VERSA BUILT ROBOTICS

MultiGrip Workholding Design Manual

Table of Contents

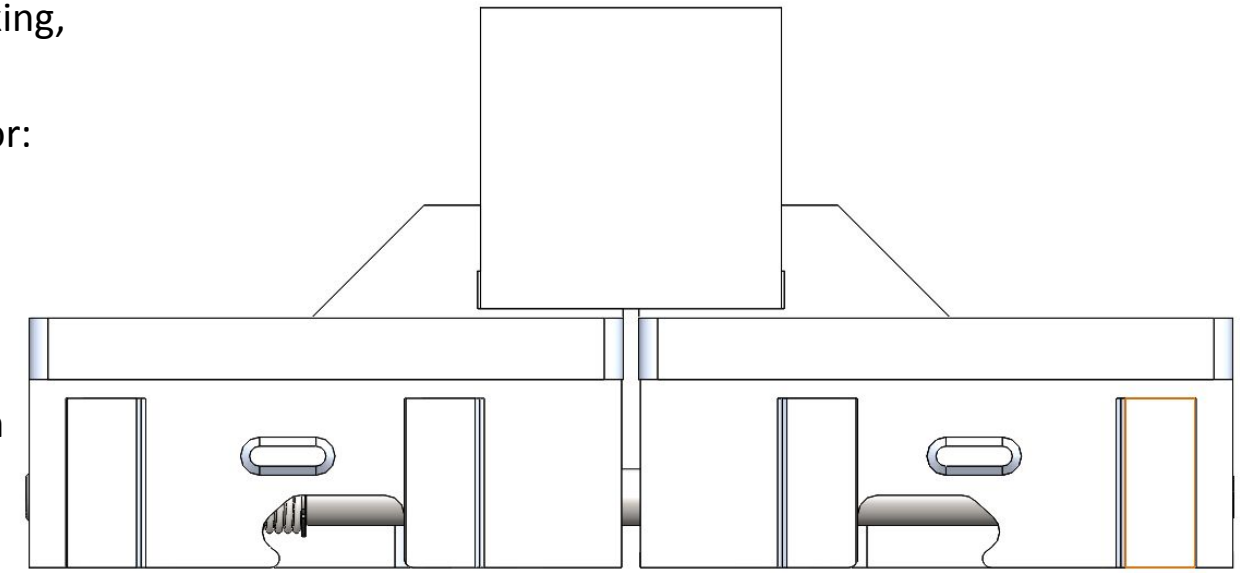
Section 1 Workholding Design with MultiGrip
Section 2 Application Options and Best Practices

MultiGrip Workholding Design

Section 1

MultiGrip Jaw Guidelines

- Designing and cutting MultiGrip Jaws should follow the same best practices used with any other vise soft jaw.
- Design MultiGrip Jaws that will be rigid enough for the intended machining operations and capable of reliably picking, transfering or placing parts.
- The following pages include MultiGrip specific guidelines for:
  - Nominal Gap
  - Pick/Place Clearance
  - Jaw Pocket Depth
  - Jaw selection and design
- Refer to the “Best Practices” section for specific application guidance
- Factors in determining Jaw selection and OD/ID Clamping:
  - Part geometry
  - Part strength/deformation during clamping
  - Tab-out machining
  - Clamping clearance
  - Tool Clearance



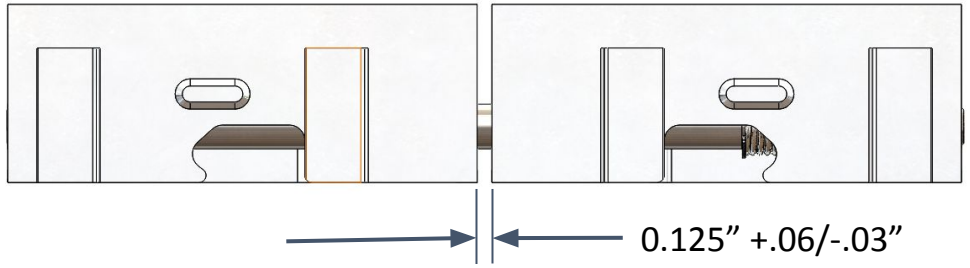
Example - OD Base Jaws with 1.5” Top Jaws cut to hold 2x2” material

Jaw design examples are shown in the appendix, with solid models available at www.versabuilt.com or via emailing sales@versabuilt.com

MultiGrip Jaw - Left Jaw/Right Jaw Nominal Gap

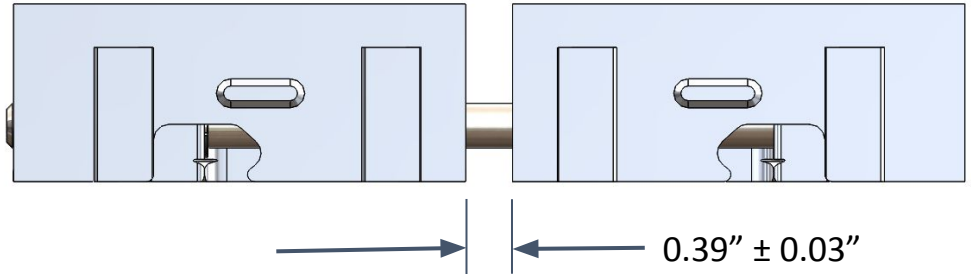
- Left and Right Jaws need to include a gap to allow for raw material variations and allow open and close operations for robot processing
- The images to the right show the nominal gaps required

OD Jaws



OD Jaws with 0.125” Nominal Gap
Machine Pocket with ⅛” spacer
*gaps above 0.19” may cause robot load/unload errors due to minimal vise to jaw feature clearance
*gaps under 0.09” may cause vise sensor errors
*with vise sensors disabled, the gap can be less, provided the jaws do not touch when clamping a part

ID Jaws

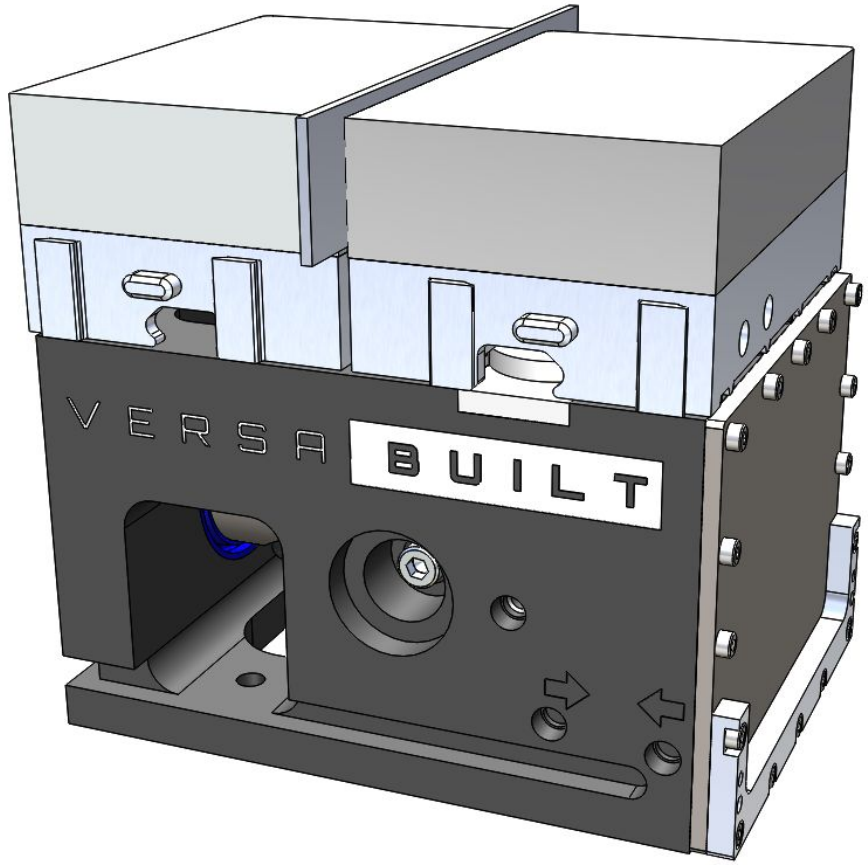


ID Jaws with 0.39” Nominal Gap
Machine Pocket with ID Jaw Fixture or Dogbone pocket

MultiGrip Jaw - Left Jaw/Right Jaw Nominal Gap

Machining Jaws at the Nominal Gap

- OD Jaws
  - Position the included 0.125” wide machinable jaw spacer in the jaws so that the bottom of the jaw spacer is between 0.125” and 0.250” below the lowest part of the jaw pocket to be cut.
- Match Clamping for Part Machining
  - Before machining the jaw pocket, set the vise clamping pressure to the intended clamping pressure during automated processing or the maximum clamping pressure of the vise

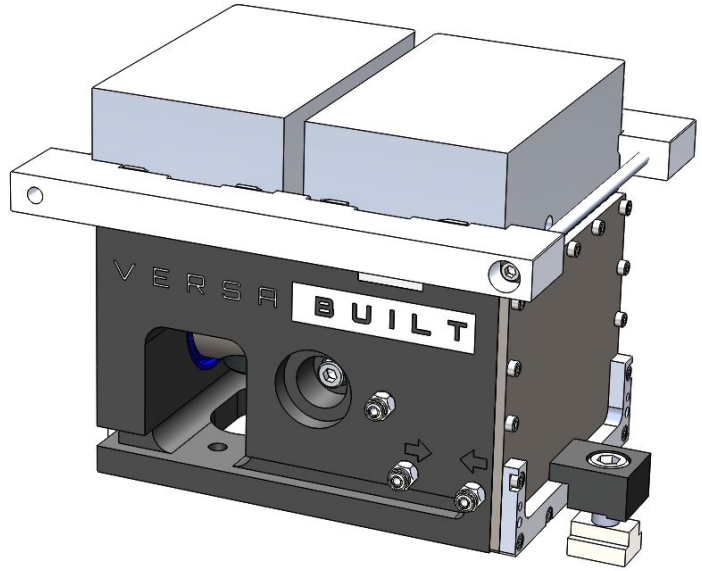


OD Jaws with 1/8” spacer

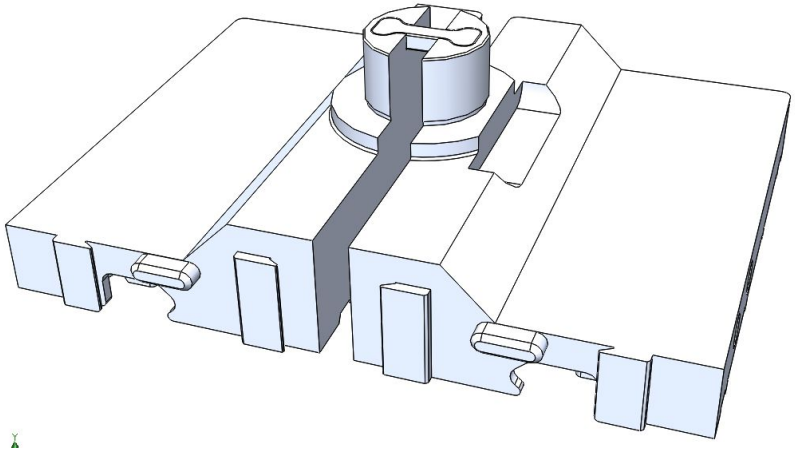
MultiGrip Jaw - Left Jaw/Right Jaw Nominal Gap

Machining Jaws at the Nominal Gap

- ID Jaws
  - Position the ID Jaw Fixture (P/N 5007434) around the lower section of the jaw (near the top of the Gripper interface features), then open vise against the Fixture stops to set the jaw gap. This sets the nominal gap to 0.39”.
  - An alternative or supplement to the ID Jaw Fixture, ID Clamp with a Dogbone. The image to the right shows a Dogbone in a pocket in example jaws, with the Dogbone set at the intended clamping Z-height. Preliminary machining/roughing of the jaws with the ID Jaw Fixture, then final machining of the part interface while ID clamping the Dogbone.
- Match Clamping for Part Machining
  - Before machining the jaw pocket, set the vise clamping pressure to the intended clamping pressure during automated processing or the maximum clamping pressure of the vise



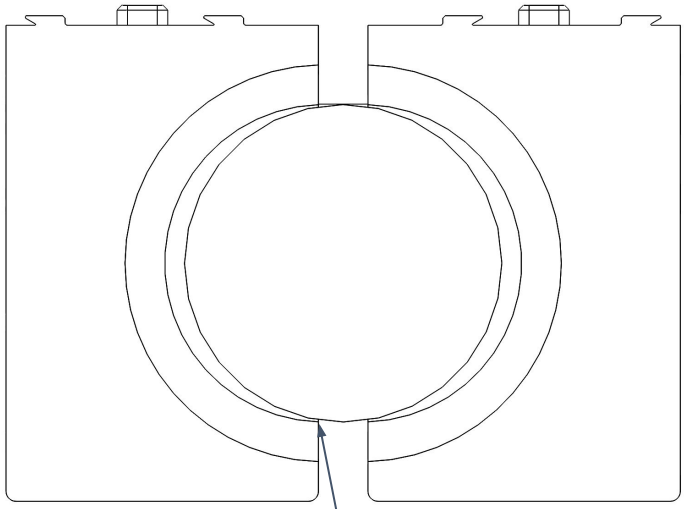
ID Jaws with ID Jaw Fixture, P/N 5007434


ID Jaws with Finish Dogbone, P/N 5003266

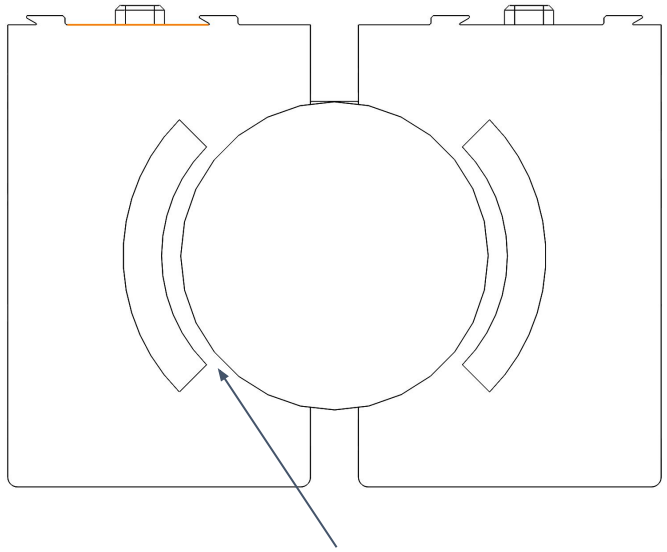
MultiGrip Jaw - Pocket Pick/Place Clearance

Pick/Place Clearance

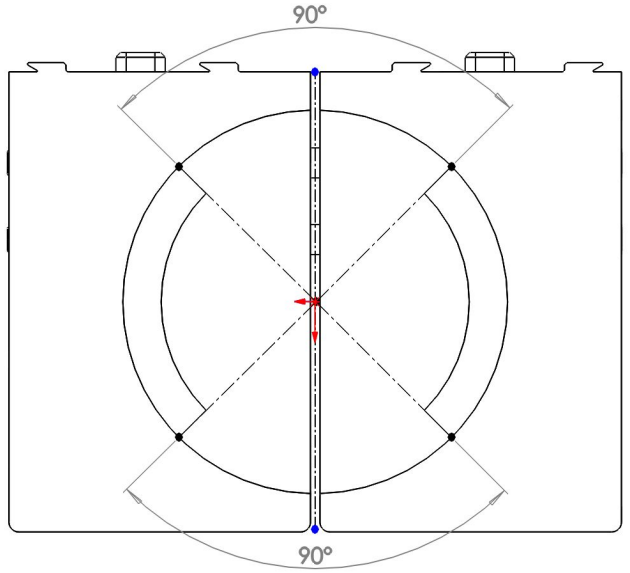
- MultiGrip Jaws open only in the X-direction and Y-clearance must be created or maintained
- Design the part pocket such that when the jaws are fully open (in the MultiGrip Gripper), there is adequate clearance between the the part and pocket
- Avoid pocket features that approach parallelism with the X plane of the jaws (lower left image)
- For round parts we recommend a 90 degree clearance cut along both sides of Y axis



Not enough clearance between part and jaws during pick



Enough clearance between part and jaws during pick

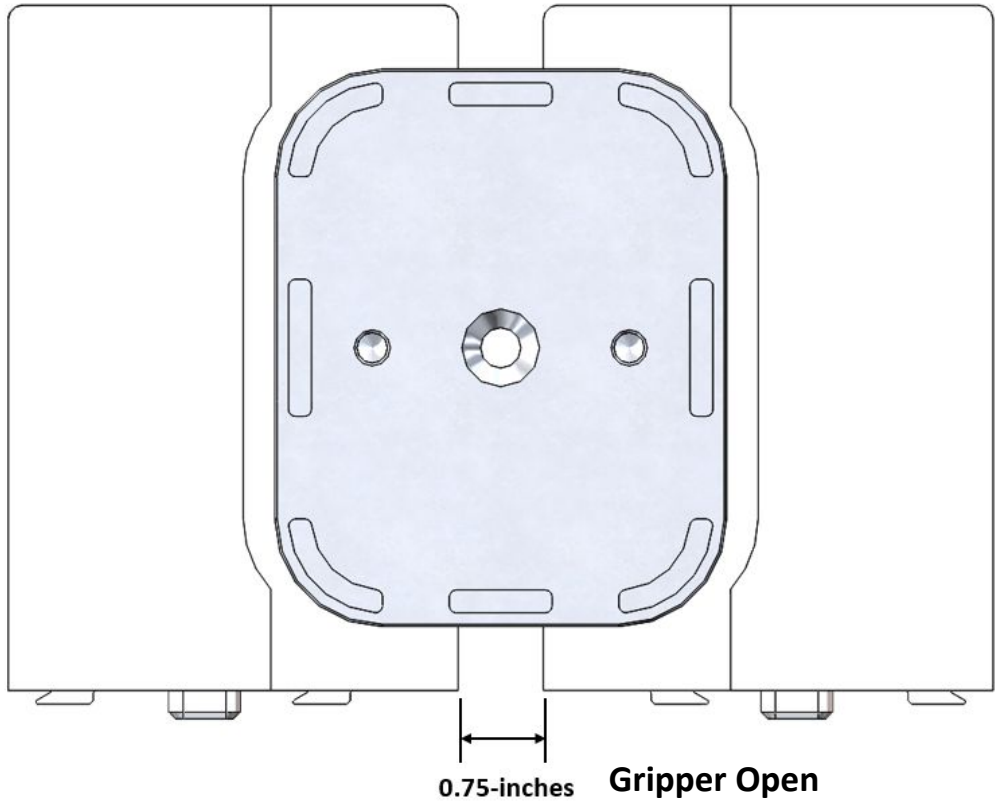


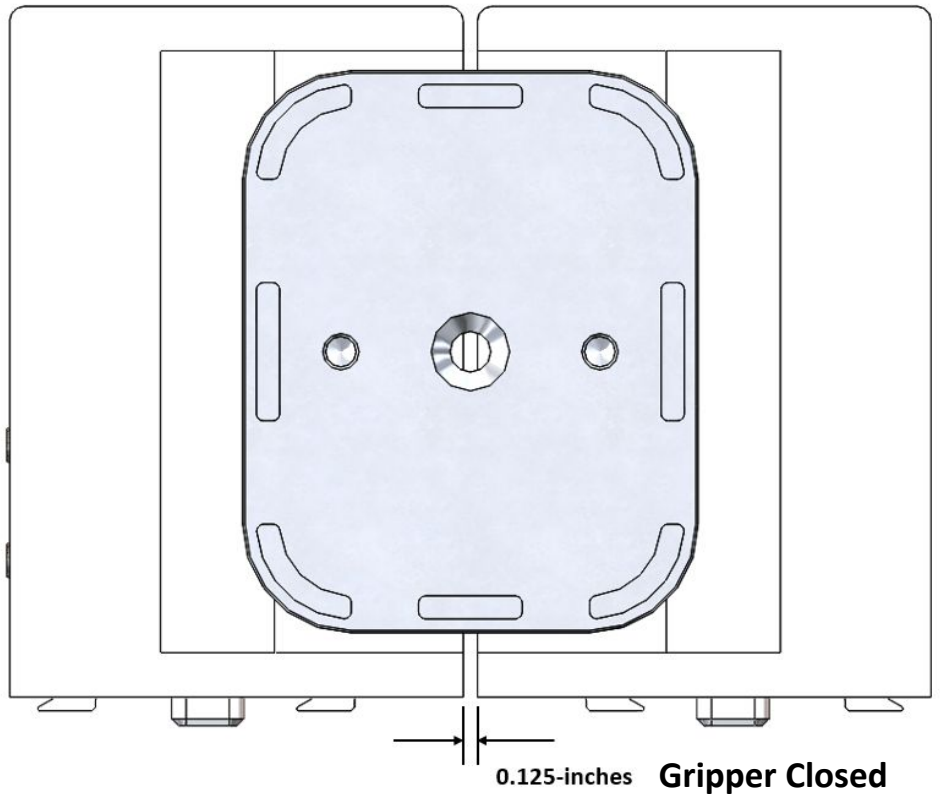
90 degree cut along Y axis for part clearance

MultiGrip Jaw - Infeed Pick Clearance

Pick/Place Clearance

- Consider the jaw stroke and nominal clamp positions during pick
- OD jaws max opening = 0.75” (~20mm), nominal vise clamp = 0.125”
- ID jaws min closing = 0.0”, nominal clamp = 0.394” (10mm)

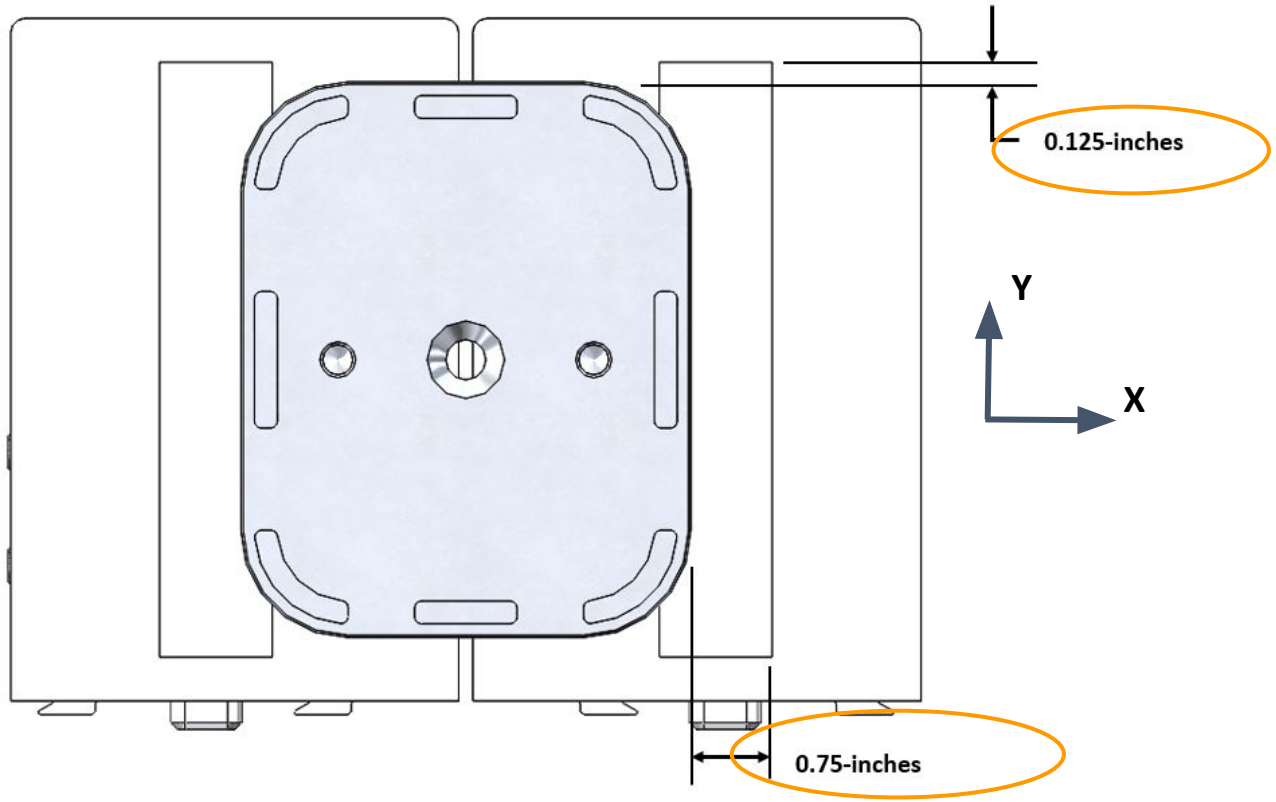




MultiGrip Jaw - Infeed Pick Clearance

Pick/Place Clearance

- Maximum X-direction sidewall = 0.75-inches
- Maximum Y-direction sidewall = 0.125-inches



Default layout of parts on the VersaCart are arranged for maximum density, assuming the sidewall dimensions shown.

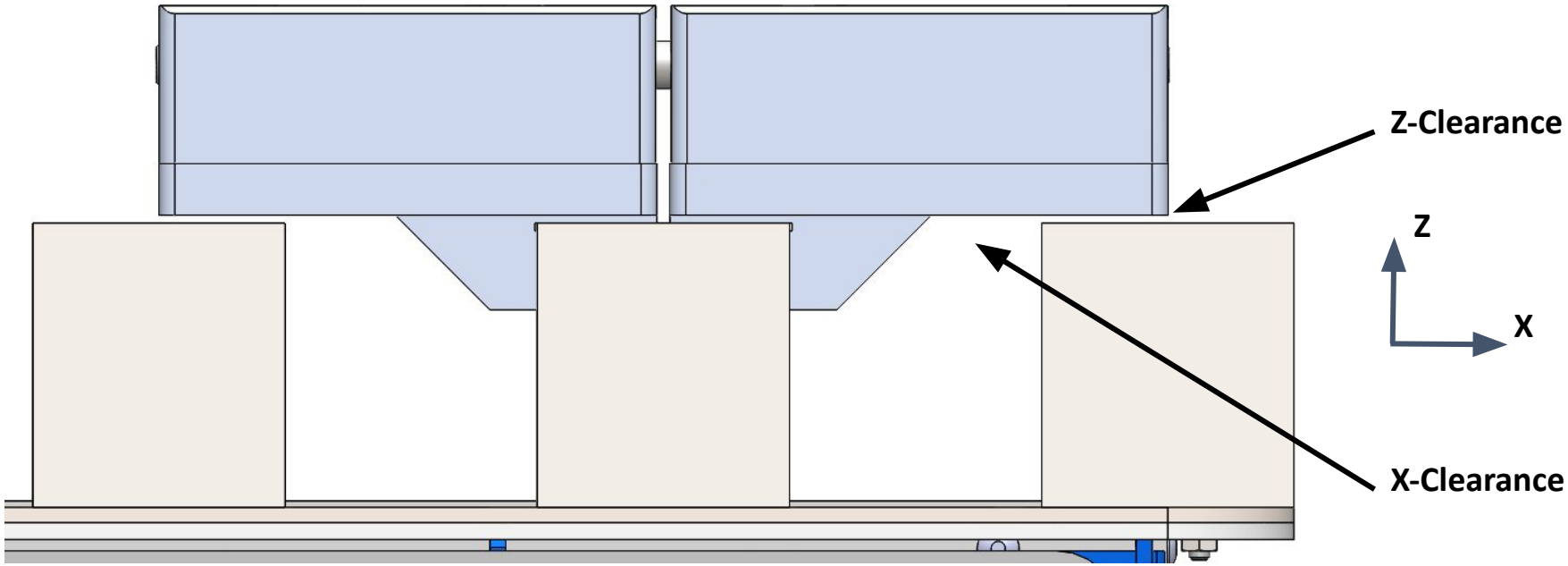
If you cannot design your jaws with minimized sidewalls, the layout of parts on the infeed will need to be changed to a lower density to clear the full jaw size.

Refer to the Configuration Manual for details custom infeed spacing.

MultiGrip Jaw - Infeed Pick Clearance

Pick/Place Clearance

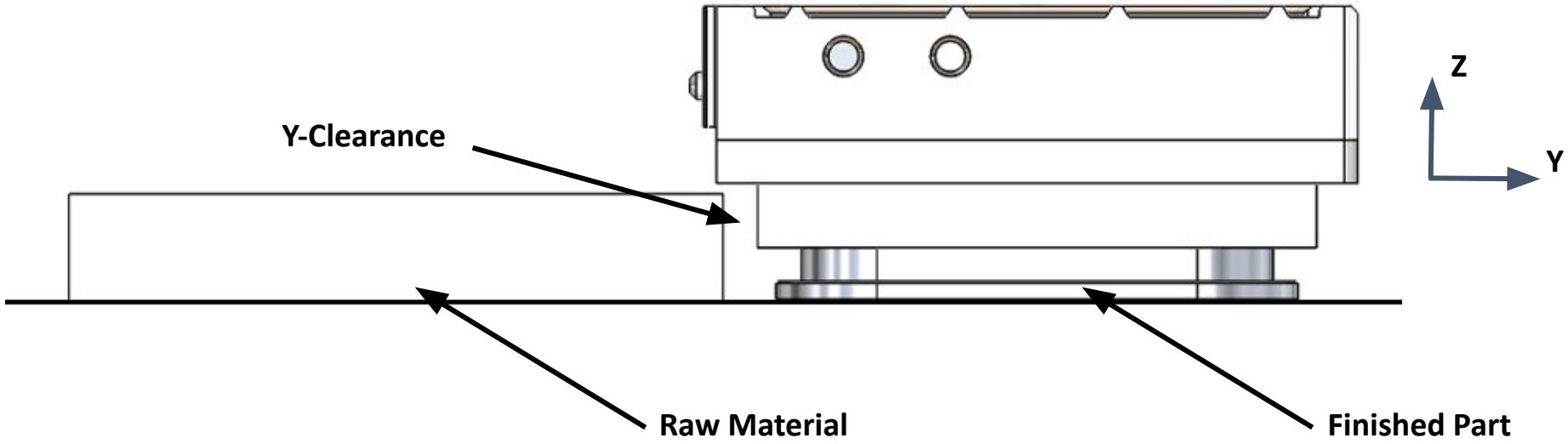
- Include Z-clearance between the jaw and adjacent parts on the infeed during pick and place of parts
- Clearance needs to be in X and Y Directions
- The image below shows placing a finished part on the infeed, with X and Z-Clearance to clear adjacent parts



MultiGrip Jaw - Infeed Pick Clearance

Pick/Place Clearance

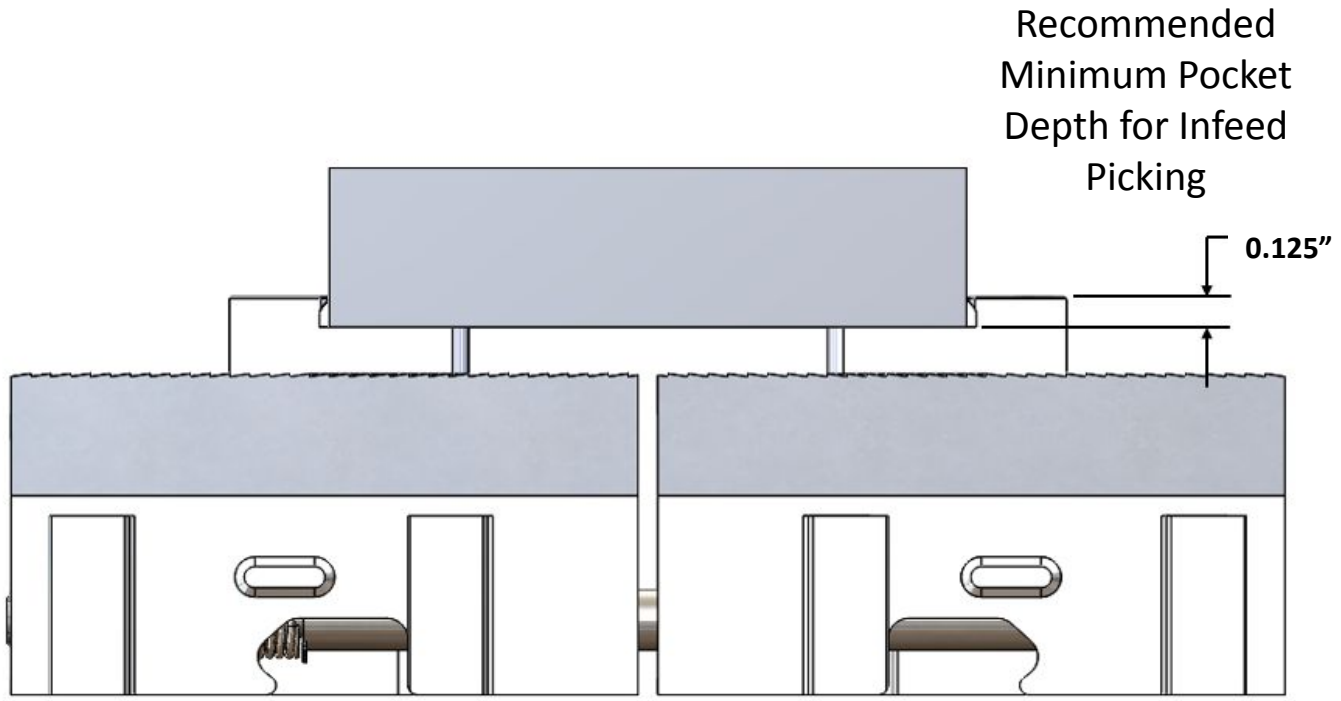
- To avoid Y-direction neighbor interference on VersaCart or a flat cart/table infeed, include Y-clearance as detailed on the previous pages.
- The image below shows placing a finished part on the VersaCart, with Y-Clearance in the jaw pocket to clear adjacent raw material



MultiGrip Jaw - Jaw Pocket Depth

Jaw Pocket Depth

- For Jaws that will pick the part from infeed, we recommend a minimum pocket depth of 0.125”.
- For process reliability, wherever possible, consider a greater clamping depth for infeed picking.
- Using the “Part Find” option in the part configuration can aid a shallow depth of pick.
- For OP2 jaws that will be used to transfer the part from OP1, we recommend a minimum pocket depth of 0.100” (2.5mm).



MultiGrip Jaw Options

There are multiple options for workholding design with MultiGrip and selection of the type of jaws depends on the needs of the application. Jaw types are:

- Swivel-Fixed Top Jaws
- Fixed-Fixed Top Jaws
- Fixed Base Jaws
- OD/ID Jaws

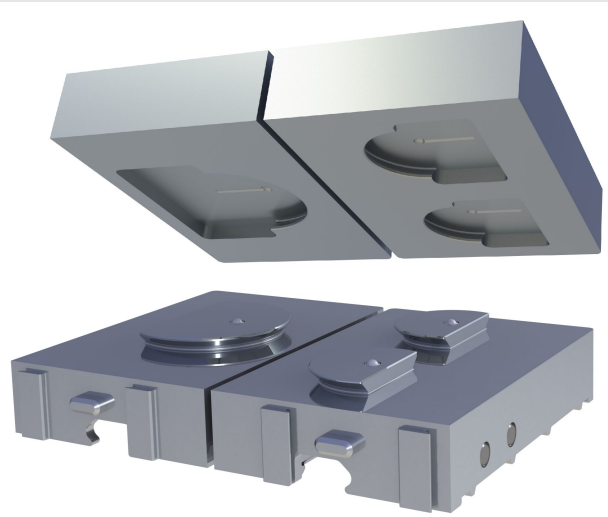
Jaw selection depends on part geometry, part height, part material type, desired clamping locations, process reliability and part precision. The following pages outline the benefits of each type, with the “Best Practices” and “Example Jaws” sections showing further details, such as:

- Jaws with steel inserts
- Jaws with Y-locator
- Jaws with overlapping Z-surface
- Large Parts

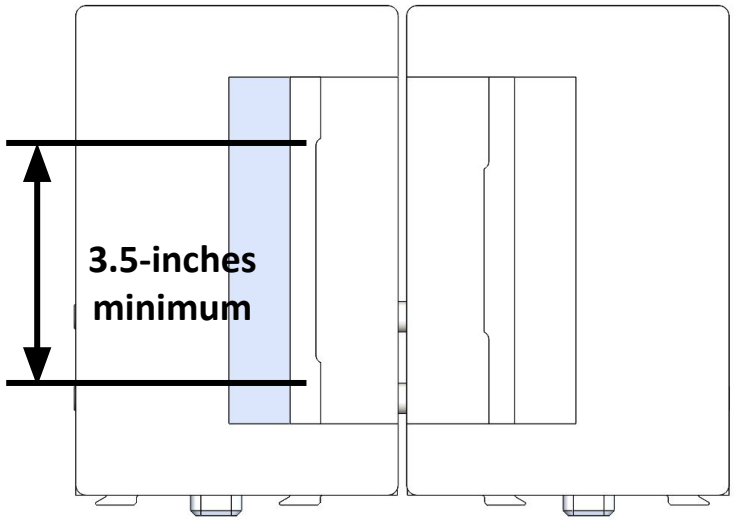
Vise and Jaw files available for download from www.versabuilt.com/resources

Swivel-Fixed Top Jaws

- Swivel-Fixed Top Jaws are the most common type of jaws used MultiGrip workholding applications
- The Top Jaws are composed of a “swivel” jaw on the left side and a “fixed” jaw on the right side
- The Swivel side allows for the jaws to conform to material variation and imperfections
- Jaw design for rectangular parts should promote rotation/swivel of the left jaw with a part interface outside the radius of the swivel features on the base jaw/underside-pocket. The swivel feature radius is 1.4-inches. If the clamping interface of the part is less than 3.00-inches apart, the lever to rotate the swivel jaws may not be sufficient for swiveling.
- Recommended **minimum part length for Swivel-Fixed Jaws is 3.5-inches** (allowing the distance of the clamping features on the jaws to be greater than 3.0-inches)

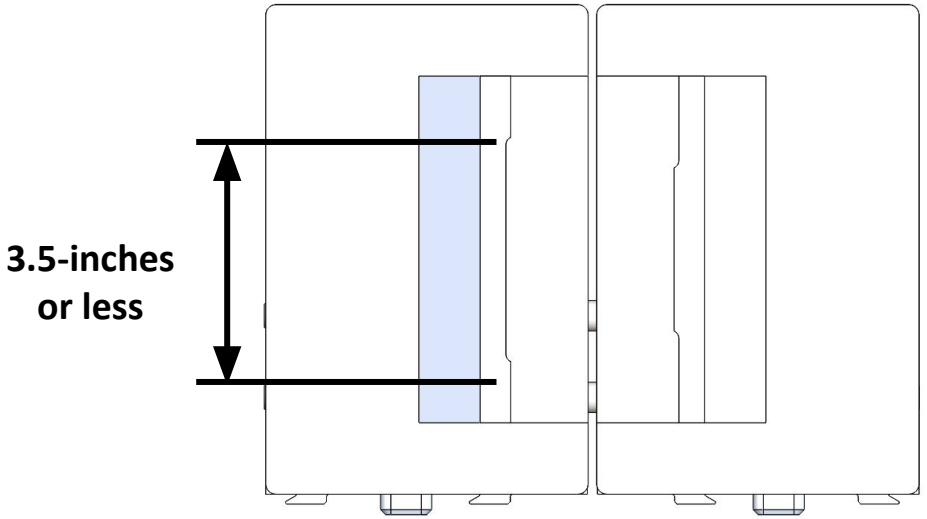


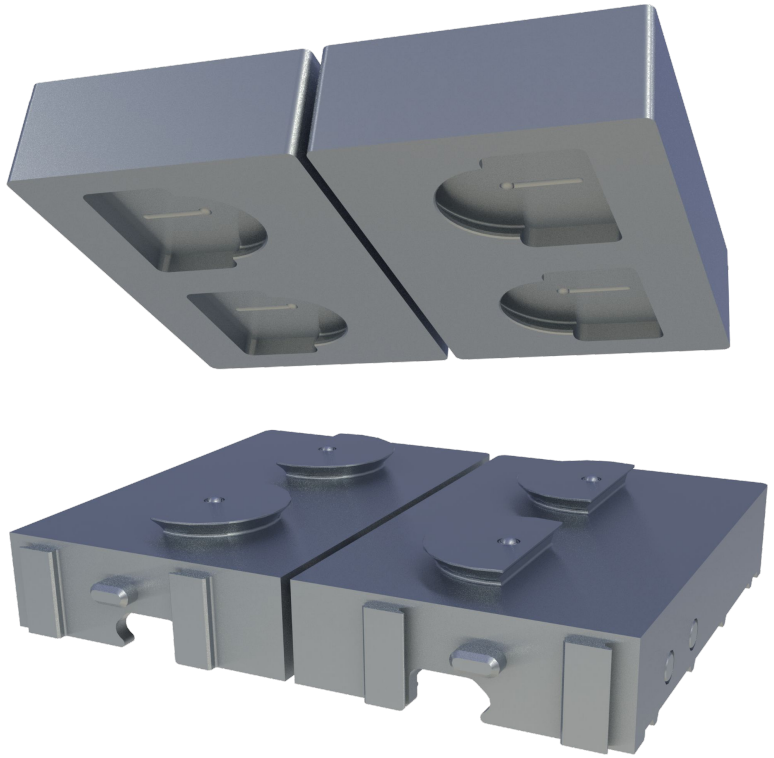
MultiGrip Top Jaws and Base Jaws (Swivel-Fixed)



Fixed-Fixed Top Jaws

- Fixed-Fixed Top Jaws are an alternative to Swivel-Fixed Jaws, when the swivel functionality is not desired or if the part length limits swivel capability.
- The Top Jaws are composed of a “fixed” jaw on the left side and a “fixed” jaw on the right side
- Recommended **for parts with length less than 3.5-inches**, rather than Swivel-Fixed Top Jaws.



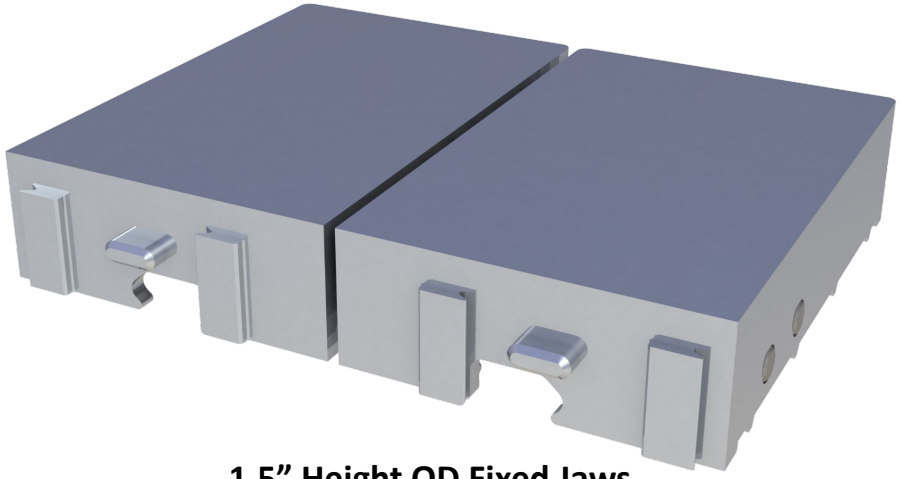


MultiGrip Top Jaws and Base Jaws (Fixed-Fixed)

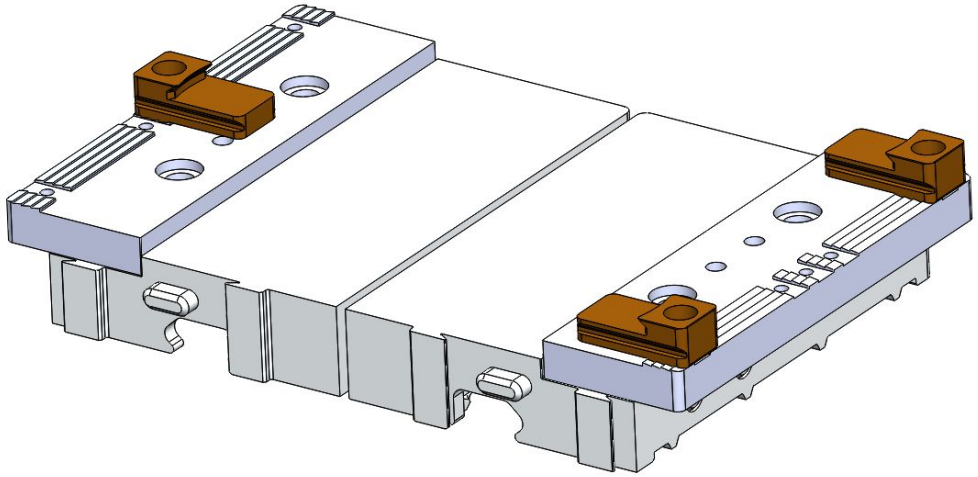
Fixed Base Jaws

Fixed Base Jaws

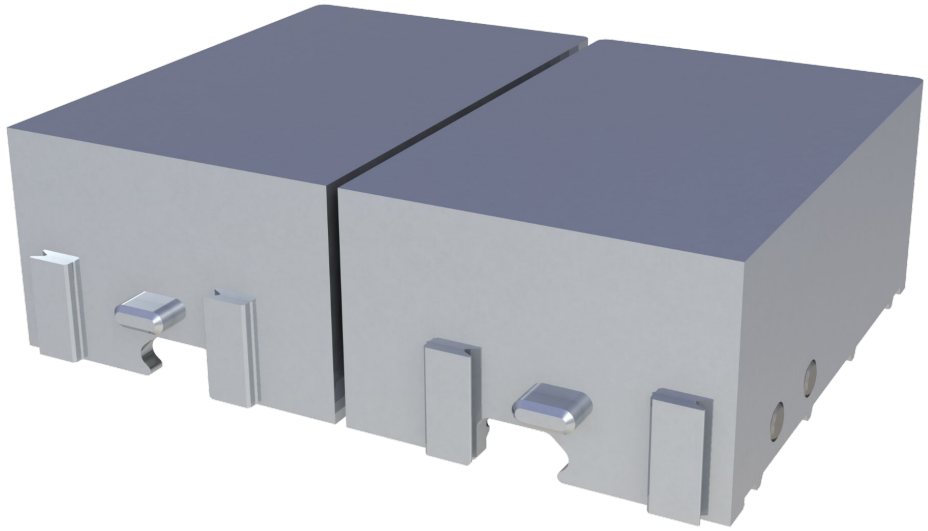
- Fixed Base Jaws provide an opportunity to make lower-profile jaws or maximize clearance for machining 4 or 5 axis parts, where tool clearance is important
- Fixed Base Jaws can also be used to bolt-on custom jaw tops



1.5” Height OD Fixed Jaws



Example Jaw - 1.5” Fixed Jaws with custom top w/ VersaBites for 10-inch wide raw material



2.5” Height OD Fixed Jaws

Best Practices

Section 2

Application Options & Best Practices

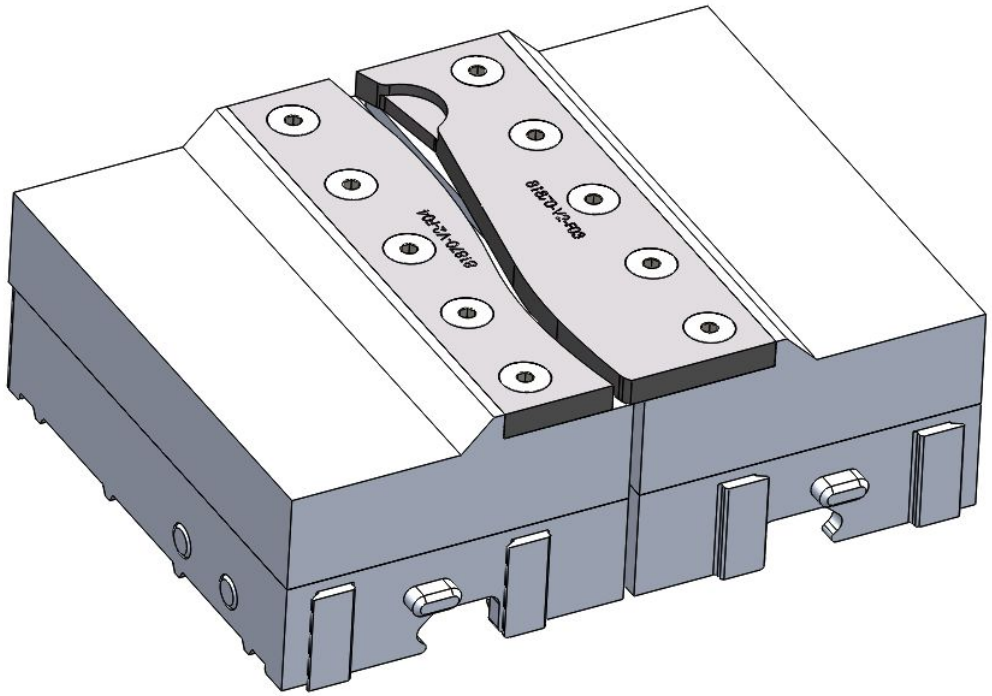
The following Best Practices are included in this section:

- Jaw Inserts
- Overlapping Z-Surface
- Y/Z Part Locating w/ Robot & CNC Tools
- G-Code Vise Control
- Lightweight Parts
- Jaw Deflection considerations
- Large Parts
- Setting the Machining Coordinate System
- Indicating MultiGrip Jaws
- Using a CNC Probe
- CNC Probe to Offset in Y
- Fixtures that Bite into Raw Material
- Chip Control
- Jaw Repeatability
- Jaw Durability
- Dry Machining

Jaws Inserts

Jaws Inserts:

- MultiGrip Jaws are composed of 6061 aluminum
- For applications requiring a harder/more durable interface between the part and the jaws, we recommend adding an insert, bolted to the MultiGrip Jaws, with the insert composed of a hard material to mitigate wear or durability concerns

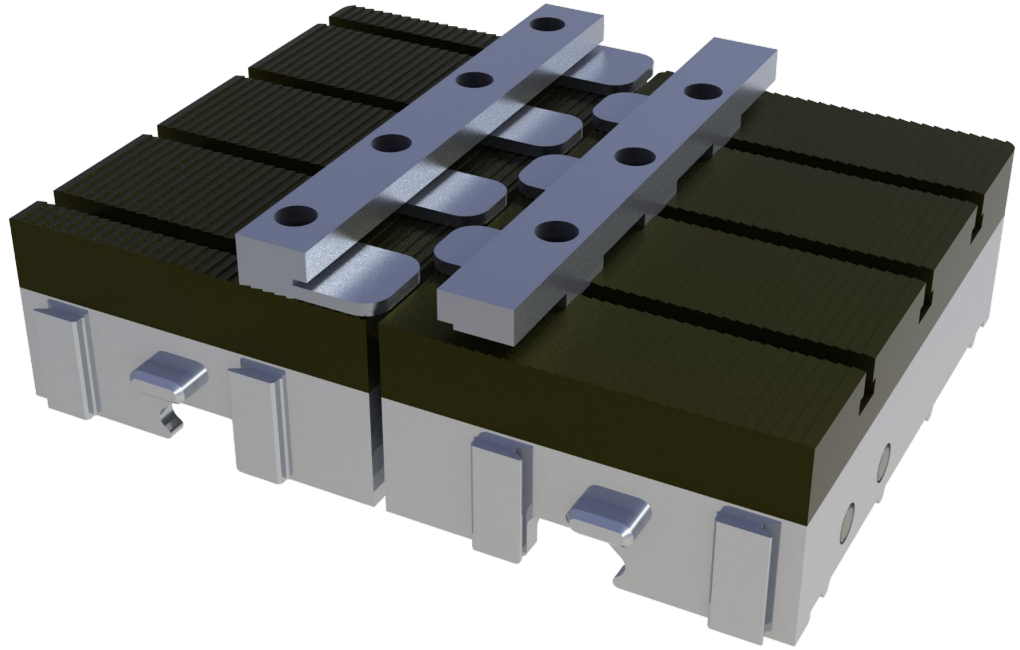


Example Jaw - Hardened Steel Insert for Stainless Steel Parts

Overlapping Z-Surface

- For applications with narrow parts or parts with tight parallelism or flatness requirements, overlapping z-surfaces may be required.
- VersaRails are available for narrow parts with interlaced z-surfaces.
- Custom jaws with an overlapping z-surface, where the part rests on a single z-surface (rather than a left and right surface) can aid parallelism or flatness needs.

*If an overlapping Z-surface is not an option, use Vise Exhaust with Z-Push to seat the part via G-Code Vise Control (refer to the VSC/CNC Communication, G-Code and Programming Manual).

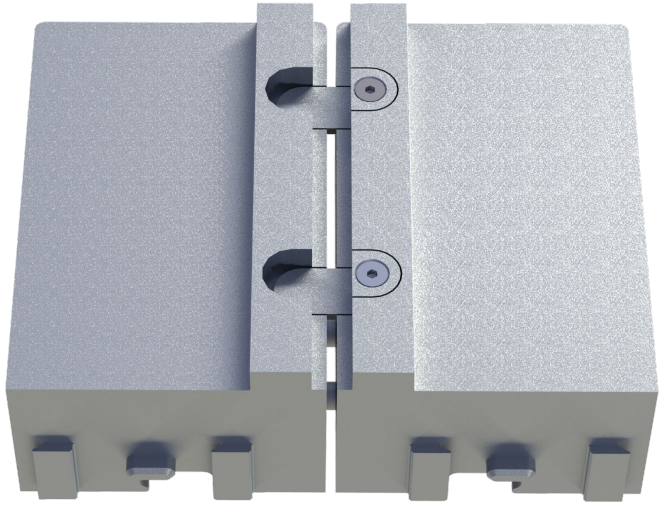


Example Jaw - Universal Top Jaws w/ VersaRails

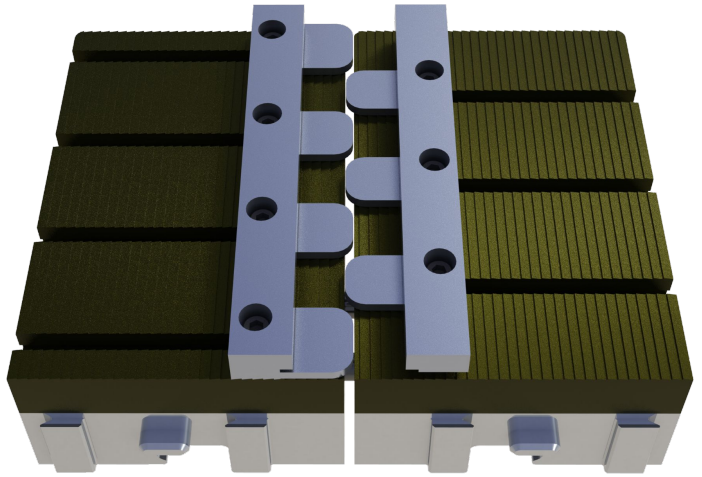
Overlapping Z-Surface

Overlapping Z-Surface - Narrow Parts

- Generally, parts less than 1.625” wide cannot be settled using Gripper or Vise Settle with standard MultiGrip Jaws (opening and closing jaws to seat the part in Y and/or Z)
- When the gripper opens, the gap between the jaws is 0.80” and the part may fall into the gap
- Adding an overlapping bridge into your MultiGrip Jaws or using Universal Top Jaws with VersaRails prevents the part from falling into the open gap during a settle operation
- The first example to the right shows 2 bridges bolted into place, then machined for clamping a 0.50” part
- The second example shows VersaRails in the 1.5” position (refer to the Universal Jaw Products manual for more information)



MultiGrip Jaws with 2 Bridges

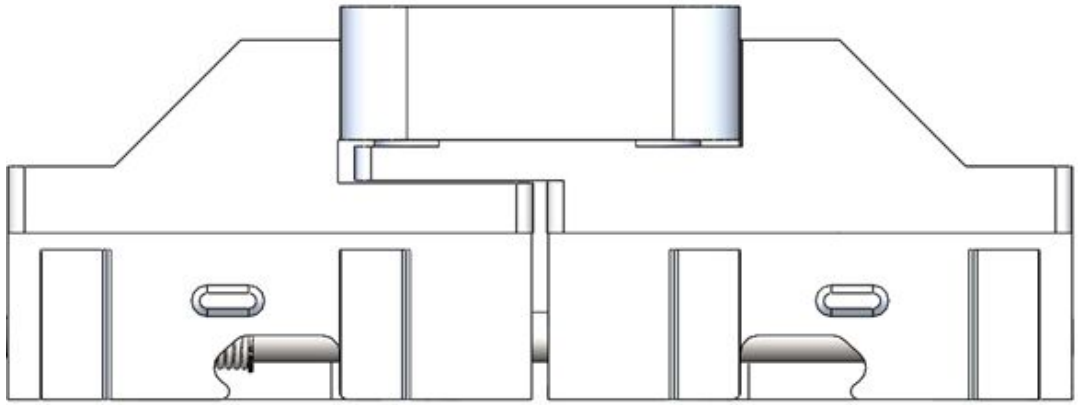


Universal Top Jaws with VersaRails

Overlapping Z-Surface

Overlapping Z-Surface - Common Z-Surface

- For narrow parts or workholding that requires a single z-surface, rather than a left surface and right surface, consider custom Top Jaws or Top Jaws with a bolt-on addition to make a common z-surface.
- Best practice - Include the Z-surface on the fixed-side of the jaws.

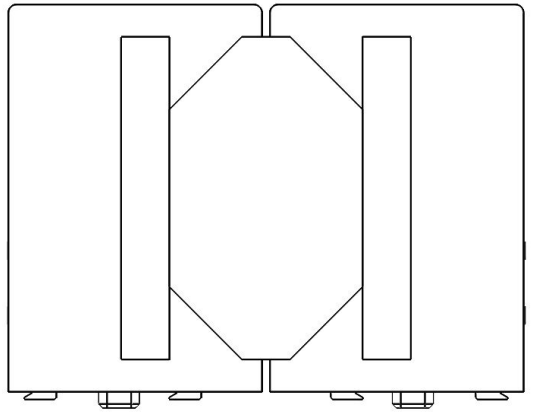


MultiGrip Jaws with
Customized Top Jaws for
a single z-surface

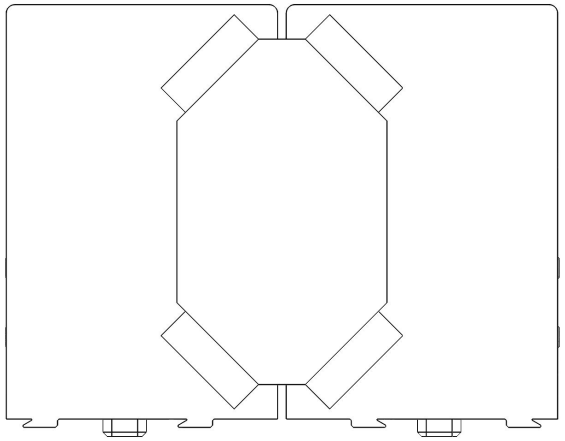
Locating Part to Y/Z Datums

Locating the Part with Pocket Design

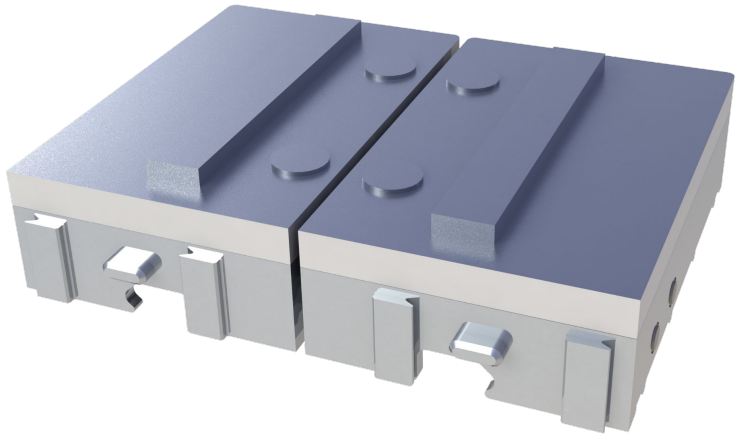
- To prevent part lift in Z during clamp, avoid a radiused corner between the Z locating surface of the jaws and the jaw pocket wall, examples:
  - Z-Pads on the floor of the jaw pocket
  - Key cutter undercut on the jaw walls
- When possible, use the shape of the part to locate the part in Y and if required, rotation about Z



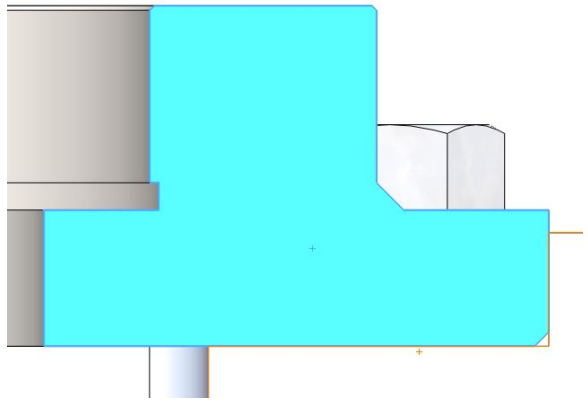
Jaw Pocket does not locate part in Y



Jaw Pocket locates part in Y and rotation about Z



Pads on floor of Jaw Pocket



X-section view of wall with undercutt

Locating Part to Y/Z Datums

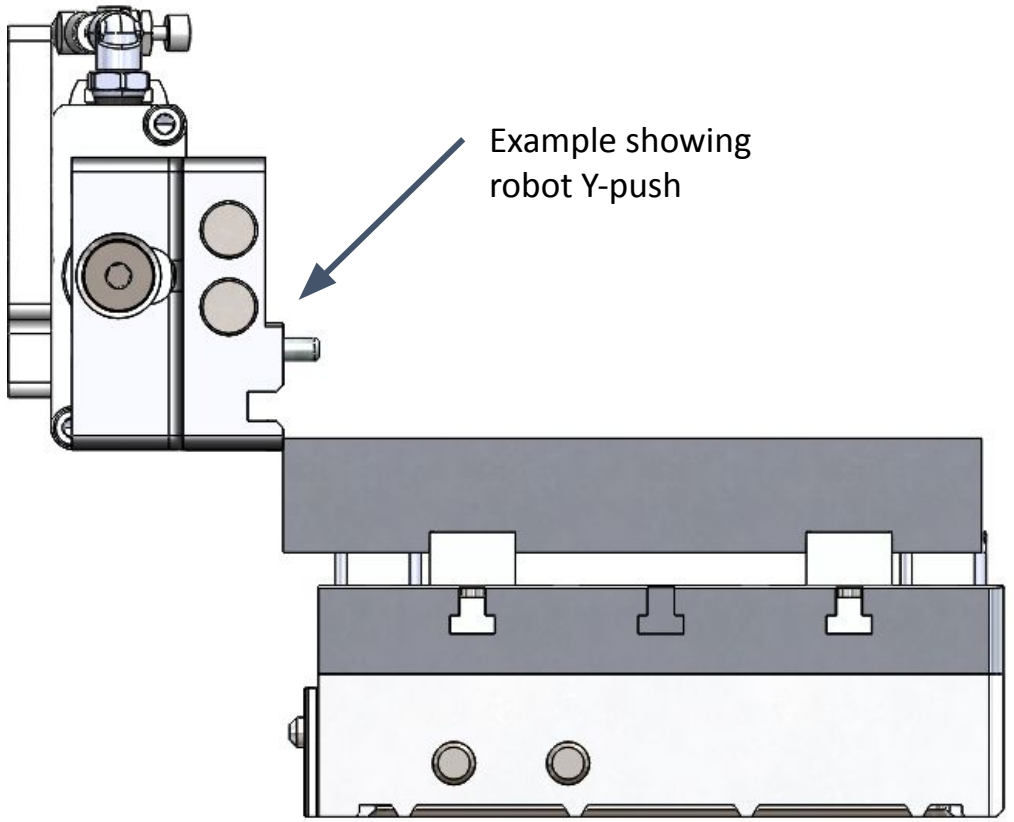
Locating Parts in Y and Z, with the Robot Gripper or the CNC

- When the shape of the part and the Jaws cannot adequately locate the part in Y during clamping, additional measures are needed
- Options for locating rectangular parts in Y:
  - Build a Y datum into the MultiGrip Jaws and using the Transfer Settle and Transfer Settle Angle options under the Advanced Configuration Options
  - Push the part with a CNC Tool, with the vise unclamped or vise exhausted, using G-Code Vise Control
  - Use CNC probe to set the Op20 CNC home location in Y from a machined feature in Op10
    - Requires a valid datum for the CNC probe to reach
    - Typically a through hole feature from OP 1 the probe can reach or a side profile that was machined in OP 1

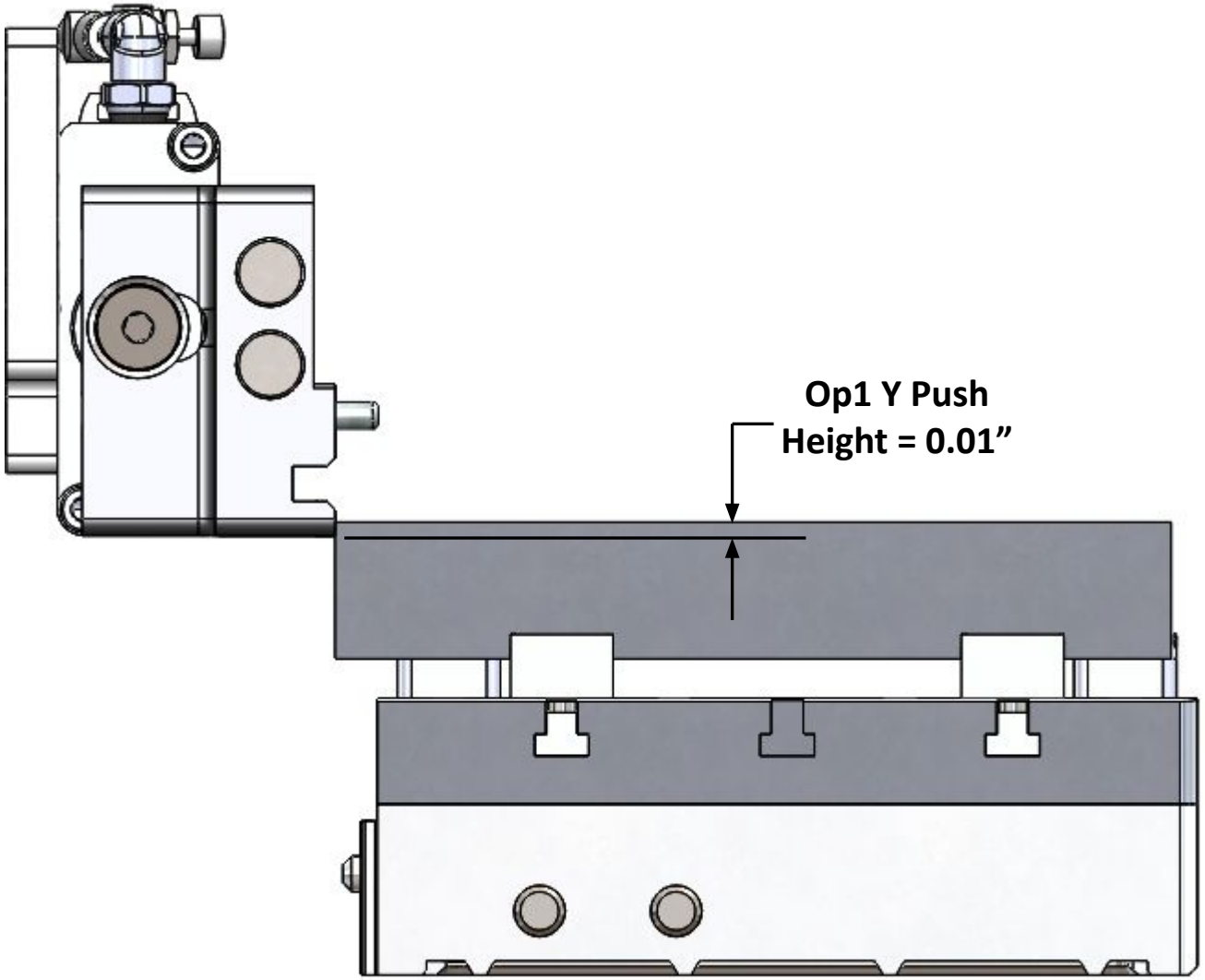
Locating Part to Y/Z Datums

Locating Parts in Y, with the Robot Gripper

- The robot gripper can be used to push the part into position a Y position. Y Push option is available when “Advanced Options” are selected in the Part Configuration
- By default, the robot will use the gripper to push the part to the center of the vise based upon the part length entered
- Optionally, the height offset the gripper pushes the part can be set
- The offset from the top of the part loaded in the vise the the gripper will push from is -0.150” (3.5mm) or 0.150” below the top of the part; positive values would be above the part *Top of the part is calculated from the Pick Height
- Gripper Y Push works best with parts wider than 2”; always test the Y Push before assuming it will work for your application



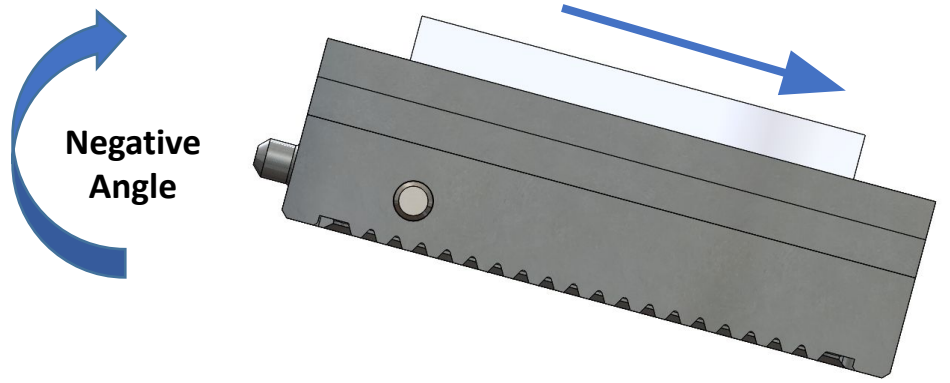
Locating Part to Y/Z Datums

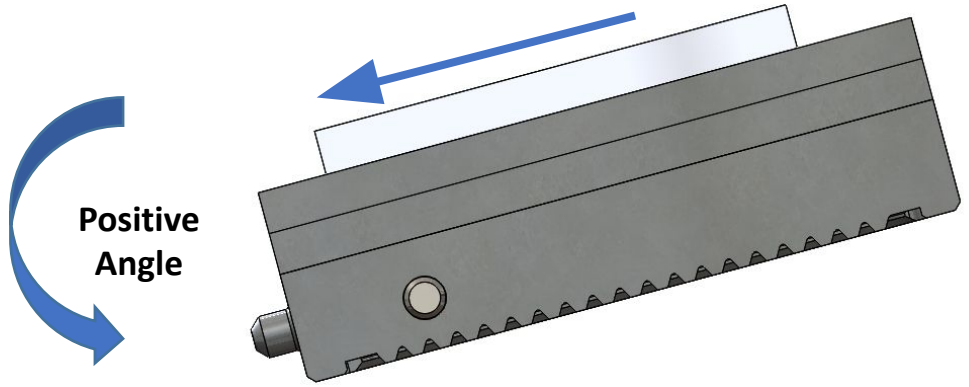


Locating Part to Y/Z Datums

Locating Parts with Robot Gripper Settle

- Using gravity to settle part in Z and Y directions.
- Unclamp the part to allow the part to drop and shift in Y (if an angle is entered)
- For Robot Z-settle, Angle = 0
- For Robot Z & Y-settle, enter + value for back tilt, - value for front tilt

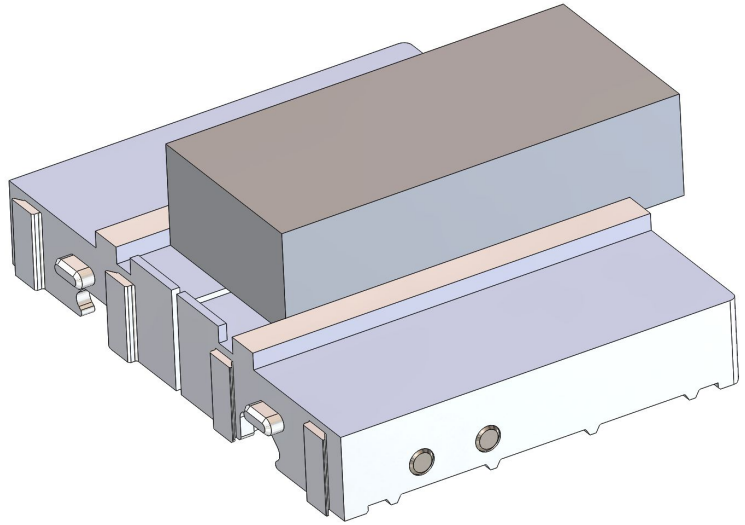


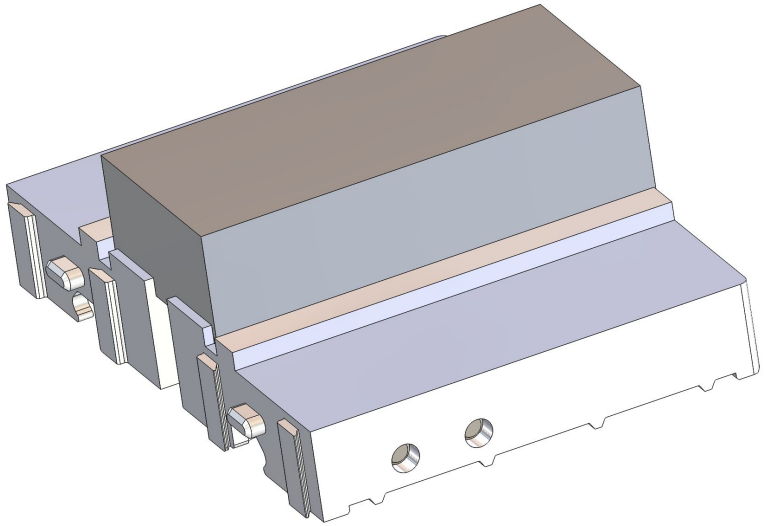


Locating Part to Y/Z Datums

Locating Parts in Y, with Gripper Settle

- To use Gripper Settle to locate a part in Y, the jaws should be designed with a datum in Y, generally near the negative Y edge of the jaws
- The datum should be positioned so the part is centered in the jaws if the part is less than 5.5” in length; for longer parts, the datum should be at the front edge of the jaws and the part will overhang the jaws in the positive Y direction
- For a Y datum nearest the gripper interface, use a positive Pick Settle Angle

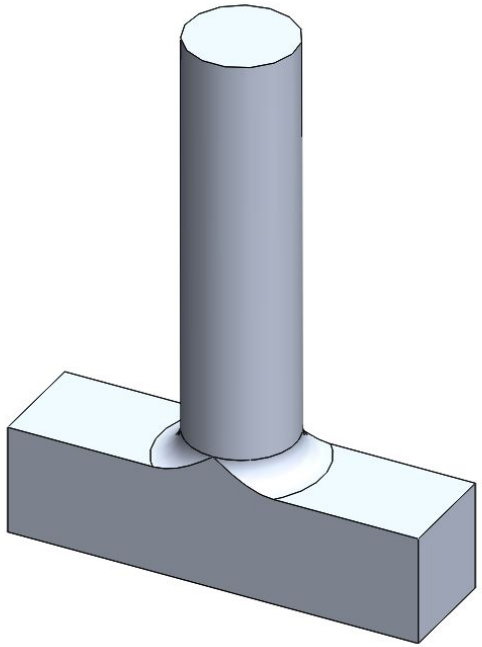




Locating Part to Y/Z Datums

Locating Parts in Y, with the CNC

- With G-Code Vise Control, use a Y-Push tool to accurately move the part to the proper position:
  - Unclamp or de-pressurize the Vise
  - Move the part with a CNC tool
  - Re-clamp or re-pressurize the Vise
- For applications using a Standard CNC driver (Cycle Start/Cycle End handshake), the CNC Part Settle Program is selected as an option in the part configuration
  - When selected, the VSC will call a separate CNC program to perform the settle
  - The G-code program must be modified to include the call to the settle program before the milling program



Example Y-Push Tool
VersaBuilt P/N 5002202

Refer to the "VSC/CNC Connection and Programming Manual" for G-code vise control commands

Locating Part to Y/Z Datums

Locating Parts in Y, with the CNC

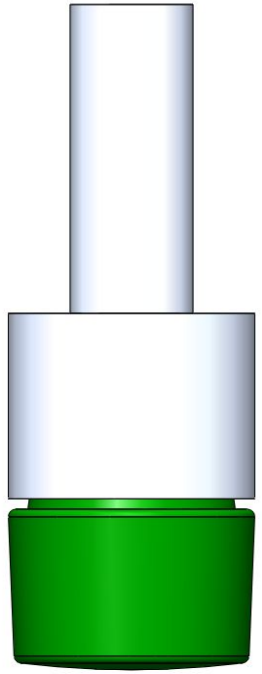
- For Y Push, locate XY to clear the part laterally
- Bring the Y push tool to Z clearance
- Feed to the Z position to push the part and feed X or Y to that location with the vise either open or exhausted.
- Close or re-pressurize the vise
- Feed X or Y away
- Return to Z clear

- Example Sequence:
  - G0 X0. Y4.2 (Position XY)
  - M19 (Orient Spindle)
  - G43 Z1.25 H44 (Bring tool to Z clearance)
  - G1 Z1.125 F50. (Feed to push level)
  - G65 P9002 D1 C1.0 (Open Vise 1) (C06. to exhaust instead of open)
  - G1 Y3.281 F50. (Feed to Y or X location)
  - G65 P9002 D1 C0. (Close Vise 1) (C07. to re-pressurize)
  - G1 Y3.5 F50. (Feed away from the part)
  - G0 Z2.5 (Return to Z clearance)

Locating Part to Y/Z Datums

Locating Parts in Z, with the CNC

- If gripper settle options do not provide consistent or sufficiently accurate results, Vise Settle (Vise unclamp the clamp) and/or Z-Push within the CNC program can be used to more accurately position the part in the jaws
- To perform Z-Push, at the start of the milling program:
  - Call up a compliant tool (Z-push tool) that can push into the part
  - Either unclamp or exhaust pressure to the vise
  - Push the part with the compliant tool
  - Clamp or re-pressurize the vise, preferably while the tool is still pushing on the part
- For applications using a Standard CNC driver (Cycle Start/Cycle End handshake), the CNC Part Settle Program is selected as an option in the part configuration
  - When selected, the VSC will call a separate CNC program to perform the settle
  - The G-code program must be modified to include the call to the settle program before the milling program



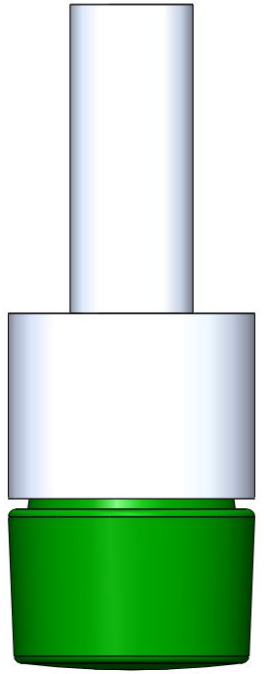
Z-Push Tool
VersaBuilt P/N 5002394

Refer to the "VSC/CNC Connection and Programming Manual" for G-code vise control commands

Locating Part to Y/Z Datums

Locating Parts in Z, with the CNC

- For the Z push, position X and Y first.
- Call the tool offset to the clearance level >> aim for ~.050” of push.
- Example Sequence:
  - G0 X0. Y0. (XY Push Location)
  - M19 (Orient Spindle)
  - G43 Z2.2 H46 (Position Z to clearance Level)
  - G1 Z1.95 F30. (Feed down .050”) (Z push can be done with the vise pressurized, or exhausted)
  - G0 Z2.2 (Return Z to Clear)



Z-Push Tool
VersaBuilt P/N 5002394

Refer to the “VSC/CNC Connection and Programming Manual” for G-code vise control commands

G-Code Vise Control

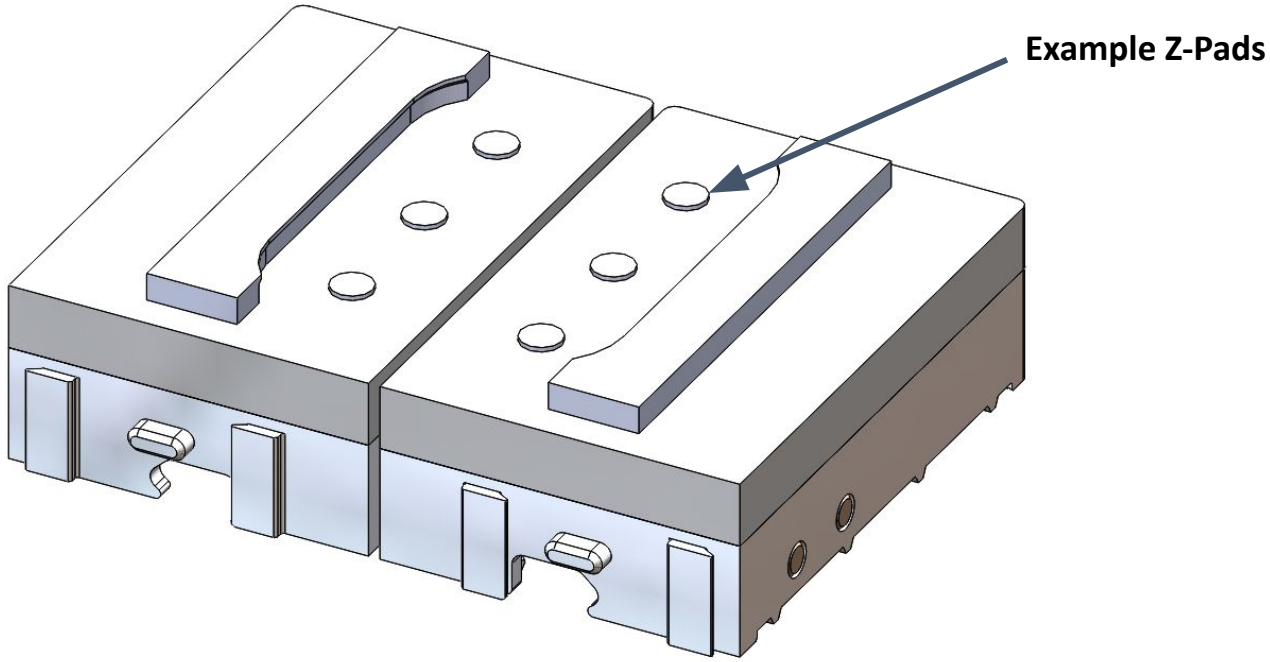
As noted in the previous pages, with VersaBuilt Automation Systems, control of vises is available with G-Code Commands, with the VSC Macro Driver or the Standard “Handshake” Driver. This allows the machining processes to include:

- Vise Open
- Vise Close
- Exhaust Pressure to the Vises*
- Pressurize Vises*

*With air pressure to the vises exhausted to atmosphere, the part is held by the vise without active clamping force. This allows a CNC tool to be used to position the part, akin to tapping a part with a mallet, while lightly clamped in a manual vise

Lightweight Parts

- Due to coolant surface tension, lightweight parts, with flat surface area between the part and jaws and in a machining environment using coolant, may not release from the jaws during place or operation transfer.
- When machining lighter parts with large surface areas, minimize surface contact between part and jaws
- Use “pads” in Z and X clamping surfaces as necessary to reduce surface area

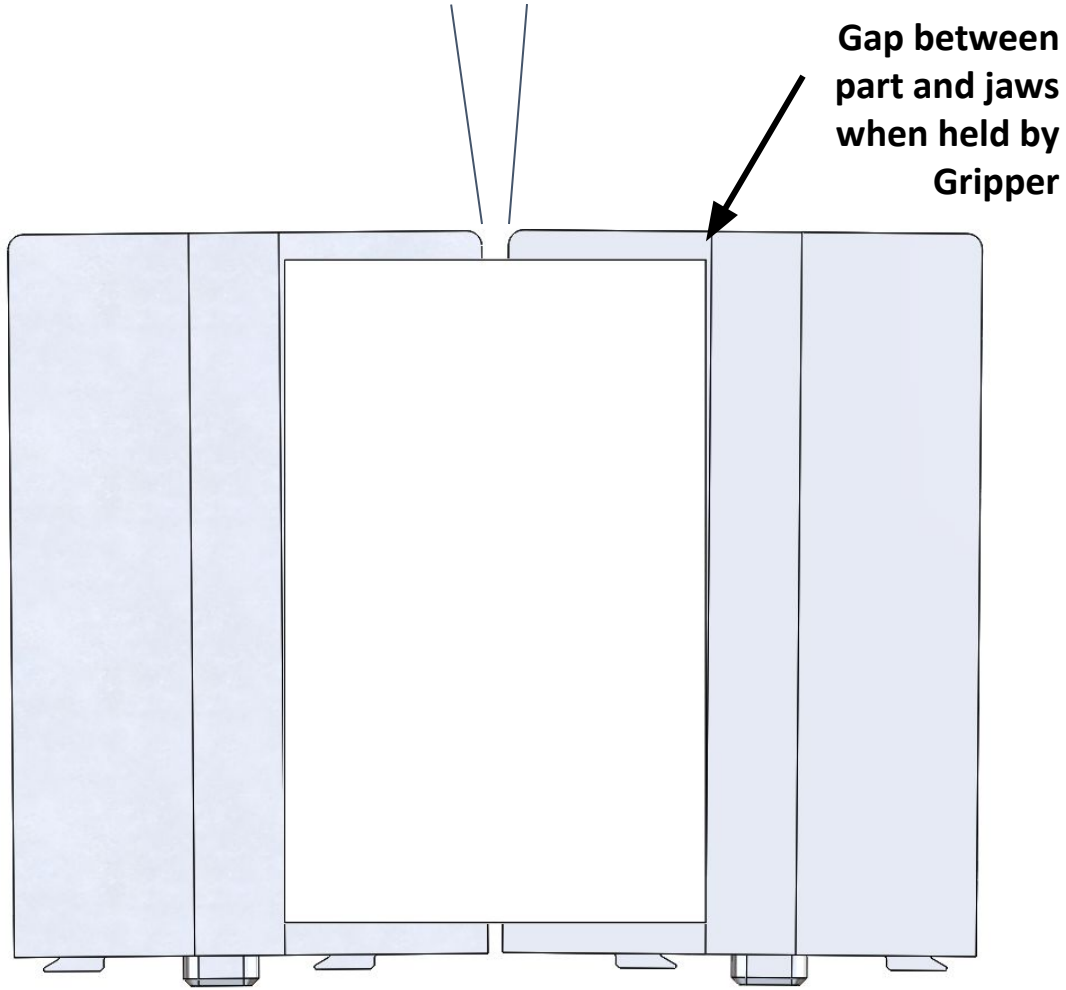


Addressing Jaw Deflection

Gripper Clamping Deflection

- MultiGrip ***Fixed Jaws*** will deflect a small amount during part grip* and with parallel wall jaws. *The MultiGrip Gripper interfaces with the jaws at the front of the jaws, causing a small "V" and can result in poor picking results (see the following page for fixed jaw pocket design for rectangular parts)*
- MultiGrip Top Jaws include a fixed jaw and a swivel jaw; the swivel jaw is designed to rotate to ensure full part contact with the part during part pick as the jaw deflects
- MultiGrip Fixed Jaws do not have a swivel jaw and will not be able to pick some part shapes without additional considerations, like 3-points of contact (shown on the following page)

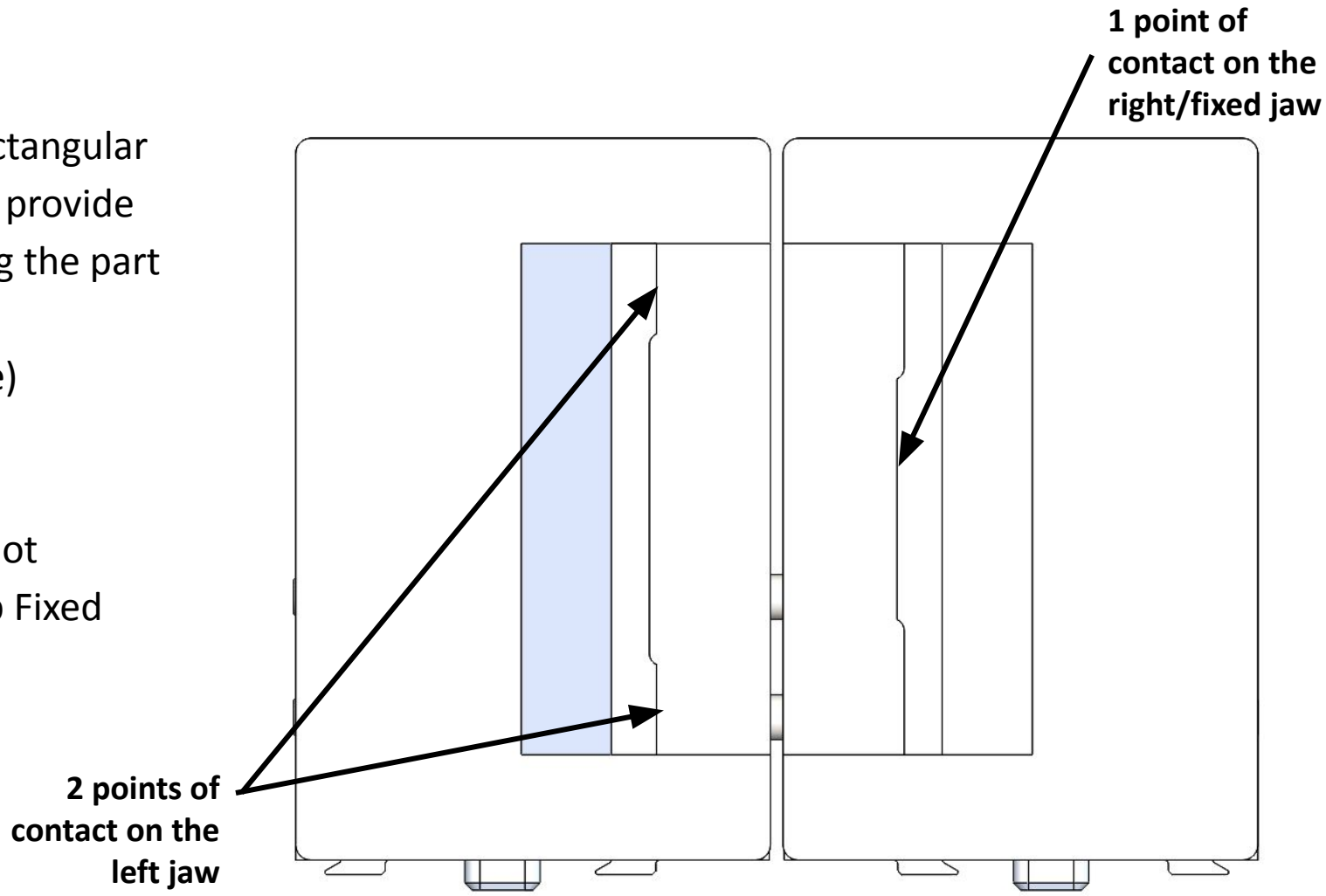
** Jaw deflection shown does not occur when MultiGrip Jaws are loaded into a MultiGrip Vise. MultiGrip Base Jaws with Top Jaws accommodate jaw deflection and generally no changes for jaw deflection are required.*



Addressing Jaw Deflection

Gripper Clamping Deflection

- When using MultiGrip Fixed Jaws with rectangular parts, triangulation of the jaw pocket will provide good results during pick, fully constraining the part in 6-degrees of freedom.
  - Z-surface - 3-points of contact (Plane)
  - Left Jaw - 2-points of contact (Line)
  - Right Jaw - 1 point of contact (Point)
- Triangulation of the of the jaw pocket is not necessary for round parts using MultiGrip Fixed Jaws.



Addressing Jaw Deflection

Vise Clamping Deflection

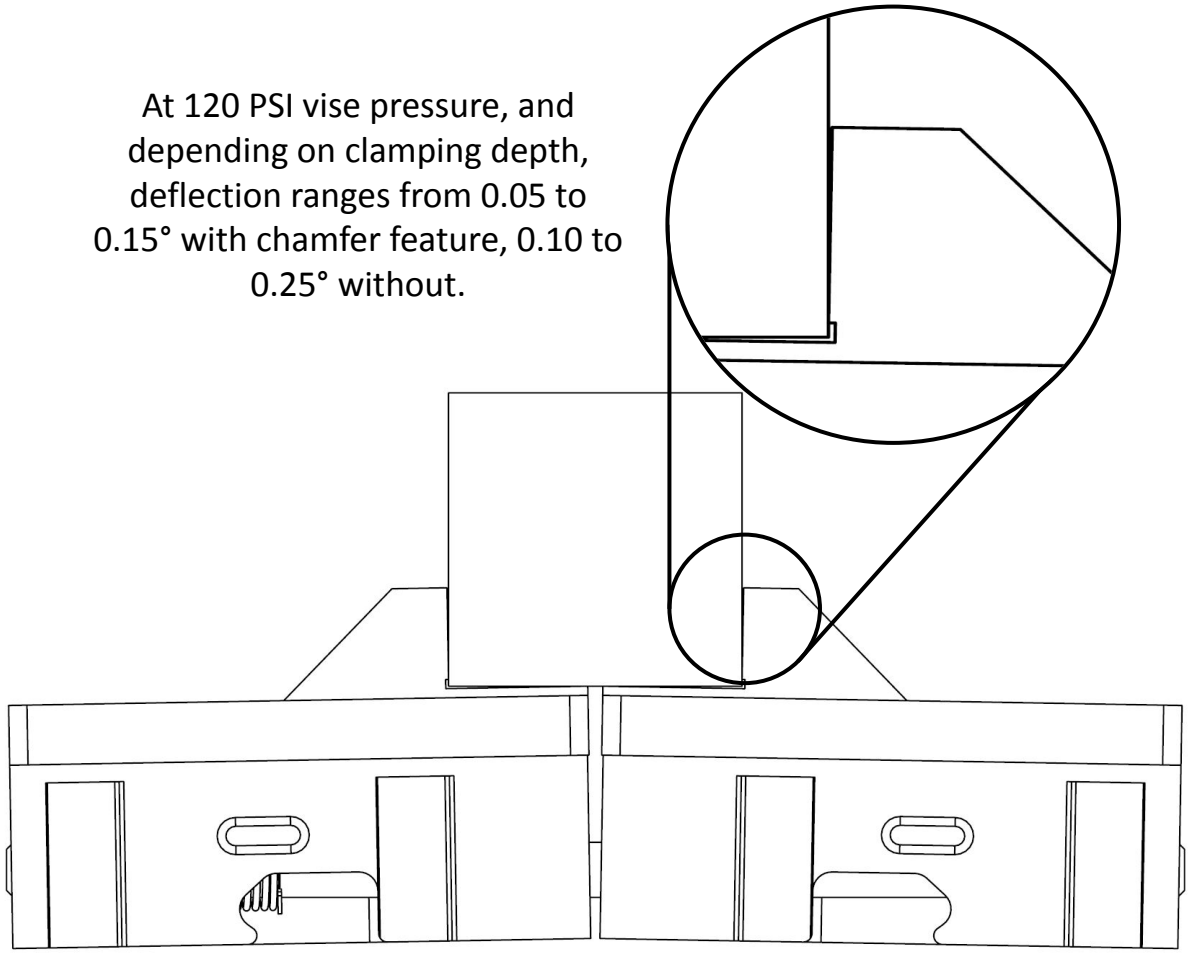
The clamping force of the MultiGrip Vise is on the bottom side of the MultiGrip Jaws, with the clamping surface against the part on the top side. With this design, there is a small deflection of the jaws proportional to the clamping force and height of the jaws.

- OD Jaws will rise in the middle and deflect out (frown)
- ID Jaws will rise on the outside and deflect in (smile)

To account for this deflection:

- Machine jaw pockets with the spacer upper end of the part clamping area
- Add an undercut to the jaws to force the clamping surface as high as possible
- Include a reinforcement feature/gusset/buttress to the sidewall, chamfer or fillet
- If available, machine the pocket with a 1-degree tapered end-mill

At 120 PSI vise pressure, and depending on clamping depth, deflection ranges from 0.05 to 0.15° with chamfer feature, 0.10 to 0.25° without.

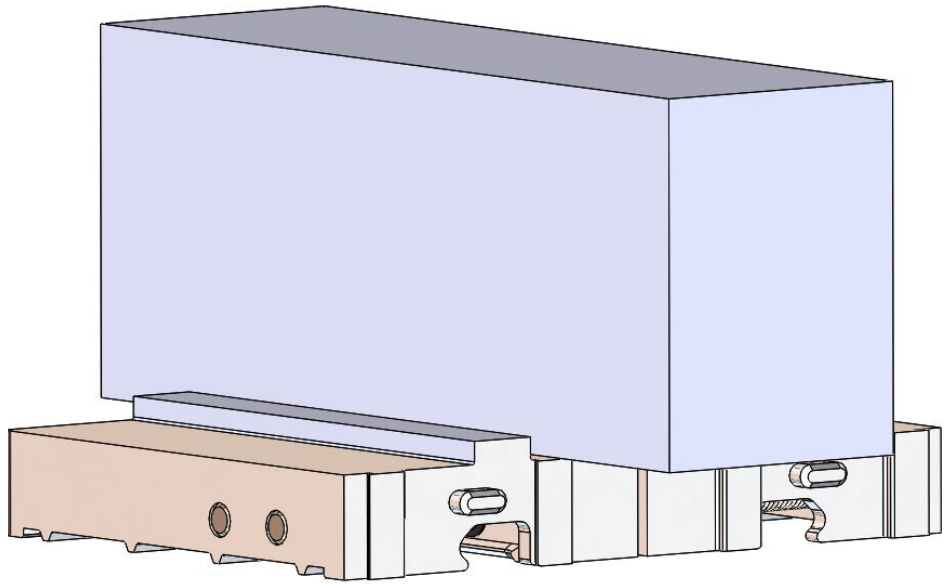


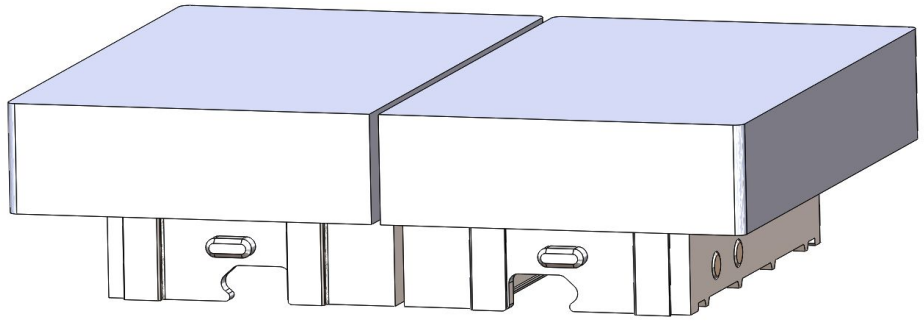
Exaggerated view of Jaw Deflection with OD Jaws

Large Parts

Large Parts

- Parts may overhang the front or back of the jaws
  - Parts up to 16 inches long can be robot loaded
- Without a Y datum to locate against, the part will need to locate the Y datum using a Y-push, either by the robot or a tool in the CNC
- Oversized Top Plates can be used to better support larger parts
  - Oversized Top Jaws are two inches wider and two inches longer than standard Top Jaws
  - Oversized Jaws be used to better support larger parts during the CNC machining process
  - Custom oversized jaws are available



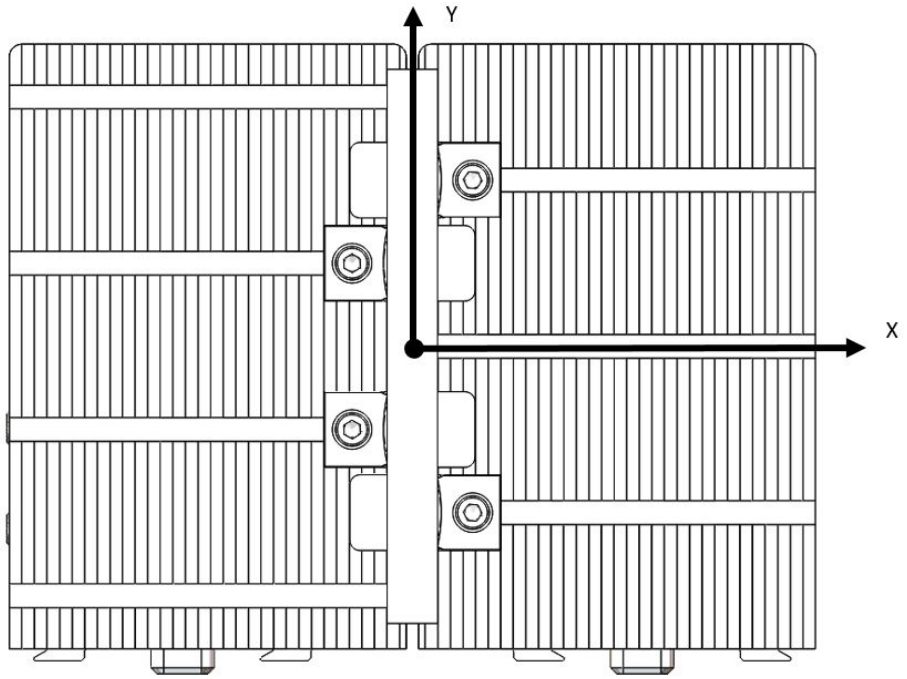


Coordinate System

Setting the Machining Coordinate System

- When machining raw stock in the first operation, the requirements of the absolute position of the machined part relative to the raw stock are typically low
  - In this case, it is generally safe to use assumed center position of the vise found from the calibration plate in the installation process

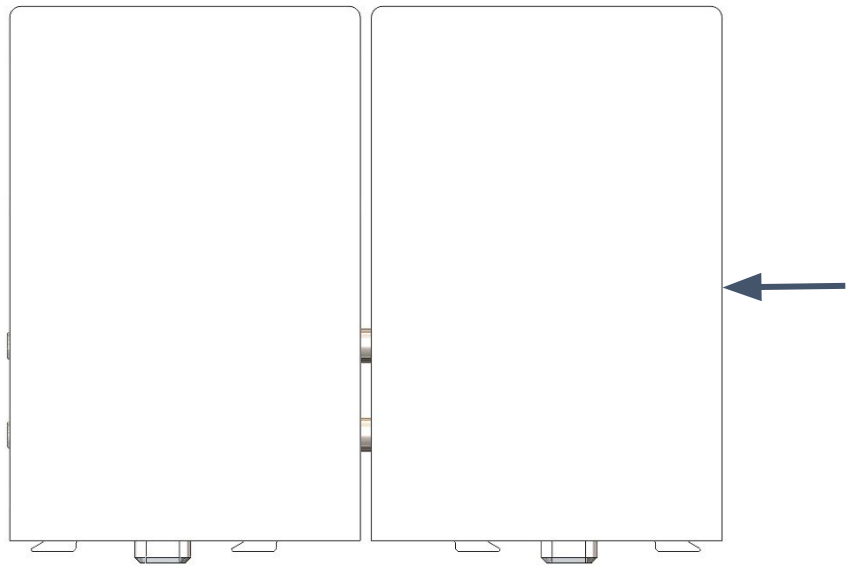
- When machining the second operation or any operation in which critical dimensions must be maintained between how the part is held in the jaws and how it is finished
  - In this case best practice is to set the Machining Coordinate system by indicating the fixed (right) MultiGrip Jaw



Indicating MultiGrip Jaws

Indicating MultiGrip Jaws:

- Start with the vise home position found during vise setup and installation (see installation manual)
- Set the the vise air pressure to the clamping pressure that will be used during the machining process
- Turn on CNC coolant so the MultiGrip vise is covered in coolant
- Place the jaws on the MultiGrip Vise and clamp the OD Jaws with the 1/8” machineable spacer installed or clamp the ID Jaws against the ID Jaw Fixture to set the 0.39” left to right jaw gap.
- Indicate the X position of the Machining Coordinate System from the right Top Plate or MultiGrip Jaw as shown
- If you prefer to set the CAM coordinate system to the center of the jaws, shift the measured X value 4” to the left (for standard jaws)
- Generally, variability in Y is minimal and does not require a change from the vise home position



Using a CNC Probe

- A CNC spindle probe is a useful tool for validating the automation process and can be used for the following purposes:
  - Automatically measure parts and perform tool wear offsets to keep parts in tight tolerance
  - Validate the positional accuracy of the part or MultiGrip Jaws in the CNC machine before machining
  - Offset home position due to thermal changes or part load position
- Refer to CNC spindle probe documentation included with your machine for more information
- Remember that spindle probes require regular calibration to maintain high accuracy

CNC Probe to Offset OP10 in Y

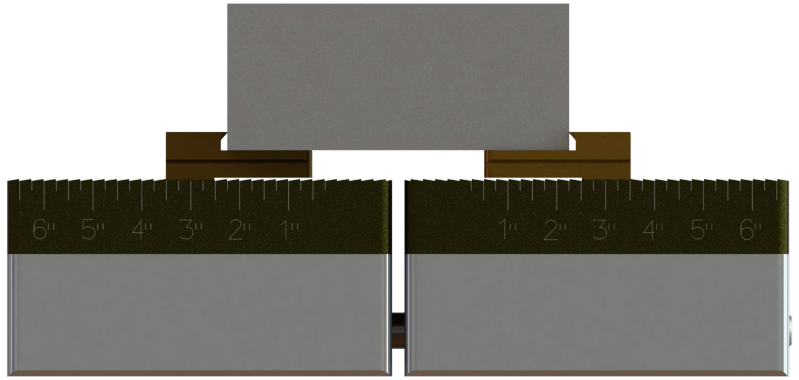
- In general, do not use a CNC Spindle Probe to offset the home location of a rectangular part in Y for OP10
  - If the part is offset in Y and the OP 2 MultiGrip jaws locate the part along the Y axis (non-rectangular part), the robot may not be able to pick the offset part after OP10 is complete because the part is shifted from the robot's center of pick
  - If the OP 2 jaws do not locate the part in Y, the part may be offset in Y using a probe in OP10

- For raw stock that is cut very closely to nominal length, combining an OP10 Y Push with a probe **is typically OK** because the true position of the part is only offset a small amount

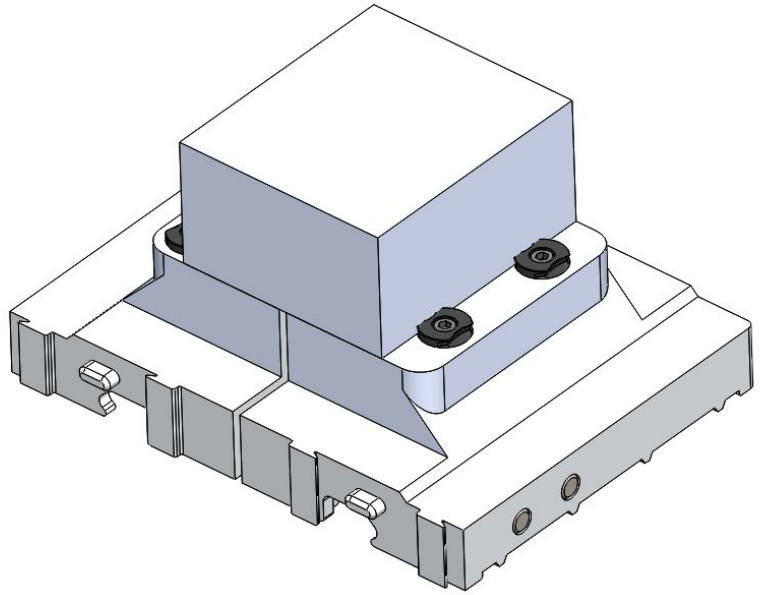
Raw Material Bite

Fixtures that Bite into Raw Material

- Biting fixtures with raw materials can be optimal for the 1st machining operation
- Examples shown are:
  - Universal Top Jaws with VersaBites
  - MultiGrip Jaws machined with Mitee-Bite VersaGrips
- Account for “bite” to maintain 0.125” nominal gap between the left and right jaws. For 6061 parts, clamping with the MultiGrip 4000, account for approximately 0.03” of bite per VersaBite or VersaGrip.



Example: Universal Top Jaws w/ VersaBites

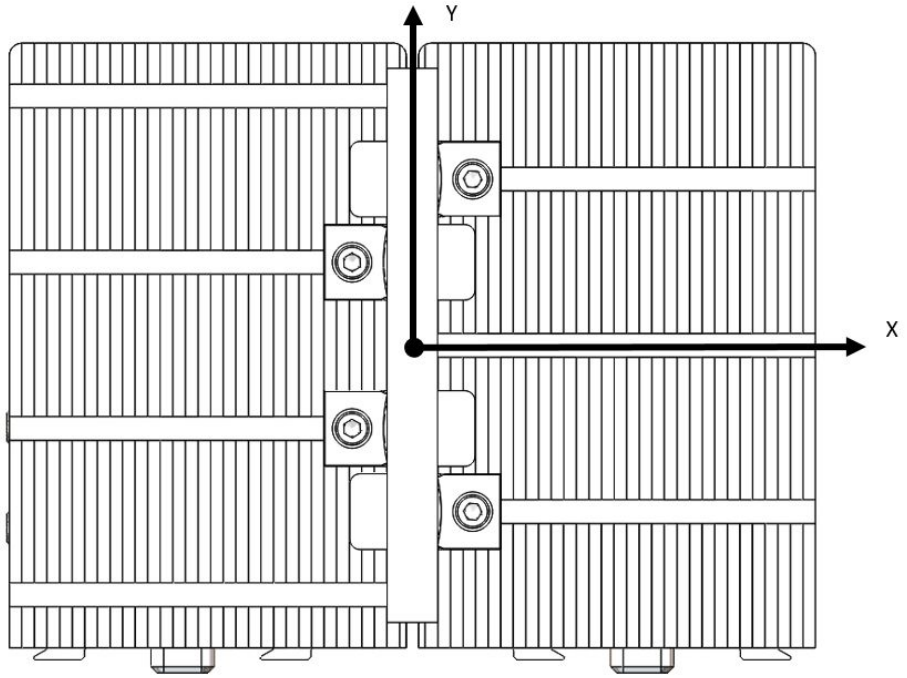


Example: Mitee-Bite VersaGrip P/N 32175

Raw Material Bite

Account for shift with Bite

- When clamping raw stock using VersaBites or equivalent “Biting” fixtures, when using a Fixed-Jaw Vise the part will shift to the right (image to the right) a small amount when clamped
- If the part boundaries are close to the width of the part, it may be necessary to offset the coordinate system to the right to compensate
- Use a probe to center the work coordinate system in X when part boundaries are close to raw material boundaries
- To measure the shift of the part without a probe, place the raw material in the jaws and push the part to the right against the VersaBites; measure the distance from the right side of the part to the edge of the right jaw
- Clamp the part with the vise and measure the difference in distance

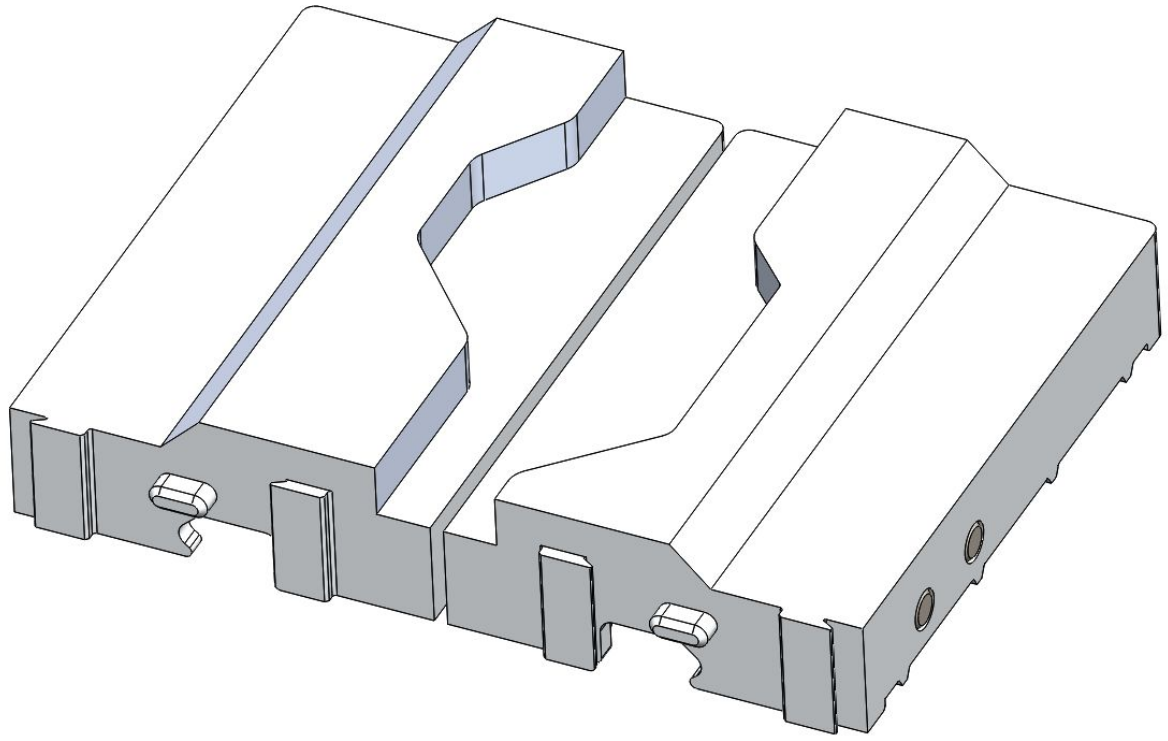


Example: VersaBites

Chip Control

Chip Control

- Verify the Jaw design includes paths for chips to exit the jaw pockets
- The example to the right shows jaws with a custom part pocket with open slots to allow chips to flow out of the jaws during the CNC wash and/or VersaWash process.
- Validate with testing/process control that the CNC wash and/or VersaWash process is effectively removing chips from the bottom and top surfaces of the jaws



Example: Custom pocket jaws with Chip Exits

MultiGrip Jaw Repeatability

Jaw Repeatability

- Best repeatability of the MultiGrip workholding system is achieved when MultiGrip Top Jaws are paired with the MultiGrip Base Jaws and the MultiGrip Vise they were originally machined on
  - A good practice is to dedicate at least one set of MultiGrip Base Jaws to each vise
  - Engrave an identifier on each Base Jaw that encodes the CNC machine and vise the Base Jaw is dedicated to
  - When machining Top Jaws, engrave both a part number for the Top Jaws and the identifying number of the Base Jaw it was machined on to make it easy for operators to match the correct Top Jaw and Base Jaw together

- Variability of the position of the MultiGrip jaws between clamping cycles occurs primarily along the X axis
  - The position of the fixed jaw (right jaw) will vary a small amount based upon the clamping pressure applied and the friction between the MultiGrip Jaws and MultiGrip Vise

Jaw Durability

- MultiGrip jaw components are made from 6061-T6 aluminum for a good balance between low weight and durability
- When machining harder materials, additional considerations may be required for long jaw life:
  - Will the jaw pocket walls deform from hard part materials under vise clamping pressure?
    - If the clamping surfaces of the part are smooth and total vertical wall clamping surface area of the jaw pocket is greater than 1” squared, bare aluminum will generally suffice
    - Otherwise, we recommend a jaw pocket be made from hardened steel and bolted to the jaws as an insert
  - Will chips from the cutting process strike critical portions of the jaws with enough force to wear the jaws?
    - Hard anodizing the MultiGrip Top Jaws or the use of a hardened steel insert will generally manage wear issues

Dry Machining with MultiGrip

Dry Machining:

- MultiGrip relies on CNC coolant to lubricate the vise interface, the gripper interface and the jaws
- If possible, run a vise wash program with coolant after the dry machining is completed to wash away chips and lubricate the vise, gripper and jaws
- If no coolant is available, use of a dry lubricant is required to be applied at least daily to the vise interface, gripper interface of the jaws, cross-pins of the jaws, and the face of the gripper, with air blasts to remove chips from the vise/jaw interface in between machining operations. Note: Using air to remove chips from vises and jaws can be unpredictable, as the chips fly around. Test the blow-off, cleaning process and troubleshoot with the number of nozzles and air pressure/jet flow.

New MultiGrip Jaw Break-in

- New MultiGrip Fixed Jaws or MultiGrip Base Jaws have a break-in period
- During the break-in period the position of the jaws after each clamping cycle will move more than after the break-in period
- After the break-in period, MultiGrip Jaws will generally repeat to position within 0.0005” between clamping cycles
- Most of the break-in movement takes place in the first 100 open/close cycles when the jaws will move primarily in X
- Jaws can be broken in by hand by first soaking the vise with coolant and then clamping empty jaws in the vise, using a dead blow to move the right jaw off the dovetail after each open
- Alternatively, indicate the position of the jaws with a spindle probe before each machining cycle
- See next page for chart details

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