RD10070 CNC Vise Actuator User Manual

US Patent#11253973

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Contents

Introduction

The Patent Pending CNC Vise Actuator (actuator) is intended for use with high quality vises used for machining operations. It allows manual or automatic operation of a vise via pneumatic control.

Warnings!

The actuator produces a high amount of torque and reaction force:

- **Do not operate the vise actuator on a vise without the anti-rotation blocks installed and secured with the block screws.**
- **Do not operate the vise actuator with a hex key or allen wrench in the center hole (center socket) because accidental actuation could cause wrench to turn quickly causing injury. If actuator position needs to be changed this is easily accomplished by LIGHTLY blowing compressed air into the end of either of the quick disconnect fittings or hoses with a standard compressed air blow gun (make sure both actuator airlines or fittings are disconnected from compressed air source or valve first). The actuator has arrow markings that show**

corresponding rotation direction:
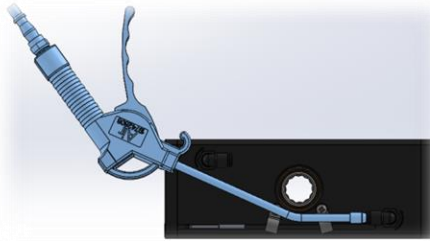
- **Do not put your fingers in the center hole.**
- **Unplug all air pressure before installing or removing the actuator from a vise.**
- **Remove the workpiece from the vise before installing or removing the actuator.**

Use only clean, dry, filtered air for the Valve Kit and actuator. Wet or dirty air will quickly destroy the seals!

Mechanical Installation

1) Valve Kit installation:
    a. Mount Valve Kit onto backside of UR Robot Control Box via the magnets.

NOTE: Before installation please lubricate the vise leadscrew/nut with the Fluorinated PFPE grease included with your actuator. It will increase the reliability and repeatability of your vise.Please see the instructional video at http://www.rapiddesignsolutions.com/cnc-vise-actuator.html for step by step instructions for using the vise actuator. The summarized steps are listed below:

2) Actuator Installation:
    a. With no air pressure lines connected, install the actuator by engaging the center socket with the vise hex handle then slide it onto the front of the vise and adjust the anti-rotation blocks (blocks) by sliding them up or down in the grooves so the flats engage with a the flat surface of the vise body. Snug the four 10-32 x 5/8" long screws with a 1/8" hex key to 36 **in**-lbs (3 ft-lbs). **Do not overtighten**! The anti-rotation blocks should be adjusted to allow the actuator to rotate only slightly in either direction (about .005/.025" as observed at the block locations). See red arrows below. It is not helpful to force the blocks tight as this can create a bind on the center socket; a small amount of slop (.005/.025") is beneficial to overall operation:
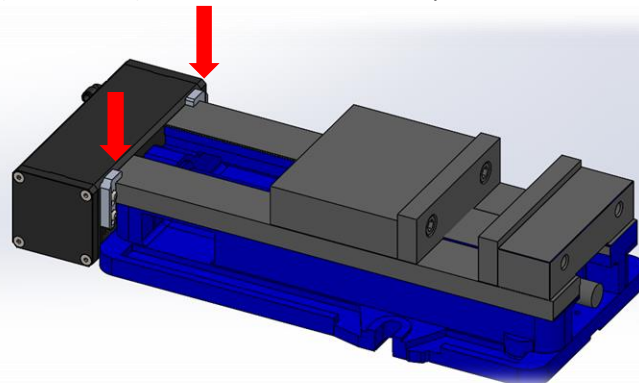
Shown below are the installation locations/orientations of the anti-rotation blocks for specific vises that the actuator is known to be compatible with. KURT® AND ASSOCIATED VISE MODEL NAMES ARE REGISTERED TRADEMARKS OF THE KURT MFG. COMPANY. RAPID DESIGN SOLUTIONS, LLC IS NOT AFFILIATED WITH THE KURT MFG. COMPANY IN ANY WAY

Setup with a Kurt® D688® or D675®:
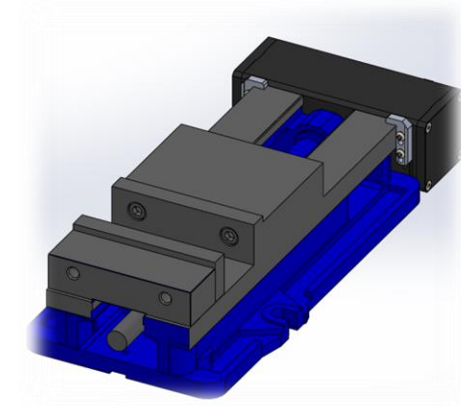
Setup with a Kurt® DX6®:

REMOVE RIVETS & TAG 1ST
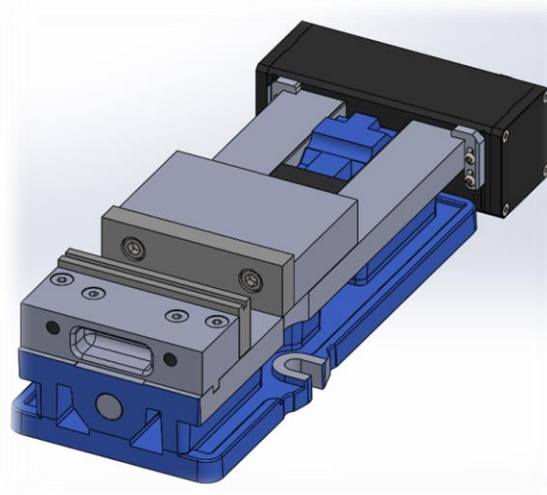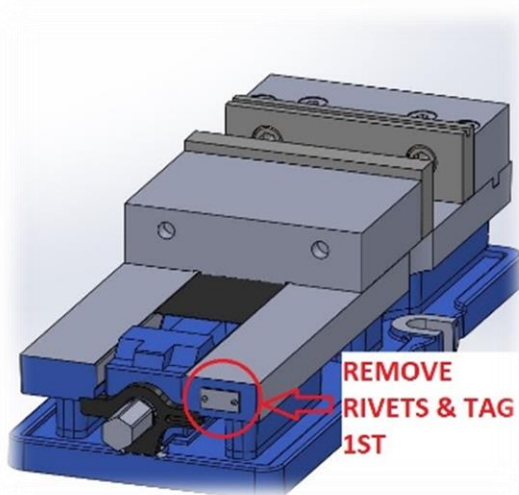
Setup with a Kurt® 3600V:
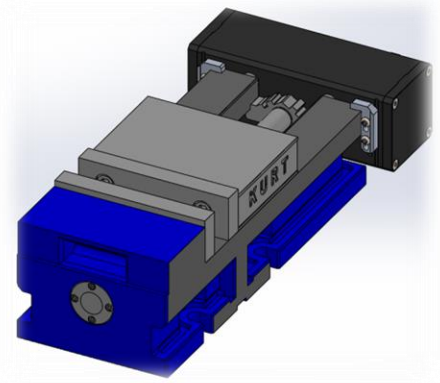
Setup with a Kurt® 3610V:
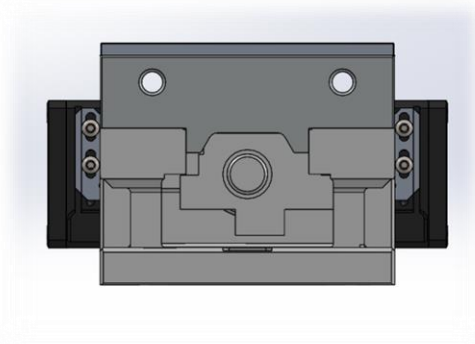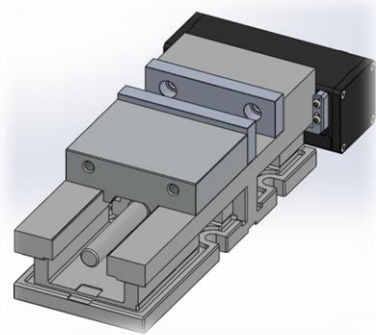
Setup with a Kurt® HD690:

HD690 NOTE: This model of vise does not have the normal screw in the back of the moving jaw that is adjusted with ¼" hex key to control the slop. Because of this, some HD690s may not open as far as desired due to "backlash". There are a couple fixes for this; Use a spring in between the two jaws similar to a common "parallel keeper" or "V-spring", or modify the moving jaw to accept a standard adjustment screw per instructions available by contacting us.
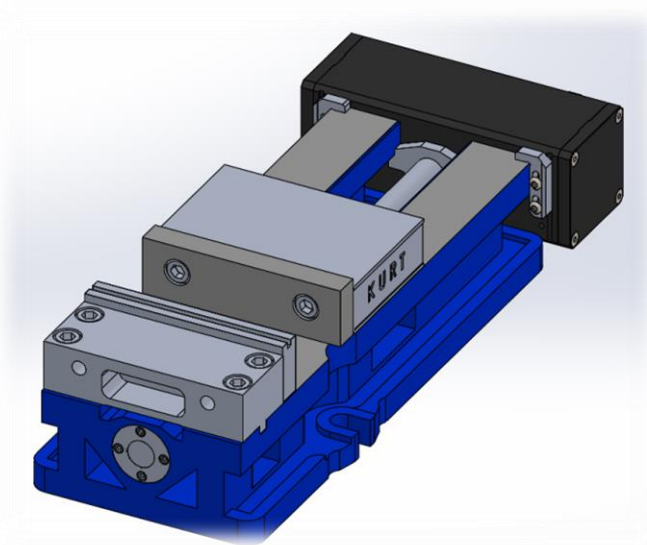
b. Remove the actuator by pulling straight back from the vise.
c. Clamp the intended CNC workpiece in the vise and tighten normally with a wrench to the desired torque.
d. Using a wrench, loosen the vise ~**170-180 degrees**. This will establish how far the vise opens during normal pneumatic vise actuator operation. The actuator produces 225 degrees of total rotation , thus opening the vise 170-180 degrees in this step allows the actuator to operate with an additional 55-45 degrees to account for workpiece variance etc. Workpiece variance should be factored in during the initial setting as a number less than 170 degrees may need to be used to ensure the actuator completely clamps the vise before running out of rotational travel.
e. Using an air blow gun, manually actuate the vise to it's full open position (make sure both actuator airlines are disconnected and the fittings are unobstructed first):
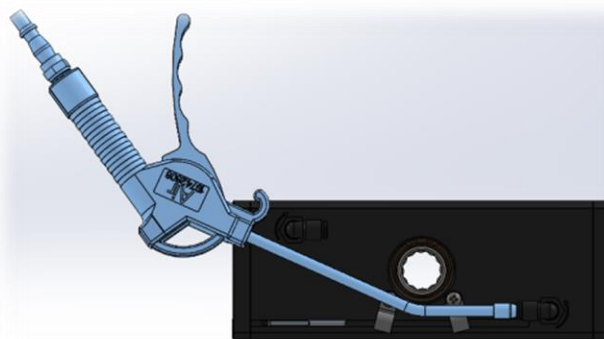
f. Install the vise actuator straight on to the vise. If the actuator and vise hexes do not line up, use a wrench to rotate the vise handle slightly clockwise until they do. Do not manually force the actuator to the correct rotation—It should slip on easily! When properly installed the actuator will be held securely to the body of the vise with

magnetic force and will have a small amount of rotational "wiggle" (.005/.025"):
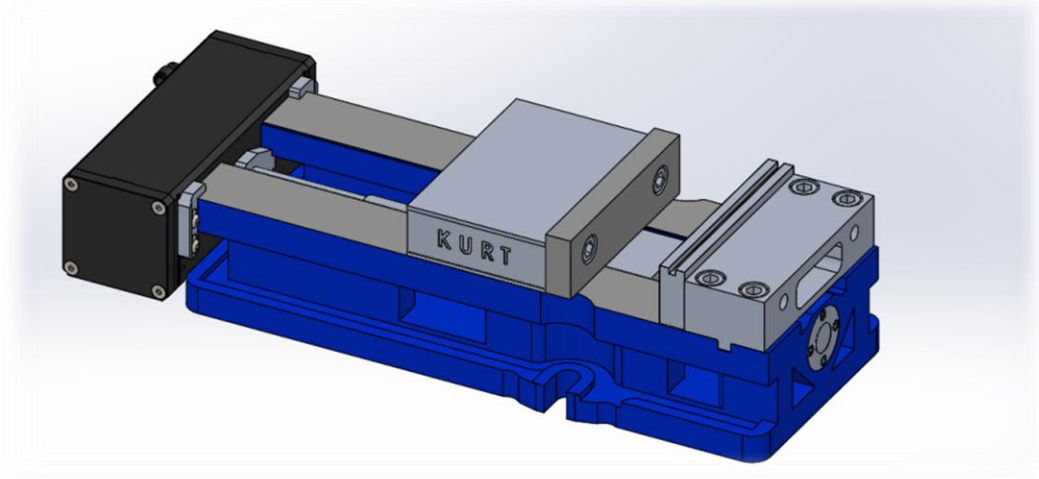

Plumbing and Wiring

Section A.1: With Rapid Vise UR+ Kit

1) Install ¼" OD flexible airlines from valve kit into the push to connect fittings and route through the 5/16" diameter p-clips approximately as shown below. Clear line into left fitting and black line into the right fitting. If applicable connect the Yellow M8 sensor cord to the sensor lead coming off the actuator.

2) Ensure robot and teach pendant are powered down and robot controller box is unplugged from AC power.
3) Open up UR control Box and remove 2 right hand plastic caps covering the holes where the wires come through as shown to the right:
4) Bring the Valve's wire bundle through the front hole as shown to the right:
5) If applicable bring the yellow M8 sensor cable's through the back hole as shown to the right:
6) Remove the left "Digital Output" terminal block. If using 3 or 4 vises user will aslo need to remove the right "Digital Output" block as well.
7) Using a screwdriver install each black wire and each red wire into its corresponding position in the terminal block's. All black wires are labeled "0V" and can go into any of the "0V" ports on the "Digital Outout" terminal block. Each red wire will be labeled with its corresponding "Digital
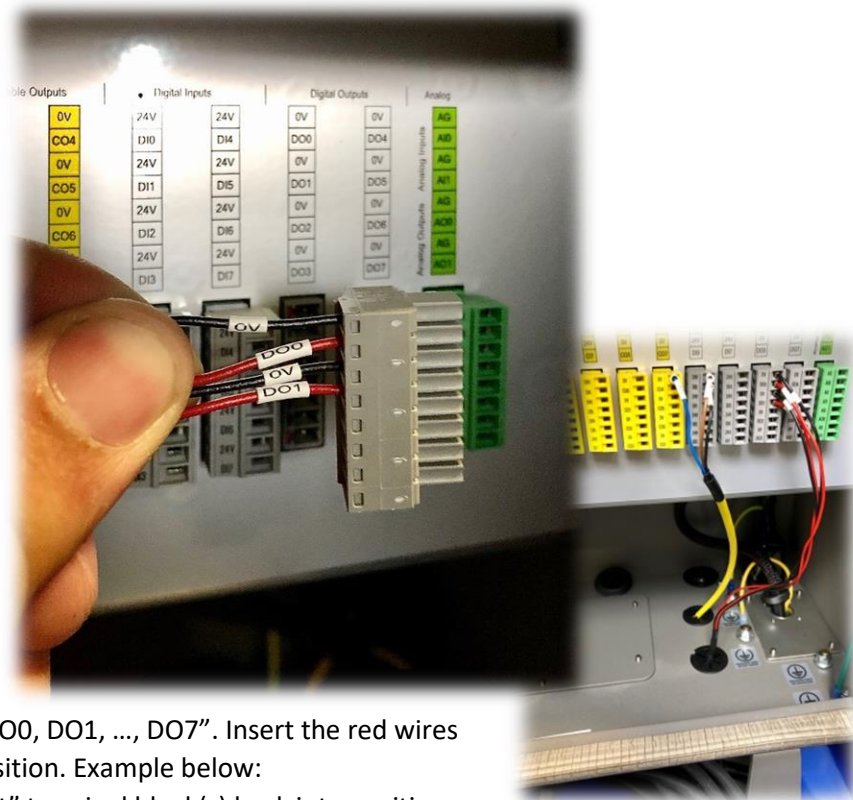
Output" such as "DO0, DO1, …, DO7". Insert the red wires into the correct position. Example below:

8) Plug "Digital Output" terminal block(s) back into position.
9) If using Vise Open sensors remove right "Configurable Outputs" terminal block and left "Digital Inputs" terminal block.
10) Each sensor cable will have 3 labeled wires: Brown wire "24V", Blue Wire "0V", Black wire "DI0, DI1, DI2, or DI3" depending on which vise the sensor is for.
11) Insert the blue wire(s) into the corresponding "0V" port on the "Configurable Outputs" terminal Block. Vise 1 Sensor is the first "0V" port, Vise 2 sensor is the second "0V" port, etc..

12) Insert the Brown and Black wire(s) into their place on the "Digital Inputs" terminal block. Vise 1 sensor is the first "24V" port and "DI0", Vise 2 sensor is the second "24V" port and "DI1", etc...
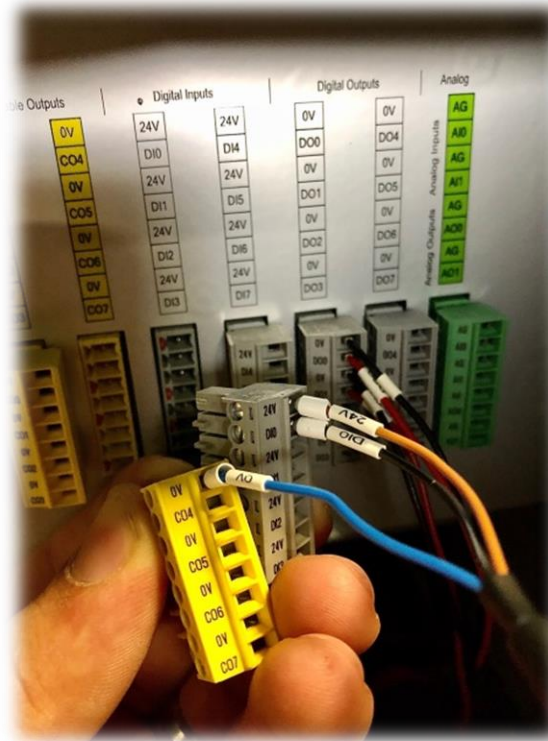
13) Plug both terminal blocks back into position.
14) Install the provdied split wire bushing's around valve wires and sensor wires and push into place in the bottom holes of the control box to provide strain relief for wires.
15) Close the cabinet door on the control box.

Section A.2: Installing UR Cap

1) Power on robot and verify Robot software is up to date. If not please update to the latest version of polyscope.
2) Plug supplied USB drive Containing Rapid Vise URcap into teach pendant. Select "manual" mode instead of "Automatic" mode in the upper right hand corner of the pendant. Click the menu icon in the upper right hand corner of the pendant and select "settings". Click the "system" tab and select "UR Caps". Click the + sign in the bottom left corner of the window and select "usb disk" in the popup window. Select the file named "RDSViseActuator-1.0.1.urcap" and click open. This will prompt a restart, so select "restart".
3) Once restarted the URcap will now be active and ready to use.

Section A.3: Connecting to air and setting vise pressure

1) Connect air to valve kit using ¼" push-to-connect located in the bottom right corner of the valve kit.
2) Setting Vise Closing Pressure:

a. Make sure pendant is powered up and turn on the robot.
b. Go to the installation tab and select "URcaps" in the tree to the left.
c. Select the "Rapid Vise" option.
d. Select which vise you are setting the pressure to by making sure there is a check mark in the box on the left side of the screen under the column " Vise #"
e. Click on the "Vise Close Wait" and change the time to 8 seconds.
f. Click the vise close "action" image on the bottom of the screen and watch the pressure gauge on the valve kit. It will tighten onto the workpiece and hold pressure for a few seconds then the valve will blow off and go into its neutral state. Loosen the locknut on the pressure regulator.
g. Vise close torque=Pressure in psi*0.37: For example, 100 psi = 37 ft-lbs of torque. Turn adjustment screw on the valve body to the right to increase the psi, in turn increasing the closing torque. Turn left to lighten the vice closing torque. After each adjustment close the vise while watching the gauge to make sure the correct pressure is set.
h. Tighten the locknut back down to ensure the pressure regulator will stay at the desired setting, and select "Restore all CNC Vise Actuator Settings to Default" on the installation tab to restore the "Vise Close Wait" to its original value.

3) Repeat steps d-h for each vise in use.

Section A.4: Operation from UR teach pendant

1) Go to the "installation" tab on the pendant, and select the "Rapid Vise" tab under "URCaps". Make sure each vise in use is active by verifying they are not grayed out. Select each vice, by clicking in the box under the "Vise #" (a check mark should appear in the box), and click the "vice-open" button on the bottom of the screen and verify it opens. If using a sensor verify the sensor is active (light on) when vice is in a fully open position.
2) To use in program, select "Rapid Vise" under the "UR Caps" in the program tree to add a programming node. Then select which vise you want to activate from the drop down menu and select whether you want it to close or open. Continue on with normal robot program and insert

"Rapid Vise" nodes where needed. Once program is complete run program and verify all vises are working correctly.

Section B: Without Rapid Vise UR+ Kit

1) Install the sensor line and ¼" OD flexible airlines in the push to connect fittings and route through the 5/16" diameter p-clips approximately as shown:

2) Plumb the ¼" OD flexible airlines to a pneumatic valve and regulator. The "vise-tighten" airline should have a pneumatic pressure regulator inline between the valve and the vise actuator. This is used to control vise closing torque and must be set appropriately for the machining operation. Pressure in psi multiplied by .37 = ft-lbs of torque. For example, 135 psi = 49.95 ft-lbs of torque and 100 psi = 37 ft-lbs of torque. The user can divide the required torque by .37 to determine the correct pressure setting in psi. The vise closing pressure should always be set to less than the vise open pressure by at least 10psi or 10%, whichever is greater. A typical pneumatic installation is shown below. These are generic instructions only and proper setup must be determined and verified by the installer. **ONLY CLEAN, DRY AIR CAN BE USED FOR THE ACTUATOR**!:
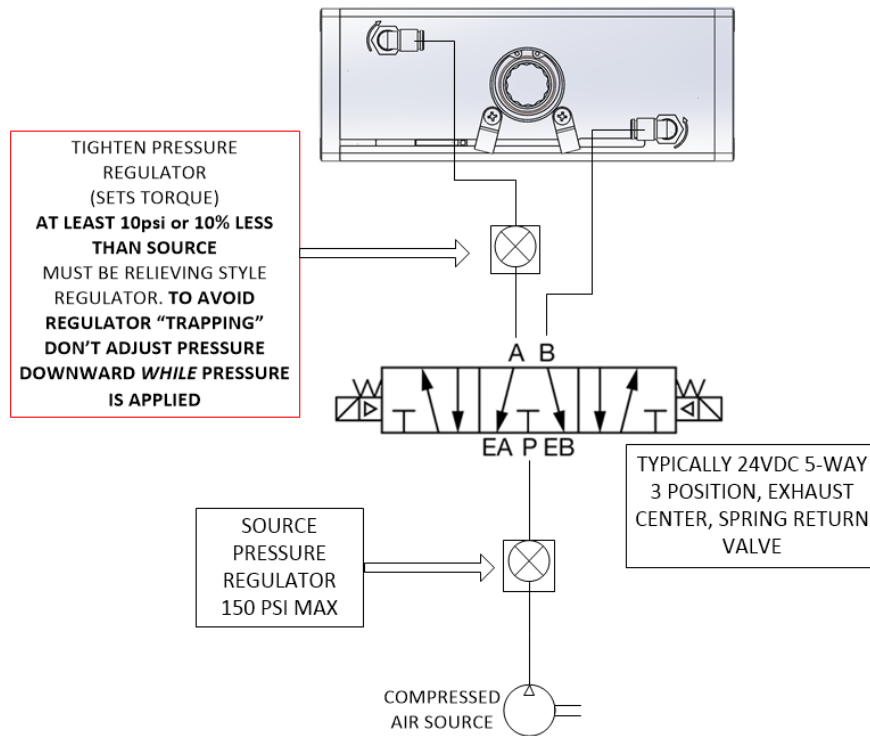
PLEASE SEE MORE IMPORTANT PLUMBING NOTES ON NEXT PAGE

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3) Plumbing Notes:
   a. In a fault, or power loss state it is generally best if pressure is either cut off or routed to the vise-tighten port to minimize the chance of the workpiece coming unclamped.
   b. Most standard *relieving* pressure regulators work well with the configuration shown above. If **your "vise tighten" regulator does not release the holding pressure** when the "vise-loosen" airline is pressurized you may need to switch regulators. The system should be plumbed so the vise-tighten line is open to atmosphere when the vise-loosen line is pressurized. **Also note that when adjusting the regulator *downward* the regulator should not be pressurized**, as this will cause most regulators to trap pressure and not relieve; when initially setting torque via the regulator, back the regulator off *then* apply pressure and adjust it up to the set point.
   c. If your application uses high torque and *heavy cutting* (Face-mills etc. that produce high vibrations), the vibrations can act like an impact wrench during machining and the Vise Actuator will continue to tighten itself during machining if left pressurized. This can be a problem for vise opening since the vibrations will not be present during opening and the vise can take much greater torque to open in this case. If you have this situation you should plumb the system with a **5 way 3 position** solenoid valve or **two 3 way spring return solenoid valves** as shown in diagram. To control the actuator, pressure is applied until the vise is tightened, then pressure is released from both airlines so it is in a *neutral* state (open center valving).
   d. For light cutting/torque applications it is acceptable to use a 4/2 or 5/2 valve which allows operation with only one electrical output. In this case it is best if routed to the vise-tighten port when the power is off or faulted to minimize the chance of the workpiece coming unclamped.
   e. **Please contact us if you need any help with plumbing or valve recommendations.**
4) Optional Sensor (Switch) Installation
   a. Magnetic switches (GMR) may be used with the actuator to provide verification of actuator open and/or closed states. Due to possible workpiece variation and thus clamping position variance, it is generally advised to only sense for "vise-open" as the actuator always opens to a consistent position that can be sensed accurately.

b. If specified at the time of order the switch will come pre-installed in the 4mm C-slot on the front of the actuator:


c. To install later, simply slide the switch in from the pocket in the right end of the c-slot.
d. After the switches are powered (see step 5), they may be adjusted. In this example we will assume we are setting up a "Vise Open" sensor as that is the most common:
   i. Pneumatically drive the actuator to the open position.
   ii. Starting with the switch at the right end of the c-slot, slowly move it leftward until the LED turns on indicating a "high" state.
   iii. Note its position in the slot then keep moving inward until it goes off.
   iv. Note its position again then move the switch outward until it turns off.
   v. Move the switch inward again until it is approximately centered between the two positions noted above. (It is important to have the sensor well centered in the active range as sensitivity can change slightly based on temperature fluctuations and other interferences.
   vi. *LIGHTLY* snug the sensor set screw with a small flat screwdriver (Tighten just enough to keep sensor from sliding sideways; overtightening will ruin sensor!)
   vii. Cycle the actuator to verify correct sensor operation.
e. Sensor wiring: These instructions are not meant to be a detailed guide for electrical integration. Some knowledge of electronics and proper wiring practices must be used by the installer (integrator). Components referenced below can be purchased from Rapid Design Solutions, LLC upon request:
   i. Connect the switch to a cable
      a. M8 3-pin female to pigtail cable may be used for 1 switch
      b. M8-3 pin T-connector to a single M12-4 pin male connector may be used in conjunction with an M12-4 pin female to pigtail cable for 2 switches.
   ii. Connect cable pigtail to ground, power, and signal (load) terminals (of robot or CNC generally). If a 5-24V PNP M8-3 pin Male sensor is purchased with the actuator, termination will be as follows:
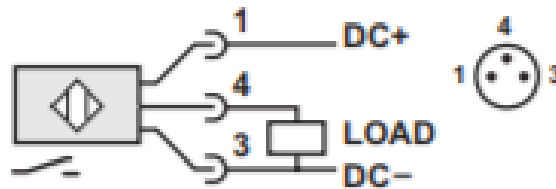
Sensor Specifications:

Operating Voltage	5-24 VDC
Voltage Drop	1.0 V @200 mA
Current Rating	.2 Amps Max.
Switching Power	4.8 watts Max
Short Circuit Protection	No
Reverse Polarity Protection	Yes
Overload Protection	No
Leakage Current	<.01 mA
Off Delay Time	150-200 ms
Switching Frequency	<1000 Hz
Operating Temperature	-14° F to 158° F (-10° C to 70° C)
Protection Rating	NEMA 6/IP67
Approvals	CE, RoHS, REACH

iii. If multiple sensors are used an M8-3 pin female 2x to M8-4 pin male "Y" connector is recommended (P/N RD10069). Typical wiring termination for this connector is as
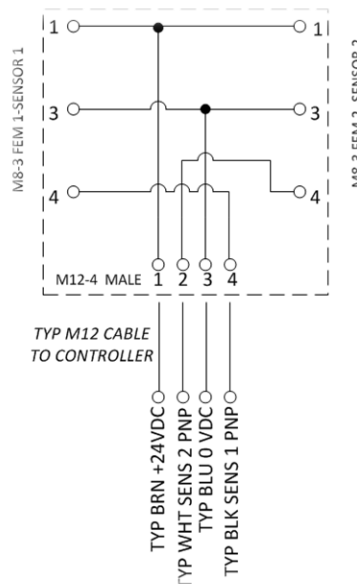
follows:

Maintenance

1) The actuator should be kept free of fine, gritty chips and swarf. It can be cleaned with a soft rag and gentle air-blowing. When Not in use or connected to air lines, plug fittings with included plugs.
2) The actuator is grease lubricated and sealed. Providing clean, dry air is used additional lubrication is not required.
3) **However**, the vise leadscrew and nut should be lubricated at initial setup then every 5000-10000 cycles with the included fluorinated PFPE grease (Finish Line Brand Extreme Fluoro Pure Flourinated PFPE Grease).

Troubleshooting:

1) Actuator does not open vise:
    a. Ensure the vise-tighten pressure is set to less than the supply pressure. Generally at least 10psi or 10% less (whichever is greater), but this may be reduced in some cases.
    b. **Ensure the vise leadscrew threads are smooth and well lubricated with grease. Your actuator is provided with a small amount of Finish Line Brand Extreme Fluoro Pure Flourinated PFPE Grease: it is highly recommended that you apply this grease to your vise's lead screw during initial setup and every 5000-10,000 cycles thereafter!** *Some new vises have sharp burrs on the threads which can be removed with a wire brush then greased to prevent "dry-locking", or popping when released which causes a much greater loosening than tightening torque. Also refer to plumbing note 9c.*
    c. Refer to plumbing note (9b) if your air regulator isn't allowing pressure to be released. There are several ways to solve this problem, the most common are listed above.
    d. Refer to plumbing note (9c) if you are performing heavy cutting with vibrations.
    e. See note in the General Installation section for HD690s.
2) Actuator hex does not fit on your vise:
    a. Use a smooth stone to ensure there are no burrs on your vise handle hex, especially where the flats meet the diameter. This is very common on brand-new vises and occasionally on older vises that have been used heavily or damaged.
    b. Measure the hex widths of the vise handle. It should be .7500" maximum and the OD over the points should be less than Ø.856"
3) Actuator leaks:
    a. A fitting is damaged. Please replace it with a standard 1/8 BSPP G-thread fitting with an o-ring gasket or 1/8 MNPT fitting with quality pneumatic thread sealant.
    b. A seal has become damaged. Please contact us for troubleshooting assistance.
4) Other:
    a. Please contact us. We're happy to help. support@rapiddesignsolutions.com