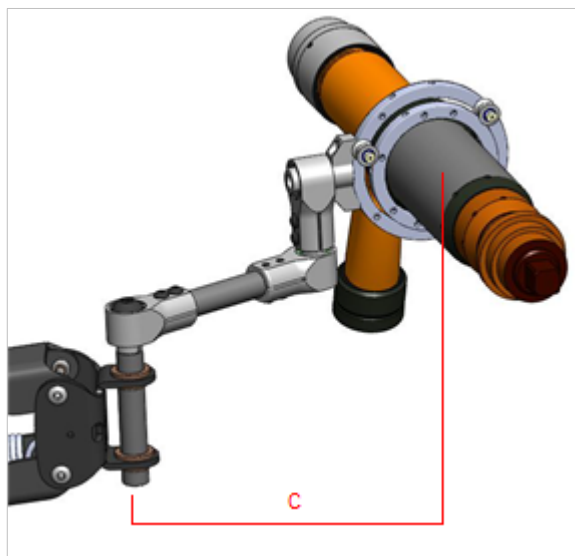


Figure 3 Span C

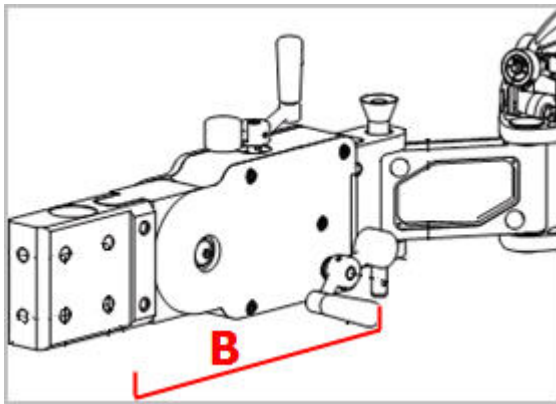


Figure 4 Span B

- The horizontal distance from the mounting point to the extremes of the work envelope is within the reach of the arm: 29 in. arm (span D) + the horizontal reach of the tool, gimbal, and post (span C) + the horizontal offset of the mounting assembly (span B).
- The vertical distance from the mounting point to the center of the work envelope is about the total vertical reach you noted above.

8. Inspect the mounting system to determine how the mounting interface block will be attached. There are three types of mounting interface blocks. As shown in Figure 5, each is bored for:
 - A. Side mounting with 4 holes set in a square 1½ inches on a side, sized for 5/16 in.-18 bolts; this is preferred.
 - B. Post mounting on a 1/8 inch post.
 - C. End mounting with holes set vertically 1½ inches apart, sized for 5/16 in.-18 bolts.
9. Make sure you have the tools and fasteners for attaching the mounting interface block to its support.
10. You will need these Allen wrenches:
 - 3/32 -inch for the hinge stops and the cord cinches
 - 3/16 -inch for adjusting the two-piece collar
 - 1/4 -inch for attaching the combo anchor

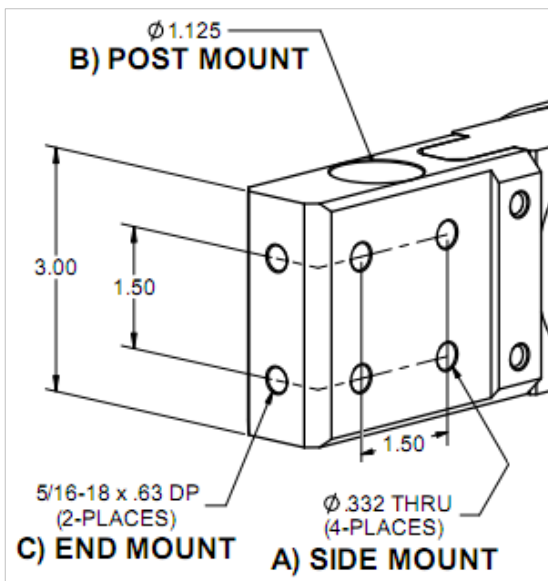


Figure 5 Mounting interface block borings

11. The arm is designed to bend slightly at the shoulder and elbow to accommodate the operator’s arm—right-handed unless you ordered left-handed or no-handed.
 - a. Check the packing list to determine the handedness of the arm.
 - b. If you will be switching the arm’s handedness from right to left or vice-versa, or removing the bungee cords, go to the “Bungee adjustments”, Page 19 to see what tools you will need.

Attach the zeroG arm to the mounting system

Attaching the mounting interface block

In the previous section, you verified that your mounting system is ready. In this section you attach the mounting interface block to the mounting system.

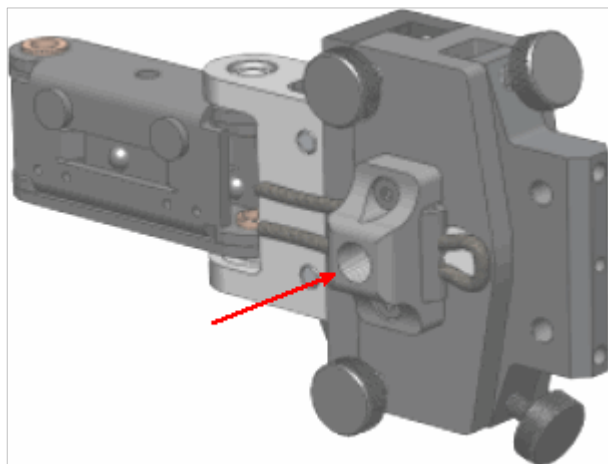


Figure 6 Combo anchor on preset mounting interface block

If your customization includes bungee-cord arm centering or a docking kit (you checked on page 7), you have to fasten the combo anchor to the side of the mounting interface block. It is bored and threaded to receive a docking device, and it is the anchor for the bungee cord that controls the horizontal positioning of the shoulder hinge.

1. If you have a combo anchor:
 - a. Place it on the side of the mounting interface block that faces the operator, with the recessed slot facing away from the arm.
 - b. Use a ¼-inch Allen wrench to tighten the bolts.
2. Attach the mounting interface block to the support.
3. If you have a docking kit, follow its installation instructions.

Safety notes

The zeroG arm is made to flex effortlessly and follow you as you work, and it uses very strong springs to support the payload. Because the arm can move very fast and powerfully on its own, you must take care to keep it under control.



PINCH POINTS

- Keep fingers, clothing, tools, work pieces, and other items away from the labeled pinch points on the zeroG arm.
- During operation, use the tool’s grips and avoid touching the arm, except the adjustment cranks of the dynamic mounting interface block.
- When the arm is not docked, handle it only by the end blocks and the adjustment knobs.
- Use of protective covers is recommended.

DOCKING & POSITIONING

Dock the zeroG arm in a horizontal position when it is not in use. Do not leave the zeroG arm free or floating where it can easily swing or move.

UNDOCKING AN UNLOADED ZEROG ARM

An unloaded zeroG arm RISES FORCEFULLY and can injure users if it is released suddenly from its docked position. Never undock a zeroG arm unless the payload is loaded or the spring tension is balanced by restraints or a counter weight.

PAYLOAD REMOVAL

Mount or dismount the payload only if the zeroG arm is fully extended or is securely docked.

Attaching the arm to the mounting interface block

1. Before handling the arm, reread the safety notes above.
2. Read through this section.
3. Unpack the arm:
 - c. Remove the arm from the shipping case.
 - d. Lay it on a table or the floor and hold it down.
 - e. Loosen the wire restraint and carefully let the arm extend.
4. If necessary, reposition the elastic cords, as described in the “**Error! Reference source not found.**” chapter **Error! Bookmark not defined.**

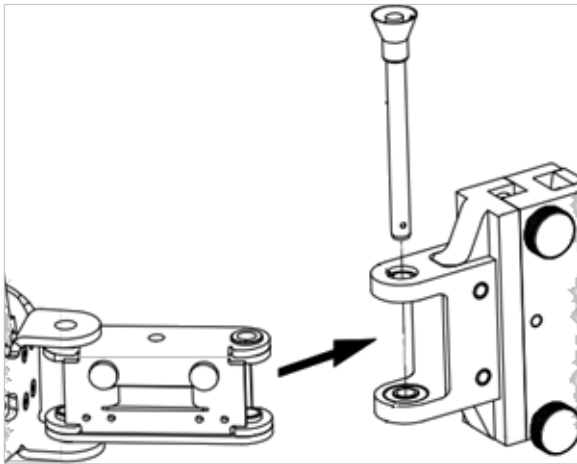


Figure 7 Pinning the hinge block and the mounting interface block

5. Mount the arm.
 - a. Avoiding pinch points and keeping your fingers and clothing from slipping inside the links:
 - Either pick up the arm with your left hand
 - Or cradle the arm in your left arm
 - b. Align the sockets on the shoulder hinge block and the mounting interface block, as in Figure 6.
 - c. Insert the quick-release clevis pin through the sockets, as in see Figure 7.

Mounting the payload

Before you begin:

- You need a $\frac{3}{16}$ -inch Allen wrench for adjusting the two-piece collar.
- If you are mounting the payload on an extended arm, you may need an assistant, especially if it is an underslung mount.

1. Attach the tool to the gimbal.

The instructions for mating the tool and the gimbal are specific to the tool and gimbal and are in either the packing list, the application summary, or the assembly drawing for your system.
2. Extend the arm or dock it securely.
3. Mount the payload—the tool-gimbal-post assembly—on the arm:
 - a. Loosen the two-piece collar with the Allen wrench.
 - b. If this is a top-mount, position the collar for the desired height and tighten it.
 - c. If this is an underslung mount, remove the collar.
 - d. Insert the gimbal post into the socket at the end of the arm.
 - e. If this is an underslung mount, have an assistant help you position and tighten the collar.
4. Tie off cables and hoses with zip ties at the gimbal post and the elbow hinge.

Adjusting the lift

Lift is the force that the links of the arm exert to resist the pull of gravity on the tool. The goal in this section is to adjust the lift so the tool floats in the work area when the operator releases it. The zeroG² arm comes in one of three standard types, each optimized to exhibit a particular vertical behavior when the arm is released. The configuration of your arm is in the bill of materials.

The zeroG² arm typically consists of two adjustable, dynamic links:

- The distal link is the forearm, the link that holds the tool.
- The proximal link is the upper arm.

The proximal link can be a static link. It provides horizontal reach but cannot be swung up and down, and it is not adjustable. The static link can also be a third link added to two dynamic links, when the extra horizontal reach is needed.

The three types of arm are:

normal—When released, the proximal link returns to the preset rest position. The arm offers very little resistance to vertical motion. The distal link is [typically] a normal type.

floating—When released, the proximal link rises. The arm offers virtually no resistance to vertical motion.

positioning—When released, the proximal link maintains its vertical position. There is a slight drag as the operator begins to move it up or down.

The usual adjustment is to have the lift just sufficient to produce the appropriate behavior. Some operators prefer to use a greater lift, to help with a high average working height or to assist in keeping the tool engaged with the work, for example, to push a drive-tool upward on a nut or to press a grinder against a surface.

To adjust the lift of the arm:

1. With the payload in place, extend the arm.
2. Move the payload so that the spring of the distal link is perpendicular to the adjusting mechanism. The link should be slanting at about 10° above level and the Lift knob should turn easily. See Figure 8.
3. Turn the Lift knob until the link balances at the 10° slant:
 - a. Turn the knob clockwise to increase lift, if you lifted the payload.
 - b. Turn the knob counterclockwise to decrease lift, if you pulled the payload down.
4. Adjust the proximal link:
 - a. If you have a normal arm, adjust the lift so the link balances at a near-horizontal rest position (0°-10° slant).
 - b. If you have a floating arm, adjust the lift so the link rises when it is released.
 - c. If you have a positioning arm, adjust the lift so the link balances at a near-horizontal rest position (0°-10° slant).

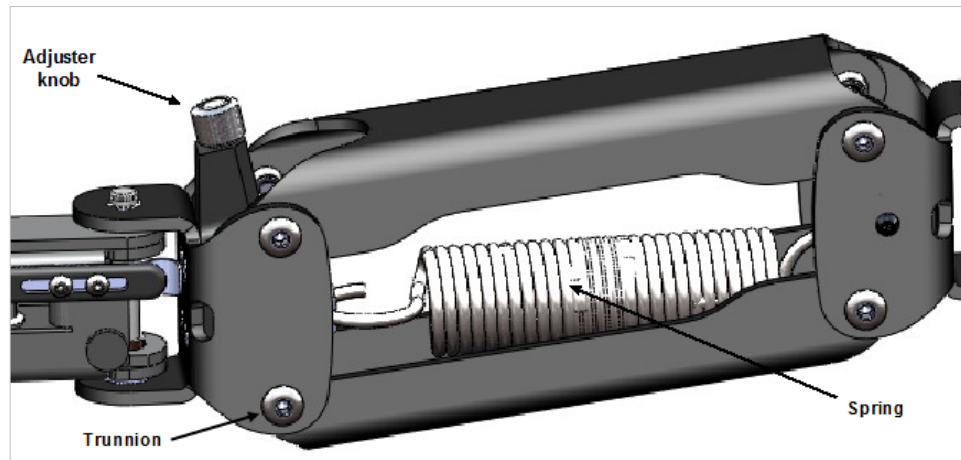


Figure 8 Lift-adjusting knob and the distal link in position for adjusting lift

5. Make some tests of the proximal link's adjustment by moving it up and down and releasing it in raised or lowered positions:
 - If you have a normal arm, it should return to the near horizontal rest position.
 - If you have a floating arm, the proximal link should rise to the full or nearly full up position.
 - If you have a positioning arm, it should stay where you released it.
 - a. You can further test the adjustment of a positioning arm by giving the elbow hinge block a little shake. The link should rise or fall to the rest position.

Note: As you perform the next step, a link may lock in the full up or down position. This can happen when the link is adjusted for a heavy payload.

6. When the links are adjusted, carefully move the tool up and down to the full extent of its range. The links should track smoothly as you move the tool up and down.
 - a. If the distal link—or on a normal arm, either link—locks in an up or down position, reduce or increase the lift.

Adjust the horizontal configuration

The zeroG² arm is designed to move almost effortlessly, so it is very sensitive to gravity. The horizontal configuration controls how the arm moves both when the operator moves the tool from side to side and when it is released. The zeroG² arm is configured by elastic tensioners (usually bungee cords), hinge stops, and the mounting interface block. Table 1 summarizes how they configure the arm:

Table 1 Horizontal configuration

Configuration element	Effective components
centering*	mounting interface block
configuration for right- and left-handed operators	cords, hinge stops
angle between the links	cords, hinge stops
response of arm to horizontal movement	cords, hinge stops

*centering = the arm's movement to a horizontal rest position, when it is released

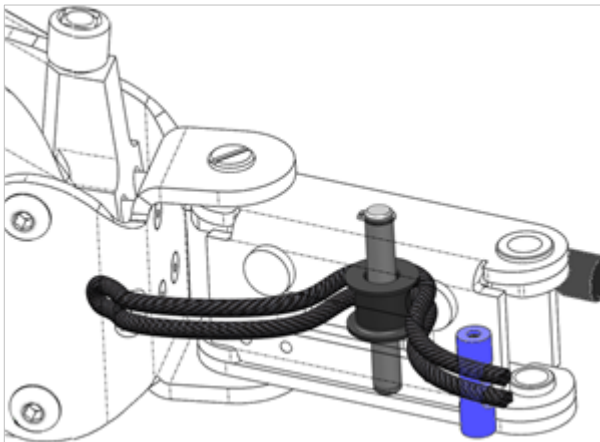


Figure 9 Shoulder bungee as delivered

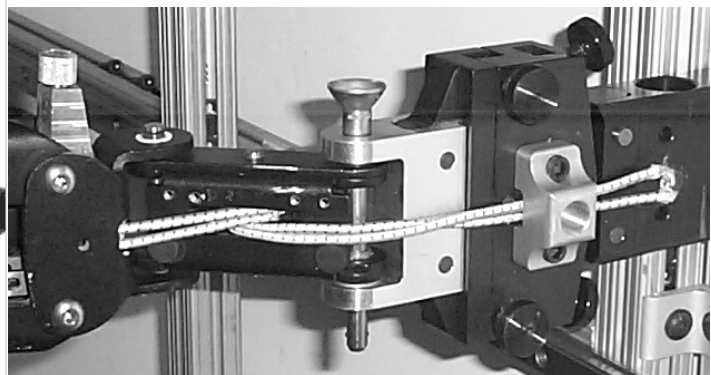


Figure 10 Shoulder bungee in combo anchor

Adjust the bungees

1. Adjust the lift of both links so they are approximately horizontal. This is optional but convenient.
2. Attach the bungee cord on the shoulder hinge block to the combo anchor:
 - a. Use a $\frac{3}{32}$ -inch Allen wrench to loosen the set screws in the ends of the cord cinch (see Figure 10).
 - b. Remove the cinch.
 - c. Insert the cords through the slot in the combo anchor.
 - d. Insert the cords through the cinch and partially tighten the set screws so the cinch does not slip freely but the cord can still be pulled through it.

- e. Slide the cinch down to the anchor and adjust its position on the cords until it holds the cords at the desired tension. See Figure 9, which also shows an alternative way to reeve the cord around the pulley in the hinge block.
3. If the angles of the links at the elbow need to be adjusted:
 - a. Pull the loose ends of the cord out of the end block to expose the cord cinch.
 - b. Use the $\frac{3}{32}$ -inch Allen wrench to loosen the set screws in the ends of the cinch until it can slide along the cord but is not loose.
 - c. Slide the cinch along the cord to adjust the tension on the cord.
 - d. Replace the cinch inside the end block.
4. Move the arm in and out, allow it to assume its rest position; repeat several times and observe two things:
 - The angles at the elbow and shoulder in the rest position
 - The resistance of the joints to opening and the strengths of their tendencies to resume the rest position
5. Adjust the tensions:
 - Increasing the tension closes the angles at the elbow and shoulder hinges when the arm is at rest and tightens the action of the joint
 - Decreasing the tension opens the rest angles and reduces the resistance to movement

If the adjustments that you want require contrary movements of the cinches, for example, you want to both reduce the resistance and sharpen the rest angles, see “Bungee adjustments” on page 19.
6. Snugly tighten the set screws of the cord cinches.

Adjust the hinge stops

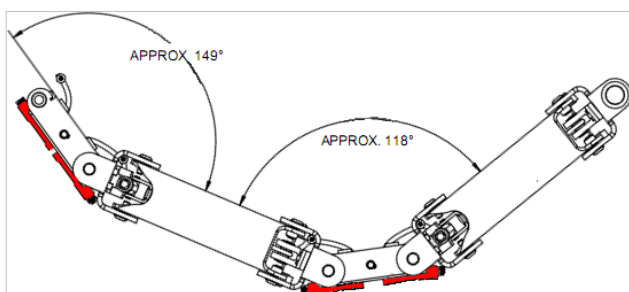


Figure 12 Hinge stops at maximum effect

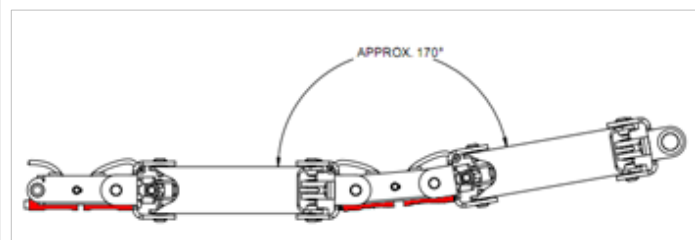


Figure 11 Hinge stops at minimum effect

The four hinge stops control how far you can straighten the arm (180°). They can be adjusted or removed individually. Figure 12 and Figure 11 show the extent of the adjustments possible by sliding the stops in and out.

Use a $\frac{3}{32}$ -inch Allen wrench on the set screws.

Adjust the mounting interface block

The mounting interface block affects centering:

- If the bracket pitches down, the arm settles toward the center.
- If the bracket pitches up, the arm falls off to either side.
- Rolling the bracket to one side moves the rest position to that side.

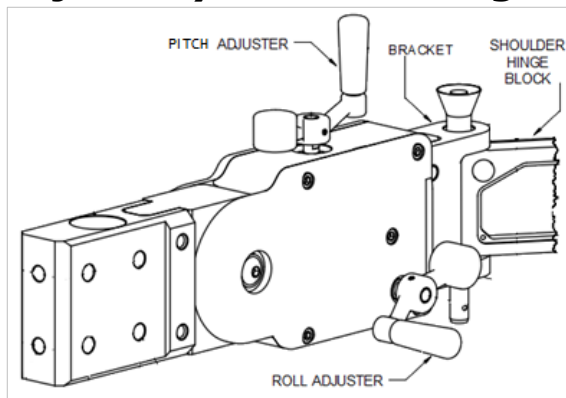
There are three types of mounting interface block. Two types are adjustable. You can adjust the mounting interface block so the arm comes to rest centered or only as far as you want it to the side.

- Two of the three types of mounting interface blocks are adjustable. The static block is not adjustable.
- *Pitch* adjustment moves the bracket—where the arm attaches—up and down, in a head-nodding motion.
- *Roll* adjustment rotates the bracket.

The dynamic and preset mounting interface blocks have different adjustment mechanisms, as described below, but the process of adjustment is the same. Repeat these steps until the rest position is centered.

1. Hold the arm pointed toward the work area and without letting go completely, let it move freely.
2. If the arm drifts consistently to one side, adjust the pitch down and the roll away from the direction of drift.
3. If the arm drifts to either side, adjust the pitch down.

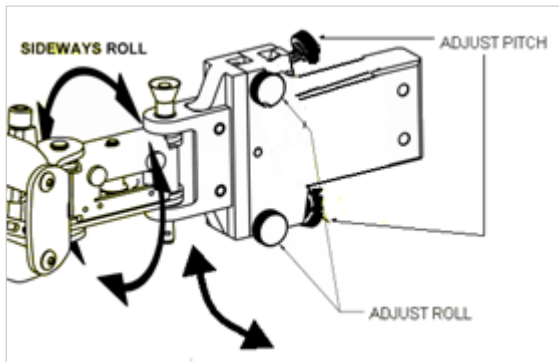
Adjust a dynamic mounting interface block



- Adjust roll by turning the crank on the side of the mounting interface block. Cranking clockwise rolls the bracket counterclockwise.
- Adjust pitch by turning the crank on the top of the mounting interface block. Cranking clockwise pitches the bracket down.

Adjust a preset mounting interface block

Adjustments are made with pairs of set screws, as shown.



- Adjust roll with the knobs on the side. Back off one screw to create slack in the direction you want to move the block and tighten the other screw to move the bracket.
- Adjust pitch with the knobs on the back. You can unload the bottom screw by lifting the arm. Back off one screw to create slack in the direction you want to move the block and tighten the other screw to move the bracket.
- When you are done, make sure both screws in each pair are tightened snugly.

Installing accessories

1. Install optional accessories, such as custom docking systems and protective covers. These are shipped with their own installation instructions.

Note: Most arms are shipped with disposable covers. Covers protect the arm from dirt and shield pinch points, but they also keep operators from easily adjusting the arm's settings. Contact Equipois for more information about covers.

Bungee adjustments

The bungee cords affect the angles that the links make when the arm is at rest and the behavior of the arm as it is moved in and out and side to side.

Use this chapter for these tasks:

- Removing a bungee
- Installing a bungee
- Moving the bungees to convert from right-hand-to-left-hand or left-hand-to-right-hand configuration

Adjusting the tension of the bungee: Basic instructions for adjusting the tension of the bungee when it is installed are in “Adjust the bungees

- Adjust the bungees” on page 15. Table 2 give more details about how to get more sophisticated results.

Table 2 Effects of bungee adjustments

Action	Effect	Consequence
Tighten the cord.	Increase tension. Reduce available stretch.	Stiffen the joint: resistance increases more rapidly with displacement. Decrease angles at hinge block.
Use a doubled cord (standard) vs. single length.	Increase tension.	Stiffen the joint: increase resistance to displacement. Increase tendency to return to rest position
Loop cord completely around hinge block pulley, rather than just running the cord behind the pulley (see See Figure 10).	Lengthen cord. Increase available stretch.	Loosen the joint by extending the range of motion and reducing the force needed to straighten the hinge
Remove cord.	Remove tension	Remove damping of horizontal oscillations; randomize rest
Remove hinge stops.	Allow joint to open beyond 180°.	Allow arm to fold and push elbow hinge block at operator.

Remove bungee

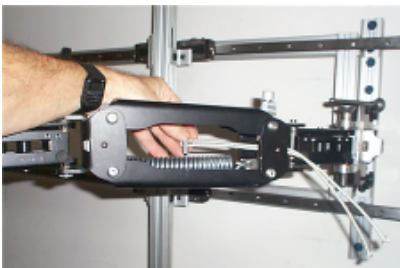
1. Pull loose ends of cord to expose cord cinch.
2. Use a $\frac{3}{32}$ -inch Allen wrench to loosen the set screws in the ends of the cinch.
3. Slide off the cinch.
4. Pull the cord out of the hinge block pulley.
5. Pull the link to the horizontal.
6. Push the cord back through the hole in the end block until you can grab the cinch.
7. Pull the cord out of the link.


Install bungee

You need:

- At least 16 inches of $\frac{3}{32}$ -inch bungee cord for each joint
- 2 cord cinches
- A $\frac{3}{32}$ -inch Allen wrench

1. Stand on the side of the arm where the operator will stand.
2. Use the $\frac{3}{32}$ -inch Allen wrench to loosen the set screws in the ends of the cinch.
3. Put the cinch on the cord.
4. If you are using a doubled cord, which is standard, adjust the cord so the cinch is in the middle.



5. Tighten the set screws.
6. Pull the outer link to the horizontal or adjust the lift so link remains horizontal.
7. Reach across the link and insert the free ends of the cord from the back over the spring and through the near hole in the end block. 
8. Pull the cinch snug against the inside of the end block.
9. Reeve the cord through the hinge block pulley.
10. Insert the ends through the hole in the opposite end block or the combo anchor.
11. Insert ends of the cord through the cinch.
12. Tighten the set screws until they hold the cord but still allow it to slide.
13. Slide the cinch down the cord and adjust its position until it holds the cords at the desired tension.
14. Tighten the set screws.
15. If necessary, move the hinge stops to the other side of the hinge blocks. See "Adjust the hinge stops" on page 16.

Appendices

zeroG² arm Maintenance and Upkeep Recommended Maintenance & Spare Parts

Customer Maintenance Items	Frequency	Parts or Maintenance Required
<p>Springs:</p> <ul style="list-style-type: none"> • Clean using clean dry compressed air after each use if possible. • DO NOT use alcohol, WD-40 or other chemical based solvents to clean the spring or any other parts • Check each spring for any dents, nicks or deformation. Make sure paint still covers entire spring – no metal <i>rust</i> showing. If there are any type of identifiable defects, CONTACT EQUIPOIS. • See ‘Payload Testing’ if degradation of performance is noted. 	Monthly	<ul style="list-style-type: none"> • Replace complete link via link exchange program if needed*
<p>Adjuster Mechanism (internal to each link):</p> <ul style="list-style-type: none"> • Clean using clean dry compressed air after each use if possible. • Make sure that mechanism is able to travel the full length of the <i>bearing shaft</i>. 	Monthly	
<p>End Block:</p> <ul style="list-style-type: none"> • Is the Delrin tool interface sleeve in place? • Are there cracks or deformation? If yes, contact Equipois. 	Monthly	<ul style="list-style-type: none"> • Kit, Tool Interface Sleeve with Clip P/N 102-6281*
<p>Covers:</p> <ul style="list-style-type: none"> • Check to make sure cover has no tears or rips and is securely fastened to the arm. Replace as needed. 	Monthly	<ul style="list-style-type: none"> • Polyco Disposable Cover P/N 300-2100* • Silicone permanent cover P/N 300-2200*
<p>Docking:</p> <ul style="list-style-type: none"> • Equipois strongly recommends the use of additional ‘hook’ docks or other mechanisms to secure the arm especially if covers are in use. 	Monthly	
<p>Arm Extrusions:</p> <ul style="list-style-type: none"> • Adjust lift knobs to zero load • Does arm function normally with no lift – are there any hitches or rough spots in the movement? • Does each arm segment move freely without binding? If not, contact Equipois. • Apply Extreme Pressure Grease to <i>bearing shaft</i>. 	Quarterly or Semi-Annually	<ul style="list-style-type: none"> • Extreme Pressure Grease – P/N 900-7005-GR*

<p>Lift knob inspection:</p> <ul style="list-style-type: none"> • Does <u>spring termination hook</u> work <u>with bearing shaft</u>? • Clean shaft thoroughly • Re-grease shaft 	<p>Quarterly or Semi-Annually</p>	<ul style="list-style-type: none"> • Apply grease to adjuster – Use Extreme Pressure Grease – P/N 900-7005-GR*
<p>Shoulder and Elbow Hinges:</p> <ul style="list-style-type: none"> • Hinges between links should be able to fully rotate on each bearing • Look for any play between where each hinge and block surface mates with the other • Inspect internal hinge roller assembly: delrin roller, roller shaft & retaining rings • Inspect to make sure bumper pads on sides of each hinge are in place. If not, replace. 	<p>Quarterly or Semi-Annually</p>	<ul style="list-style-type: none"> • Parts are included in Kit, Complete Maintenance Pack, zeroG2 – P/N 102-5910* • Contact Equipois if Hinge Roller Assembly Kit is needed
<p>Internal Bumpers (two per link):</p> <ul style="list-style-type: none"> • Check the connection. Are they loose in any way? Tighten if loose. 	<p>Quarterly or Semi-Annually</p>	
<p>Tensioning Bungee Cords (at shoulder and elbow):</p> <ul style="list-style-type: none"> • Check to see if bungee cord is still providing force • If not, replace with appropriate replacement kit. • Check hinge stops and bumpers at elbow & shoulder hinges: screws & lock washers in place and tight? 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • Kit, Centering Cord with Cinch P/N 102-6250-02* • Kit, Centering Cord Complete (includes hinge stops and bumpers) P/N 102-6250-01*
<p>Labels and Indications:</p> <ul style="list-style-type: none"> • Are any labels peeling or torn off. Replace as needed. • Check for pinch point labels and stickers for Lift and Rate knobs. 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • Contact Equipois for safety label replacements.
<p>Perform payload testing:</p> <ul style="list-style-type: none"> • Set-up testing post set-up and apply 10 lbs of weight – utilize barbells or whatever form of weights are available to get an accurate payload test. • Looks that arm can still lift payload with about 2-5 lbs of play +/-. • If there any concerns about spring payload performance, please contact Equipois. 	<p>Annual</p>	<ul style="list-style-type: none"> • Contact Equipois for Payload Test Post Kit

Interface Mounting Blocks

Customer Maintenance Items	Frequency	Parts or Maintenance Required
<p>Overall mounting block:</p> <ul style="list-style-type: none"> • Clean using clean dry compressed air after each use if possible, especially near exposed bearings on dynamic and pre-set mounts • DO NOT use alcohol, WD-40 or other chemical based solvents to clean any components or parts. 	<p>Monthly</p>	
<p>Connection to existing structure:</p> <ul style="list-style-type: none"> • Check to make sure that all bolts are secure and properly tightened. • Look to make sure that mounting block connection is still level and shows no signs of deformation. 	<p>Monthly</p>	<ul style="list-style-type: none"> • Kit, Replacement 80/20 Bolts & Nuts – P/N 500-4164*
<p>Arm Connection to mounting block:</p> <ul style="list-style-type: none"> • Is hinge able to slide in securely to female location on mounting block? • Check to make sure there are no gaps or wiggle between the male hinge and the female location on mounting block. • Make sure quick release pin can slide in and out of block and hinge. • Check to make sure KP bearings (or bushings if positioning arm) are seated correctly. • Replace KP bearings (or bushings) if needed. Consult Equipois for instructions on replacement. 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • Quick Release Pin P/N 900-9031-QP* • Kit, Spare Bearings (Fully Dynamic Style) P/N 500-4265* • Kit, Spare Bearings (Positioning Style) P/N 500-4266*
<p>Leveling knobs or handles:</p> <ul style="list-style-type: none"> • Make sure all knobs (Pre-Set) or adjustment handles (Dynamic) are present and securely fastened. • For Pre-Set mount, check that each striker plate (stop plate for each screw) is in place. Striker plates can be found on the inside surface of each block. Replace as needed. • Check that adjustment handles have clearance to turn freely. If not, it may be necessary to re-set their location. Allow for approximately 0.132 inches from surface to handle minimum. 	<p>Quarterly or Semi-Annual</p>	<p>Pre-Set 2-Axis:</p> <ul style="list-style-type: none"> • Pre-Set Knob Kit P/N 500-4262* <p>Dynamic 2-Axis:</p> <ul style="list-style-type: none"> • Adjustment Handle Kit P/N 500-4162*

S1 Ring Gimbals

Customer Maintenance Items	Frequency	Parts or Maintenance Required
<p>Overall S1 Ring Gimbal:</p> <ul style="list-style-type: none"> • Clean using clean dry compressed air after each use if possible, especially near exposed bearings on dynamic and pre-set mounts • DO NOT use alcohol, WD-40 or other chemical based solvents to clean any components or parts 	<p>Monthly</p>	
<p>Outer race of ring gimbal:</p> <ul style="list-style-type: none"> • Check to make sure that bearings rotate freely • Check to make sure that outer ring halves are properly seated and retaining screws are secure. • Quick Release Gimbal ONLY: <ul style="list-style-type: none"> ○ Locking side should have no play (snug fit) ○ Latch should shut completely. If latch does not seat, it is possible to adjust catch plate position. 	<p>Quarterly or Semi-Annual</p>	
<p>Inner race of ring gimbal:</p> <ul style="list-style-type: none"> • Check to make sure that inner ring halves are properly seated and retaining screws are secure. • Check to make sure that tool mounting set screws are each making contact and firmly seated against tool surface. • Set screws should be just flush with outside of gimbal surface after being tightened. If set screw protrudes a different size set screw should be used. 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • Kit, Retaining Screw, Inner Race, S1 P/N 400-3576* • Kit, Set screws, Assorted Lengths P/N 400-3575-01*
<p>Pivot Bearings at Yoke Connection (Double Yoke only):</p> <ul style="list-style-type: none"> • Make sure that ring can freely rotate in yoke without restriction. Replace bearings as needed. • Check jam nuts are seated and secure. If not, tighten and add Blue Loctite 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • Kit, Yoke Pivot P/N 400-3120-02* • Blue Loctite P/N 900-7001-TL*
<p>Wrist Bearing at Yoke Connection (Single Yoke only):</p> <ul style="list-style-type: none"> • Check inset bolt is tight – not to exceed 20 ft-lbs • Check that screws holding 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • Pivot, yoke to wrist P/N 400-3630

<p>Yoke Clamp:</p> <ul style="list-style-type: none"> • Make sure yoke clamp is tight around yoke. Check screws are tight and secure – tighten to 20 foot-lbs 	<p>Quarterly or Semi-Annual</p>	
<p>Gimbal Posts:</p> <ul style="list-style-type: none"> • Check to make sure no threads are visible between posts. If necessary, tighten to remove any gaps • There should be clamp collars on both the top and bottom of where the gimbal post attaches to the zeroG arm. A Teflon washer should rest underneath the top collar. • Each clamp collar should be firmly seated with screws tightened to 10 foot-lbs 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • Two-piece Clamp Collar Kit P/N 400-1112*

S2 Ring Gimbals

Customer Maintenance Items	Frequency	Parts or Maintenance Required
<p>Overall S2 Ring Gimbal:</p> <ul style="list-style-type: none"> • Clean using clean dry compressed air after each use if possible, especially near exposed bearings on dynamic and pre-set mounts. • DO NOT use alcohol, WD-40 or other chemical based solvents to clean any components or parts. 	<p>Monthly</p>	
<p>Rollers or Slides:</p> <ul style="list-style-type: none"> • Rollers or slides can be located on the inner or outer ring. Check to make sure that each ring rotates freely. • Rollers should be secured firmly via each screw. Screws should be tightened to 20 inch-lbs and Blue Loctite applied. • If slides are used, position for a controlled roll of opposing ring by adjusting to desired resistance (inner/outer). • Tighten screws on each slide to 10-12 inch-lbs. 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • S2 Roller Kit P/N 400-3610-15* • S2 Slide Kit P/N 400-3612-11* • Kit, Set screws, Assorted Lengths P/N 400-3575-01* • Blue Loctite P/N 900-7001-TL*
<p>Pivot Bearings at Yoke Connection (Double Yoke only):</p> <ul style="list-style-type: none"> • Make sure that ring can freely rotate in yoke without restriction. Replace bearings as needed. • Check jam nuts are seated and secure. If not, tighten and add Blue Loctite 	<p>Quarterly or Semi-Annual</p>	<ul style="list-style-type: none"> • Axle Pivot Bearing P/N 900-9032-BG* • Blue Loctite P/N 900-7001-TL*

<p>Wrist Bearing at Yoke Connection (Single Yoke only):</p> <ul style="list-style-type: none"> • Check that inset bolt is <i>tight</i> – not to exceed 20 ft-lbs • Check that screws are secure and tight 	Quarterly or Semi-Annual	<ul style="list-style-type: none"> • Pivot, yoke to wrist P/N 400-3630
<p>Yoke Clamp:</p> <ul style="list-style-type: none"> • Make sure yoke clamp is tight around yoke. Check that screws are <i>tight and secure</i> – tighten to 20 foot-lbs 	Quarterly or Semi-Annual	
<p>Gimbal Posts:</p> <ul style="list-style-type: none"> • Check to make sure no threads are visible between posts. If necessary, tighten to remove any gaps • There should be clamp collars on both the top and bottom of where the gimbal post attaches to the zeroG arm. A Teflon washer should <i>rest</i> underneath the top collar. • Each clamp collar should be firmly seated with screws tightened to 10 foot-lbs 	Quarterly or Semi-Annual	<ul style="list-style-type: none"> • Two-piece Clamp Collar Kit P/N 400-1112*

Palm Sander Gimbal

Customer Maintenance Items	Frequency	Parts or Maintenance Required
<p>Overall Gimbal:</p> <ul style="list-style-type: none"> • Clean using clean dry compressed air after each use if possible, especially near exposed bearings on dynamic and pre-set mounts • <u>DO NOT</u> use alcohol, WD-40 or other chemical based solvents to clean any components or parts 	Monthly	
<p>Gimbal Posts:</p> <ul style="list-style-type: none"> • Check to make sure no threads are visible between posts. If necessary, tighten to remove any gaps • There should be clamp collars on both the top and bottom of where the gimbal post attaches to the zeroG arm. A Teflon washer should be underneath the top collar. • Each clamp collar should be firmly seated with screws tightened to 10 foot-lbs • Check jam nuts are seated and secure. If not, tighten and add Blue Loctite • Check that counterweight set screw is secure. If not tighten and ad Blue Loctite 	Quarterly or Semi-Annual	<ul style="list-style-type: none"> • Two-piece Clamp Collar Kit P/N 400-1112* • Blue Loctite P/N 900-7001-TL*

RECOMMENDED SPARE PARTS

QTY	DESCRIPTION	PART NUMBER	PRICE
<u>zeroG2 Arm</u>			
1	Kit, Complete Maintenance Pack, zeroG2	102-5910	\$615.00
	<u>Included in Maintenance Kit:</u>		
1	Tool Interface Sleeve	102-6280	
1	Retainer Clip	900-9117	
4	Disposable, Polyco Arm Cover	300-2100	
1	Silicone Arm Cover	300-2200	
2	Extreme Pressure Grease	900-7005-GR	
1	Kit, Centering Cord, Complete	102-6250-01	
2	Blue Loctite, 243, 10 mL	900-7001-TL	
<u>Available Separately:</u>			
1	Kit, Tool Interface Sleeve with Clip	102-6281	\$42.50
1	Disposable, Polyco Arm Cover	300-2100	\$26.50
1	Silicone Arm Cover	300-2200	\$250.00
1	Extreme Pressure Grease	900-7005-GR	\$24.00
1	Kit, Centering Cord with Cinch	102-6250-02	\$118.20
1	Kit, Centering Cord, Complete (bumpers, stops)	102-6250-01	\$290.78
 <u>Fixed, Interface Mounting Block</u>			
1	Kit, Replacement 80/20 Bolts & Nuts	500-4164	\$12.50
1	Quick Release Pin	900-9031-QP	\$50.00
 <u>Pre-Set, 2-Axis, Interface Mounting Block</u>			
1	Kit, Complete Maint. Pack, Pre-Set Mount	500-4260	\$250.00
	<u>Included in Maintenance Kit:</u>		
1	Kit, Replacement 80/20 Bolts & Nuts	500-4164	
1	Quick Release Pin	900-9031-QP	
1	Kit, Spare Brgs, Full Float Mtg Interface	500-4265	
1	Kit, Spare Brgs, Positioning, Mtg Intfc.	500-4266	
1	Kit, Replacement Knobs, Pre-Set Mount	500-5262	
<u>Available Separately:</u>			
1	Kit, Replacement 80/20 Bolts & Nuts	500-4164	\$12.50
1	Quick Release Pin	900-9031-QP	\$50.00
1	Kit, Replacement Knobs Pre-Set Mount	500-4262	\$68.00

RECOMMENDED SPARE PARTS (Cont'd.)

QTY	DESCRIPTION	PART NUMBER	PRICE
<u>Dynamic, 2-Axis, Interface Mounting Block</u>			
1	Kit, Complete Maintenance Pack, Dynamic Mt.	500-4160	\$250.00
<u>Included in Maintenance Kit:</u>			
1	Kit, Replacement 80/20 Bolts & Nuts	500-4164	
1	Quick Release Pin	900-9031-QP	
1	Kit, Spare Brgs, Full Float Mtg Interface	500-4265	
1	Kit, Spare Brgs, Positioning, Mtg Intfc.	500-4266	
1	Kit, Replacement Knobs, Dynamic Mt.	500-4162	
<u>Available Separately:</u>			
1	Kit, Replacement 80/20 Bolts & Nuts	500-4164	\$12.50
2	Quick Release Pin	900-9031-QP	\$50.00
1	Kit, Replacement Knobs Dynamic Mount	500-4162	\$75.00
<u>S1 Ring Gimbal</u>			
1	Kit, Complete Maint. Pack, S1 Ring Gimbal	400-3574	\$265.00
<u>Included in Maintenance Kit:</u>			
1	Kit, Retaining Screw, Inner Race, S1	400-3576	
1	Kit, Set Screws, S1 Assorted Lengths	400-3575-01	
1	Kit, 2-Piece Collar & Washer (Qty 2)	400-1112	
2	Blue Loctite, 243, 10 mL	900-7001-TL	
<u>Available Separately:</u>			
1	Kit, Retaining Screw, Inner Race, S1	400-3576	\$4.50
1	Kit, Set Screws, Assorted Lengths	400-3575-01	\$30.50
1	Kit, 2-Piece Collar & Teflon Wash (Qty 2)	400-1112	\$26.50
2	Blue Loctite, 243, 10 mL	900-7001-TL	\$3.50
1	Kit, Yoke Pivot, Standard S1	400-3120-02	\$130.50
<u>S2 Ring Gimbal</u>			
1	Kit, Complete Maint. Pack, S2 Ring Gimbal	400-3675	\$425.00
<u>Included in Maintenance Kit:</u>			
1	S2 Roller Kit (if gimbal employs rollers)	400-3610-15	
1	S2 Slide Kit (if gimbal employs slides)	400-3612-11	
1	Kit, Set Screws, Assorted Lengths	400-3575-01	
1	Kit, 2-Piece Collar & Washer (Qty 2)	400-1112	
2	Blue Loctite, 243, 10 mL	900-7001-TL	
<u>Available Separately:</u>			
1	S2 Roller Kit (if gimbal employs rollers vs slides)	400-3610-15	\$175.00
1	S2 Slide Kit (if gimbal employs slides vs rollers)	400-3612-11	\$220.00
1	Kit, Set Screws, Assorted Lengths	400-3575-01	\$30.50
2	Blue Loctite, 243, 10 mL	900-7001-TL	\$3.50
1	Kit, 2-Piece Collar & Teflon Wash (Qty 2)	400-1112	\$26.50

RECOMMENDED SPARE PARTS (Cont'd.)

QTY	DESCRIPTION	PART NUMBER	PRICE
<u>Palm Sander Gimbal</u>			
1	Kit, Complete Maint. Pack, Sander Gimbal	400-3970	\$130.00
<u>Included in Maintenance Kit:</u>			
1	Kit, 2-Piece Collar & Washer (Qty 2)	400-1112	
2	Blue Loctite, 243, 10 mL	900-7001-TL	
3	Kit, Axle Pivot, MAG (Multi-Axis gimbal)	400-3430	
<u>Available Separately:</u>			
1	Kit, 2-Piece Collar & Teflon Wash (Qty 2)	400-1112	\$26.50
2	Blue Loctite, 243, 10 mL	900-7001-TL	\$3.50
3	Kit, Axle Pivot, MAG (Multi-Axis gimbal ONLY)	400-3430	\$33.00

zeroG² arm technical specifications

PRIMARY WORK ENVELOPE	Vertical reach 29", horizontal reach 32", with 12.3" links, 3.6" hinge blocks, and 130° up/down sweep. Additional reach may be provided by the tool-gimbal-post assembly and the mounting interface block.
SECONDARY WORK ENVELOPE	Unlimited. Provided by auxiliary stands and mounts.
LIFT CAPACITY	Standard payload range is 3-10 lbs. The arm can be ordered configured for additional weight. Call Equipois for information.
PRIMARY ARM WEIGHT	Approx. 7 lbs; exclusive of the tool-gimbal-post assembly.
LIFT CONTROLL	Single-know adjustment for easy change of payload.
LATERAL ARM CONTROL	Elastic cords (bungees) adjust the horizontal response and angle between links.
MOUNTING INTERFACE BLOCKS	Three types compatible with OEM rail and strut systems. Two types provide 2-axis (pitch and roll) quick adjustments.

Safety and hazard review

WEIGHT CAPACITY	Payload capacity is 3-10 lbs. Do not load more than 10 lbs. on your zeroG arm unless it has been custom-fitted for the additional weight.
PINCH POINTS	<ul style="list-style-type: none"> • Keep fingers, clothing, tools, work pieces, and other items away from the labeled pinch points on the zeroG arm. • During operation, use the tool's grips and avoid touching the arm, except the adjustment cranks of the dynamic mounting interface block. • When the arm is not docked, handle it only by the end blocks and the adjustment knobs. • Use of protective covers is recommended.
ENVIRONMENTAL HAZARDS	Keep liquids, dust, paint, and debris away from the zeroG arm, or protect arm segments with disposable or permanent arm covers from Equipois.
DOCKING AND POSITIONING	Dock the zeroG arm when it is not in active use. Do not leave the zeroG arm free so it can easily swing or move.
PAYLOAD REMOVAL	Mount or dismount the payload only if the zeroG arm is fully extended or is securely docked.
LEANING OR HANGING	Do not lean or hang from the zeroG arm.
UNDOCKING AN UNLOADED ZEROG ARM	An unloaded zeroG arm RISES FORCEFULLY and can injure users if it is suddenly released from its docked position. Never undock a zeroG arm unless it is loaded with its intended payload or the spring tension is balanced by restraints or a counter weight.
LIFT ADJUSTMENT	When adjusting the zeroG arm's lift, do not force the stop at the end of knob travel.