VERSABUILT ROBOTICS

Vertical Mill w/ DuoGrip

User Interface / Part Configuration Parametric Programming Manual

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This manual is a section of the standard automation systems manuals. Latest version of standard manuals can be found on the VersaBuilt website, Resources page: https://www.versabuilt.com/resources/

CAD Models and other resources can also be found on the resources page.

For support, contact VersaBuilt via email at support@versabuilt.com or phone 208-906-0814

Safety Warnings

Section 1

Safety Warnings

DANGER: VersaBuilt makes industrial machine tool automation components designed to be operated by trained personnel only. Machine tool automation components may move suddenly and without warning. Serious or fatal crushing injuries can occur from contact with the robot, gripper or vises.

Before deploying VersaBuilt industrial machine tool automation components, a safety risk assessment must be completed in accordance with local, state and/or federal requirements.

VersaBuilt industrial machine tool automation components should only be used by trained operators.

Read and understand the VersaBuilt Automation System Safety Manual before proceeding

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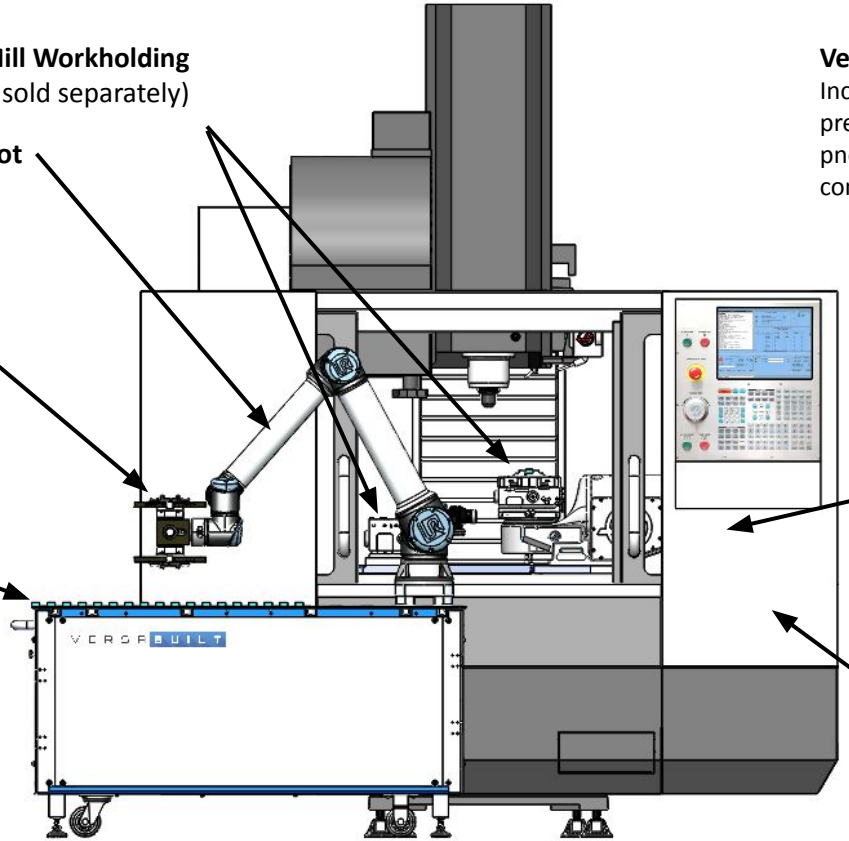
Overview

Mill Automation with DuoGrip

Section 2

Mill Automation System w/ DuoGrip overview



Vertical Mill Workholding
(Vises sold separately)

Robot

DuoGrip Gripper
w/ standard and options for custom hardware for part picking

VersaCart
Standard Stainless Steel Visual Infeed and options for custom infeed tops

VersaBuilt System Controller (VSC)
Includes software for user-interface and pre-integrated parametric programming, I/O, pneumatic valving, tubing and cable connections

Connect to VSC interface with laptop, computer, tablet or smartphone via Wi-Fi or Ethernet, or direct monitor/keyboard/mouse

VSC Enable Button
Enables the system for local control

Diverter Valve
To switch between Auto and Manual Modes

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Mill Automation System w/ DuoGrip overview

- VersaBuilt provides standard automation products for CNC Mill and CNC Lathe Automation, with pre-programmed, generalized software interface, “VSC” (Versabuilt System Controller).
- New parts are introduced with the creation of “Configurations”, entering parameters, rather than creating or revising a robot program, i.e., “Parametric Programming”. There is no limit to configurations.
- Systems include pre-programmed robot positions for generalized CNC machine tending, including:
  - Table Home - Robot Positioned over the VersaCart infeed/outfeed, poised to pick or place parts, or pivot to the CNC
  - CNC Home - Robot positioned in front of CNC, poised to move into the CNC, or pivot to the Table Home
  - InCNC Home - Robot positioned inside the CNC, in a neutrally poised position for the Vise or Chuck load/unload moves

    **calibrated/optimized at installation on the calibration page*
  - For all part processing, the robot moves to these intermediate positions
- Systems include these variations:
  - Gripper Type (MultiGrip or DuoGrip)
  - Infeed Type (Lathe, Mill, Robot Size, VersaCart Size, Stacked Infeed)
  - Process scripts (pre-programmed sequences available for MultiGrip or DuoGrip). *Custom scripts are available for quote.*

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Mill Automation System w/ DuoGrip overview

Robot Overhead

i. Total time processing parts where the CNC is not running
   1. First Part load to CNC Program Start
   2. CNC program end to CNC program start for subsequent parts
   3. Last part CNC program end to finished unload and stop

ii. Includes:
   1. Time to open/close CNC door
   2. Chuck or Vise actuation time
   3. Robot motion outside CNC while CNC is waiting
   4. Regripping process for 2Op w/ Regrip with 1 Vise or Single-Spindle Lathe
   5. CNC processes used for automation
      a. Y/Z push to locate the part against a datum or to a precise position
      b. Table Wash & Table Load programs

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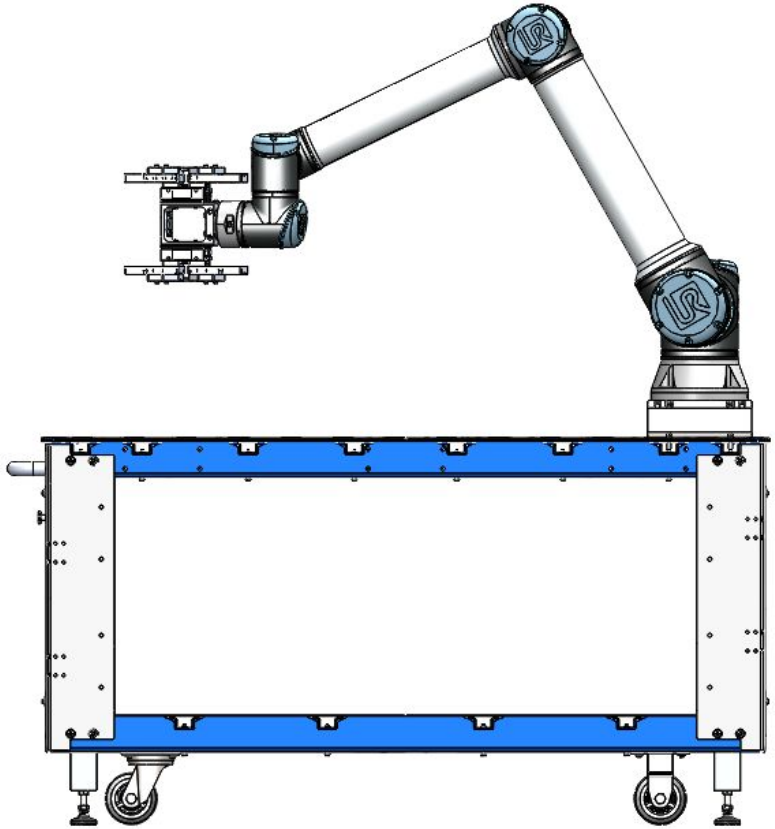
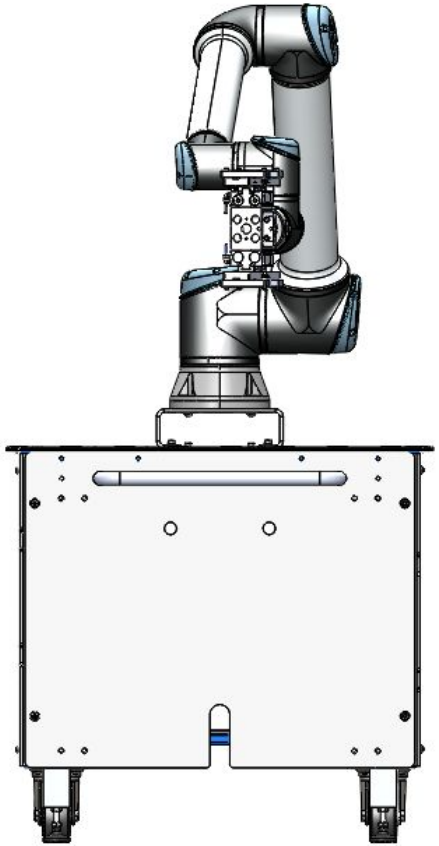
DuoGrip Table Home Gripper 1 & 2

Robot is positioned over the table

Table Home Gripper 1
Gripper 1 is facing down toward the table

Table Home Gripper 2
Gripper 2 is facing down toward the table





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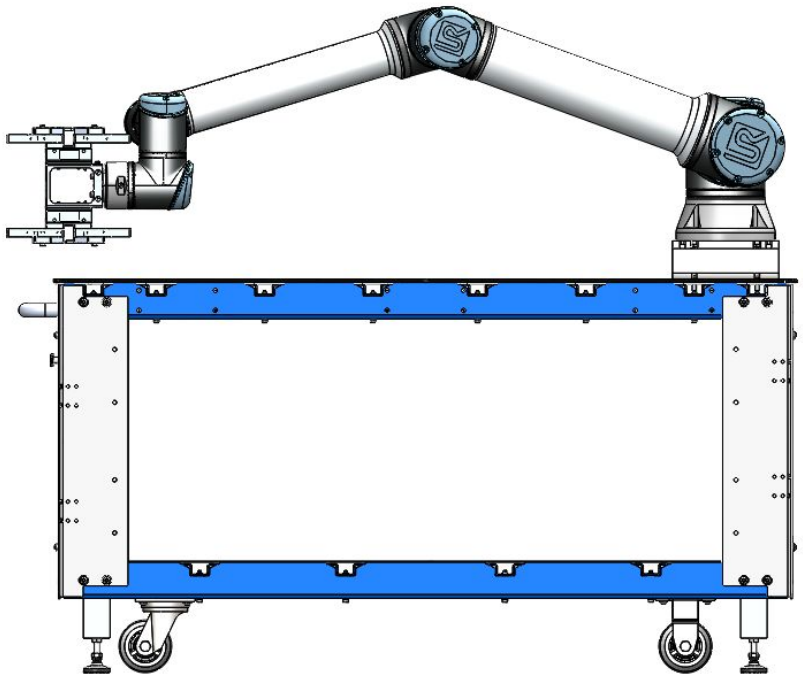
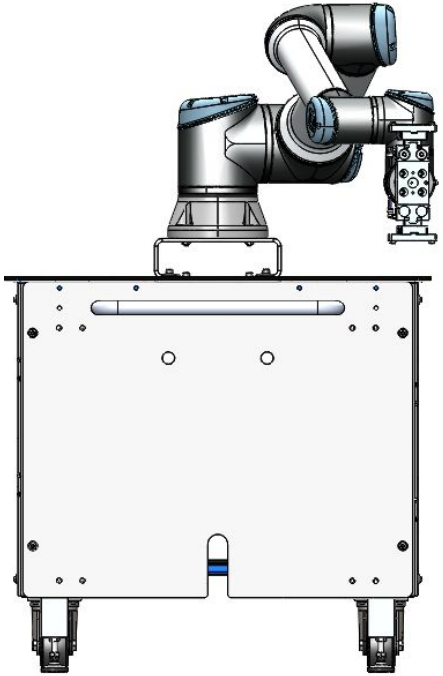
DuoGrip Table Home Pick/Place

Robot is positioned over the table in the corner/table origin

Table Home Pick
Gripper 1 is facing down toward the table

Table Home Place
Gripper 2 is facing down toward the table





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DuoGrip CNC Home Gripper 1 & 2

Robot is positioned in front of the CNC in the ready-to-load or unload position

CNC Home Gripper 1
Gripper 1 is facing down toward the ground

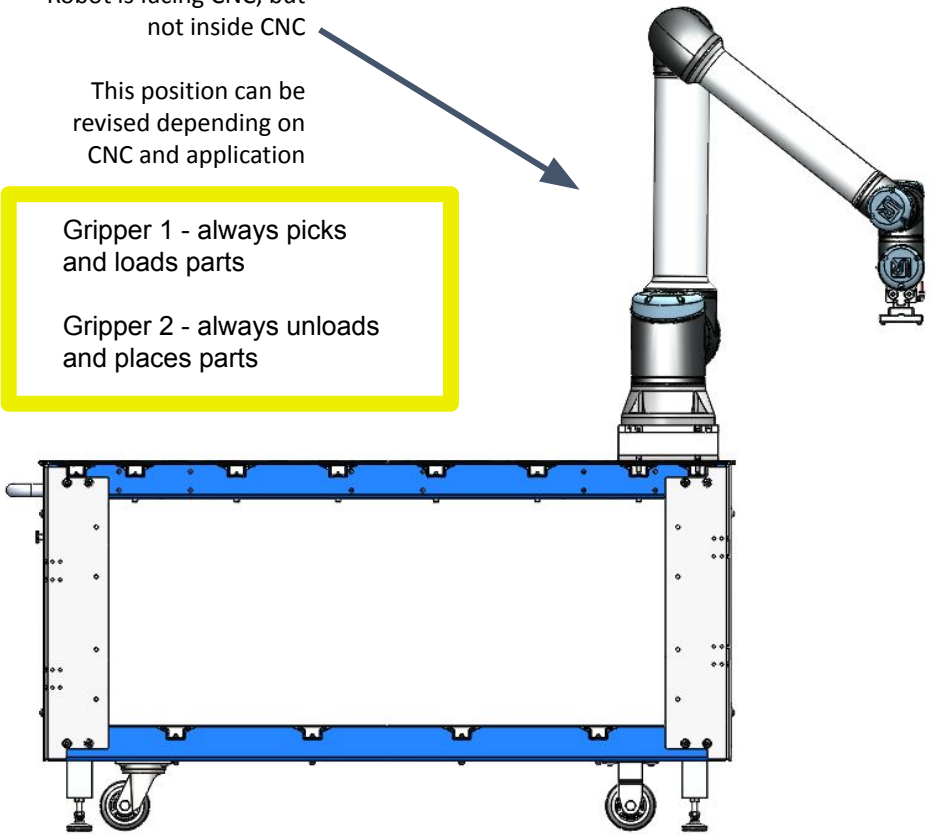
CNC Home Gripper 2
Gripper 2 is facing down toward the ground

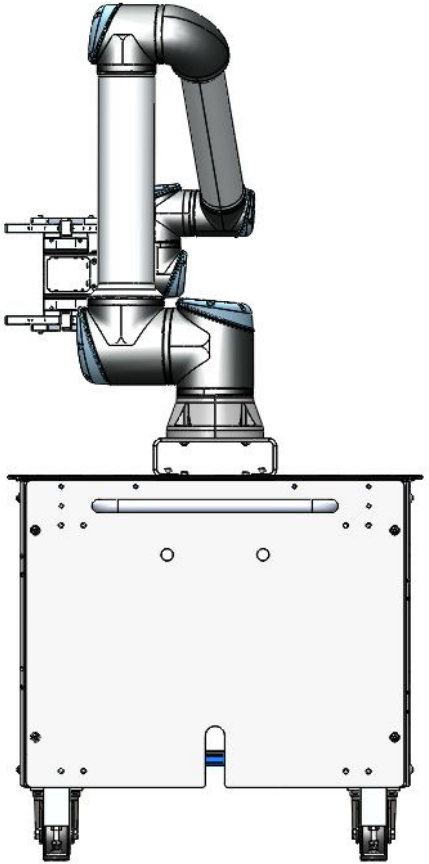
Robot is facing CNC, but not inside CNC

This position can be revised depending on CNC and application

Gripper 1 - always picks and loads parts

Gripper 2 - always unloads and places parts





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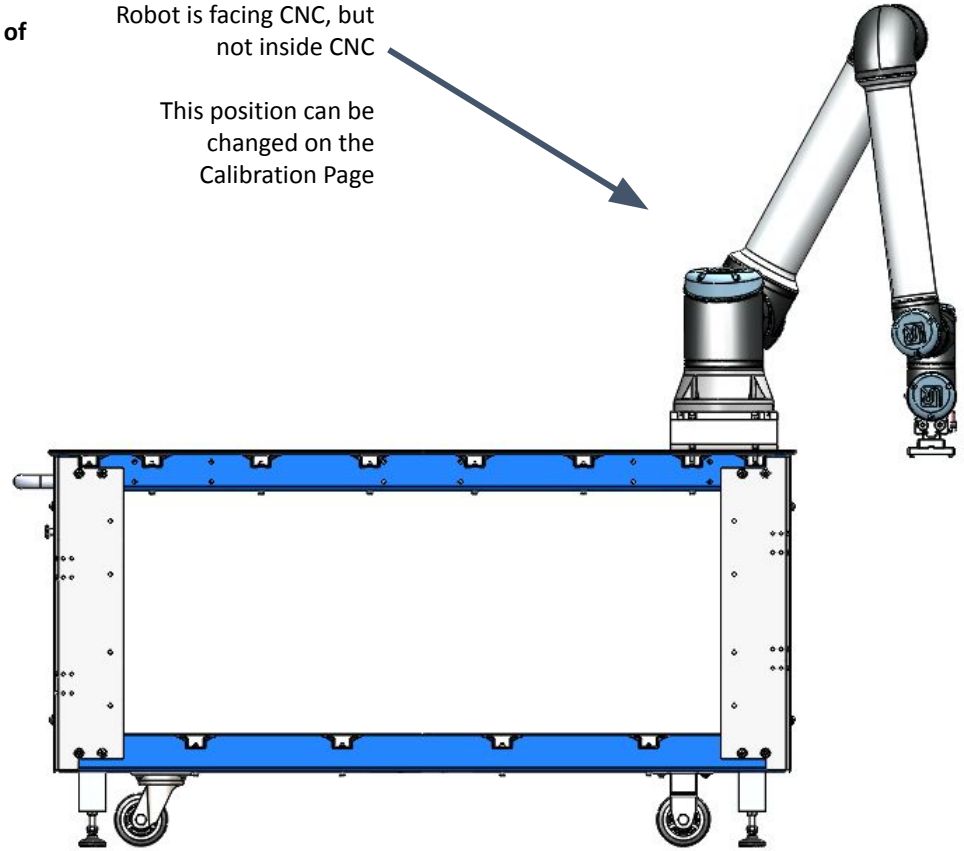
DuoGrip Bin Drop

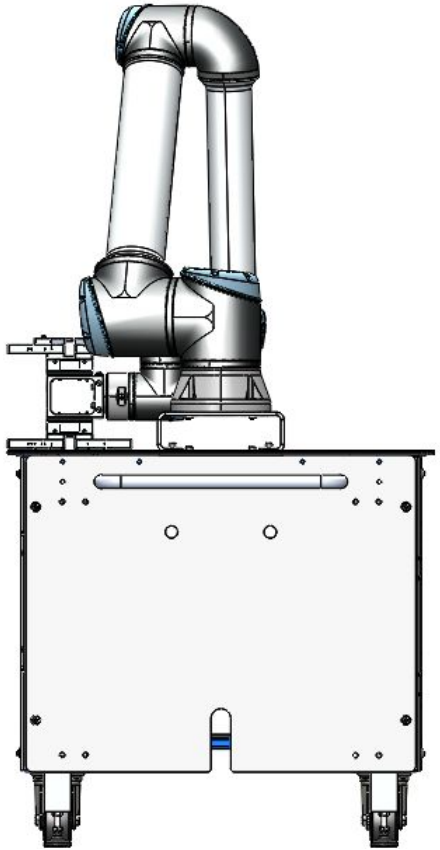
Robot is positioned in front of the CNC in position for dropping parts

Gripper 2 is facing down

Robot is facing CNC, but not inside CNC

This position can be changed on the Calibration Page





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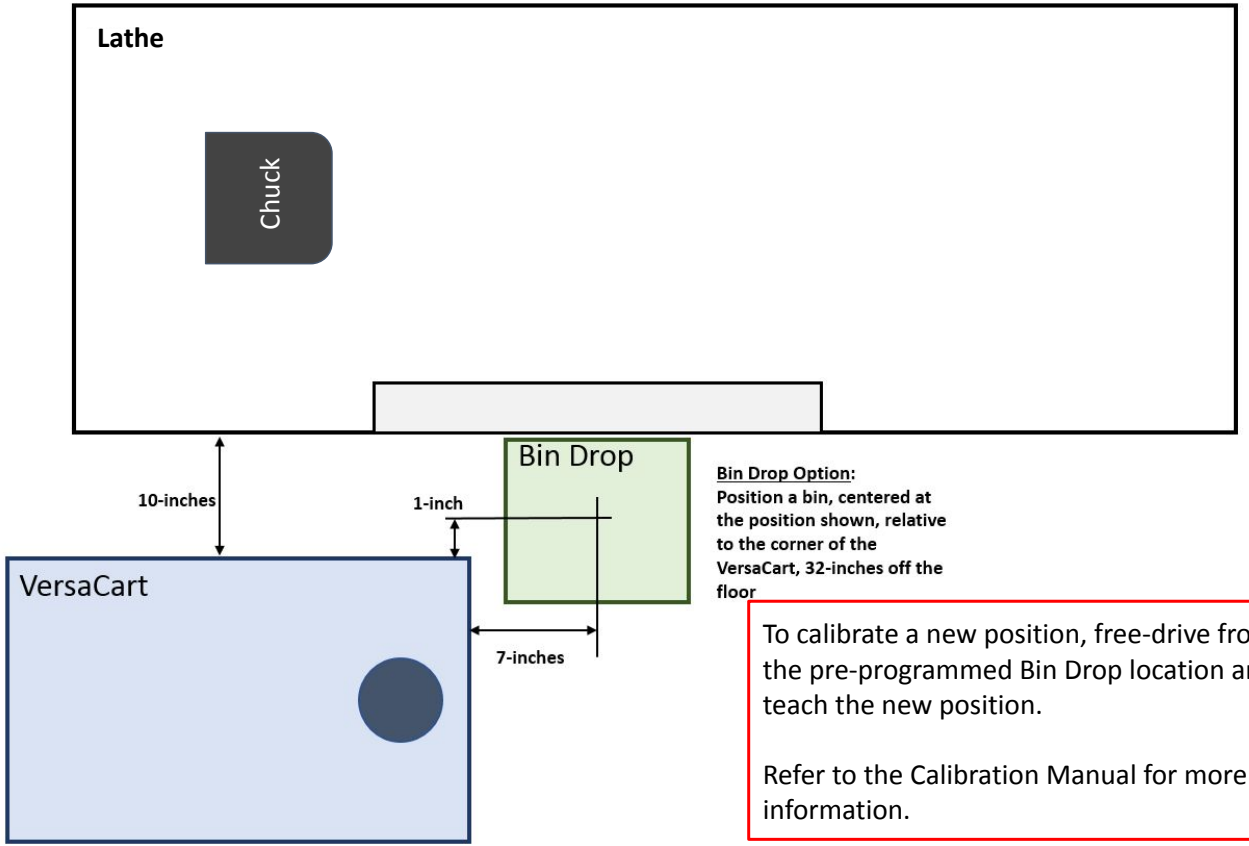
DuoGrip Bin Drop

- Place bucket or bin at location shown
- Protect parts with foam, water or other means



To calibrate a new position, free-drive from the pre-programmed Bin Drop location and teach the new position.

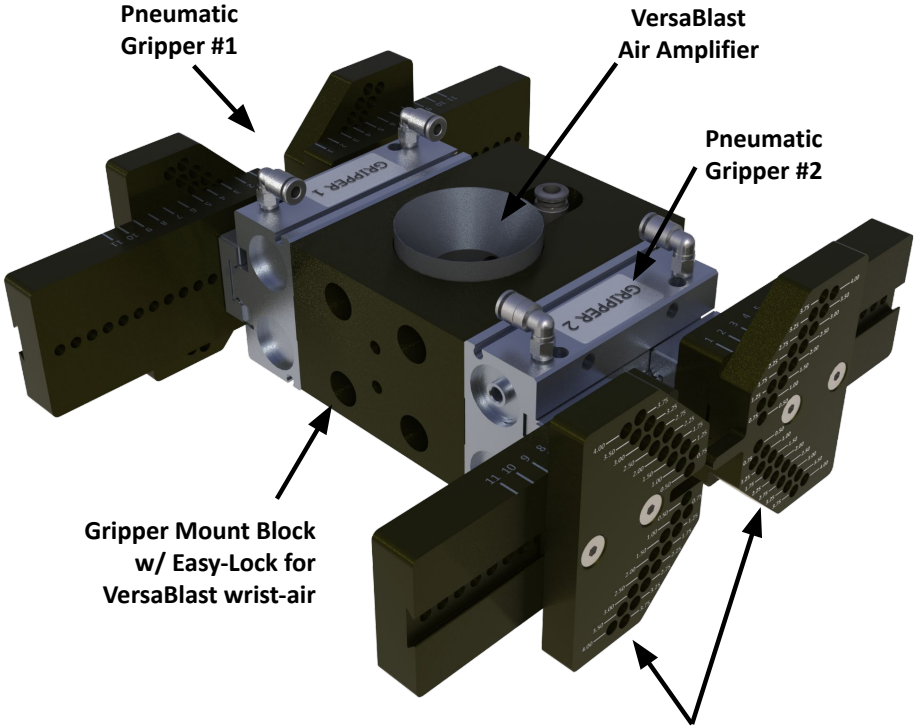
Refer to the Calibration Manual for more information.

DuoGrip 400 Gripper

- Max Part Weight = 10 lbs @ 110 psi
- 2x Pneumatic Grippers mounted 180° apart, with hardware for shaft picking* and puck picking**
- Adapter Plate to attach to Robot conforming to ISO 9409-1-50-4-M6, with available adapter for UR15, UR20 and UR30 robots
- 5/32” Tubing to connect to supply from gripper valve in robot controller
- Tube Routing Kit provided for tube routing on Robot arm

*shaft picking for parts with length much greater than diameter (shaft, shaft, etc) - picked and placed from the side. shaft fingers for diameter ranges 0.25 to 3.0” available.

**Puck picking for round parts that can stand up. Diameter ranges from 0.50” to 4” standard and optional up to 8”



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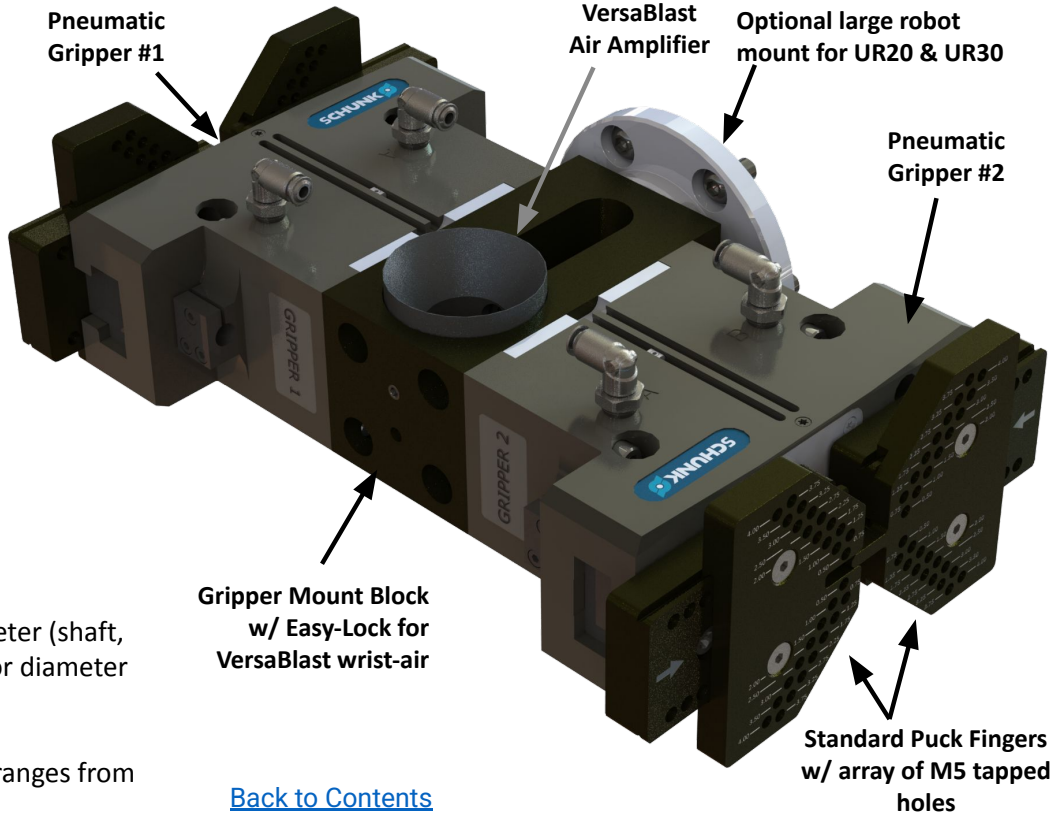
DuoGrip 2000 Gripper

- Max Part Weight = 45 lbs @ 110 psi
- 2x Pneumatic Grippers mounted 180° apart, with hardware for shaft picking* and puck picking**
- Adapter Plate to attach to Robot conforming to ISO 9409-1-50-4-M6, with available adapter for UR20 and UR30 robots
- 5/32” Tubing to connect to supply from gripper valve in robot controller
- Tube Routing Kit provided for tube routing on Robot arm
- This gripper can not use the ‘Float’ function (exhausts air to allow user to open/close by hand.

*shaft picking for parts with length much greater than diameter (shaft, shaft, etc) - picked and placed from the side. shaft fingers for diameter ranges 0.25 to 3.0” available.

**Puck picking for round parts that can stand up. Diameter ranges from 0.50” to 4” standard and optional up to 8”



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Workholding

Section 3

Workholding

- Mill Automation w/ DuoGrip can accommodate most actuating Vises and Chucks, as well as vacuum chucks.
- VersaBuilt workholding is available:
  - MultiGrip 2000 Vise - 12mm Stroke
  - MultIGrip 4000 Vise - 12mm Stroke
  - MultiGrip 100 Vise - 10mm Stroke
  - MultiGrip 160 Vise - 16mm Stroke
  - MultiGrip Jaws

    *refer to the MultiGrip Manuals for more information
- Select actuating workholding with sufficient stroke for reliable loading and unloading
  - Minimum of 3 mm total stroke
- Actuation methods:
  - VSC Valves - Pneumatic vises can be actuated by pneumatic valves in the VSC. Vise valves are 5 port, 3 position, center closed.
  - Foot Pedal - CNC's with foot pedals for workholding actuation can be connected to the VSC with a relay signal to close the switch at the foot pedal.
  - M-Code - If agreeable to the process, the workholding can engage after the robot has placed the part and exited the CNC, then CNC door closes, and Cycle Start >> Then with the CNC program, the workholding engages (e.g., vacuum chuck).

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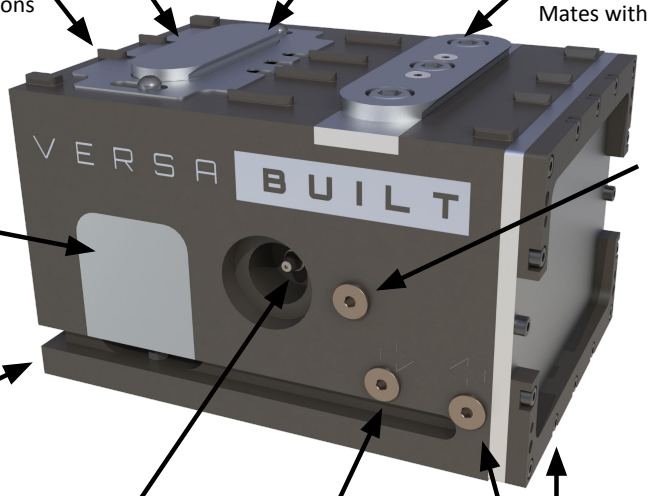
Workholding Options: MultiGrip Vises

***Notes**:
- Front ports are plugged at Factory assembly.
- Front ports can be used on the MultiGrip 4000 with automation, but note that front mounted fittings will interfere with the robot gripper on the MultiGrip 2000 Vise.
- The back-side Breather Port allows the inner chamber to push and pull air. It is also used for Grease Maintenance (refer to the Preventative Maintenance Manual in Automation System Manuals)
- Steel-top version includes Serration Interface, bolted to the vise body, machined from stress-relieved ductile iron, ASTM A536.



Sliding Cover
5052 Aluminum

Dovetail Interface Moving Side
1018 CF Steel
Mates with MultiGrip Jaw 6061-T6 dovetail feature

Vise Body, Serration Interface
Hard-Anodized 6061-T6 Aluminum
Mates with MultiGrip Jaw 6061-T6 serrations

Dovetail Interface, Fixed Side
1018 CF Steel
Mates with MultiGrip Jaw 6061-T6 dovetail feature

1/8 NPT Breather Port
Plugged on Front Side
Fitting on Back Side

Vise Cover
Front and Back Sides
6061-T6 Aluminum

Toe-Clamp Feature
All 4 Sides

Grease Zerk on Front Side
Vise Sensor hole (M8x1.0) on Back Side

M8x1.25 tapped holes and
M8 Dowel Pin holes
Bottom side

1/8 NPT Vise Closed Port
Plugged on Front Side
Fitting on Back Side

1/8 NPT Vise Open Port
Plugged on Front Side
Fitting on Back Side

Shown in image: MultiGrip Vise 4000 w/ standard hard-anodized aluminum body construction

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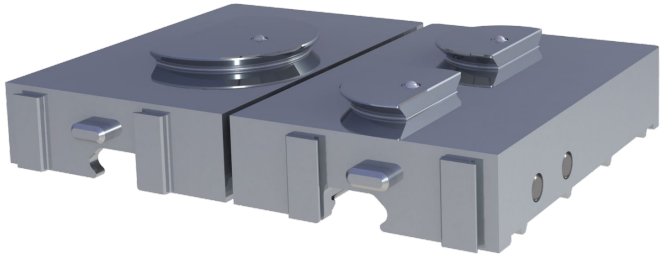
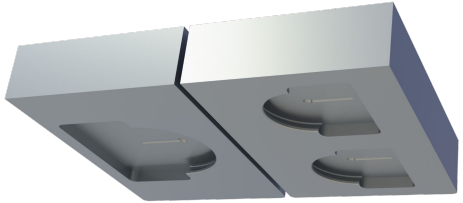
Workholding Options: MultiGrip Jaws



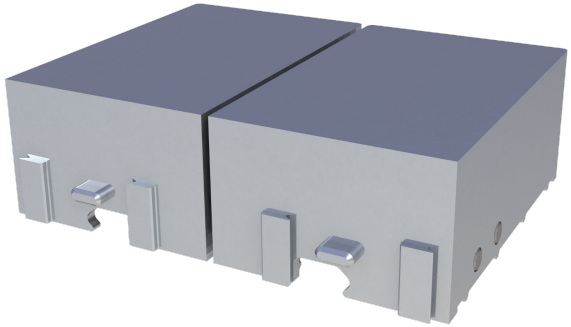
6061-T6 Base Jaws with robot and vise interface, plus Top Jaw interface for quick exchange of Top Jaws (for OD clamping only).

Available in swivel-fixed (shown) or fixed-fixed combinations.



6061-T6 Top Jaws available in multiple thicknesses (1.0, 1.5, 2.0 & 3.0”) machined or bolt-on custom part interface.

Used with MultiGrip Base Jaws. Available in swivel-fixed (shown) or fixed-fixed combinations.



6061-T6 single-piece Left and Right Jaws with robot and vise interface, plus material for machined or bolt-on custom part interface.

Available in for OD and ID Clamping in 1.5” and 2.5” heights.

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Workholding Options: MultiGrip Jaws

MultiGrip Jaws consist of left and right 6061-T6 aluminum jaws with mating features for clamping parts, engaging a vise and interfacing with a robot gripper.

MultiGrip Jaws are available in OD (outside diameter) and ID (inside diameter) clamping, with many variations of size and accessory.

Example configuration

MultiGrip Top Jaws

MultiGrip Base Jaws

MultiGrip Vise

Solid Models are available at www.versabuilt.com on the Product and/or Resources pages or by contacting VersaBuilt via sales@versabuilt.com

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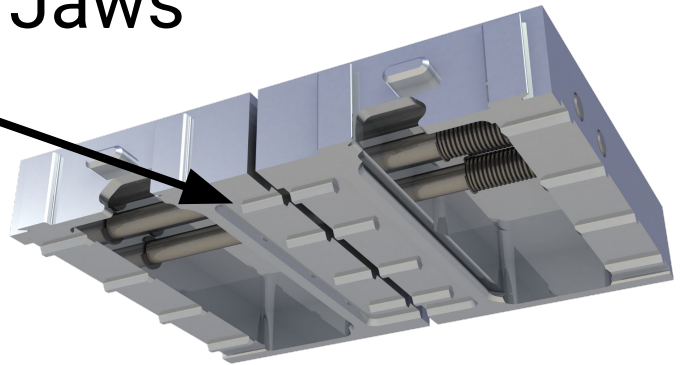
Workholding Options: MultiGrip Jaws

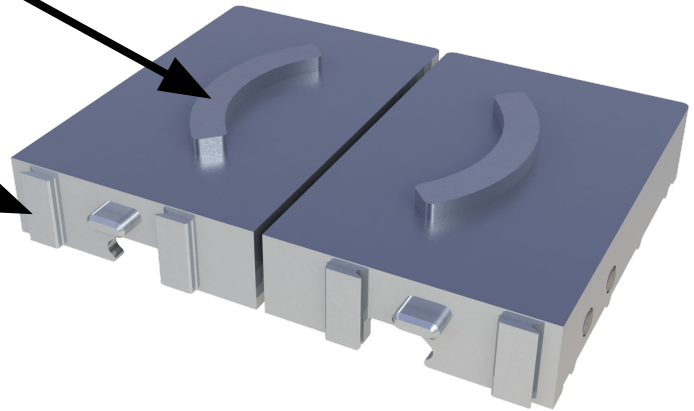
MultiGrip Vise Interface Dovetail and Serration interface



Machinable Part Interface *example

Machined or bolted onto to Fixed Jaws or Top Jaws

Gripper Interface Dovetail and boss interface on front face of jaws



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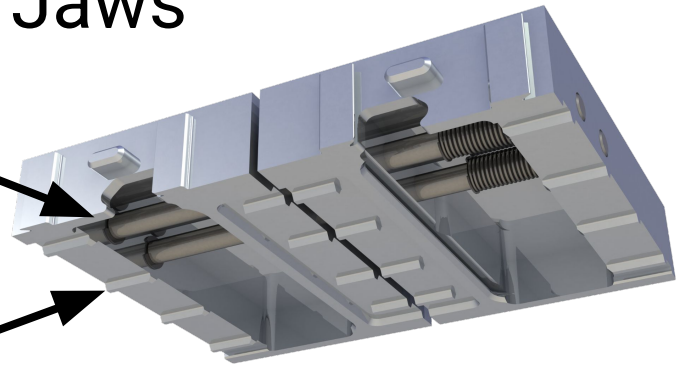
Workholding Options: MultiGrip Jaws

2X Steel TGP Cross-Pins w/ Springs

OD Jaw Spring-Open / ID Jaw Spring-Closed to unclamp the part at Vise Open/Close to release the part during pick and place

Serrations and Dovetail

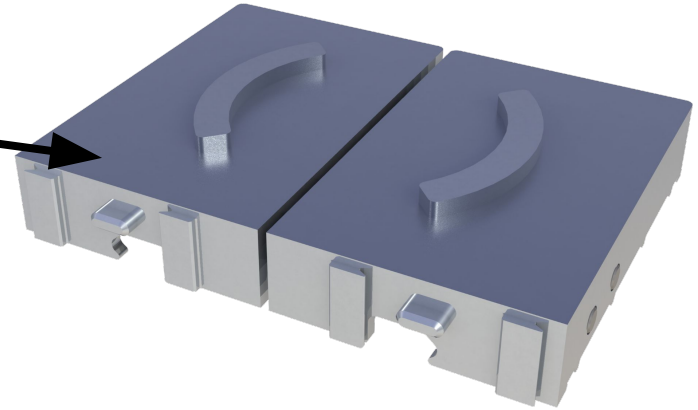
Dovetail clamps in the X-direction and pulls the Jaws down in Z Serrations locate the Jaws in Y and Z



6061-T6 Aluminum

Left and Right Jaws

**with example part pocket*



Solid Models are available at www.versabuilt.com on the Product and/or Resources pages or by contacting VersaBuilt via sales@versabuilt.com

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General Installation Instructions

Section 5

General Installation Instructions

Refer to up-to-date Manuals and Installation Checklist at https://www.versabuilt.com/resources/

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General Installation Instructions

Refer to the Calibration Manual for Calibration of:

- **VersaCart**
- **Regrip**
- **Bin Drop**
- **InCNC position**

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General Installation Instructions

Referencing the Installation Checklist, the following are the steps:

1. Prove out manual process
2. Powerup VSC and Enable Remote Support
3. Configure CNC Connections
    a. VersaBuilt CNC Software (programs 8000 & 9000)
    b. Cycle Start Cable
    c. Ethernet Connections
4. Automation Equipment installation:
    a. Robot
    b. Gripper
    c. Position Cart to CNC*****
5. Test Inputs and Outputs (I/O), Configure Settings on VSC
6. Calibration
    a. Standard VersaCart Calibration
    b. Vise Centerline Calibration
7. Configure Parts
    a. Select Process, Enter Parameters
    b. Calibrate Datum Bar, if needed
    c. Calibrate Part specific Vise locations, if needed
8. Run Parts

***Application specific instructions are shown on the following pages/sections**

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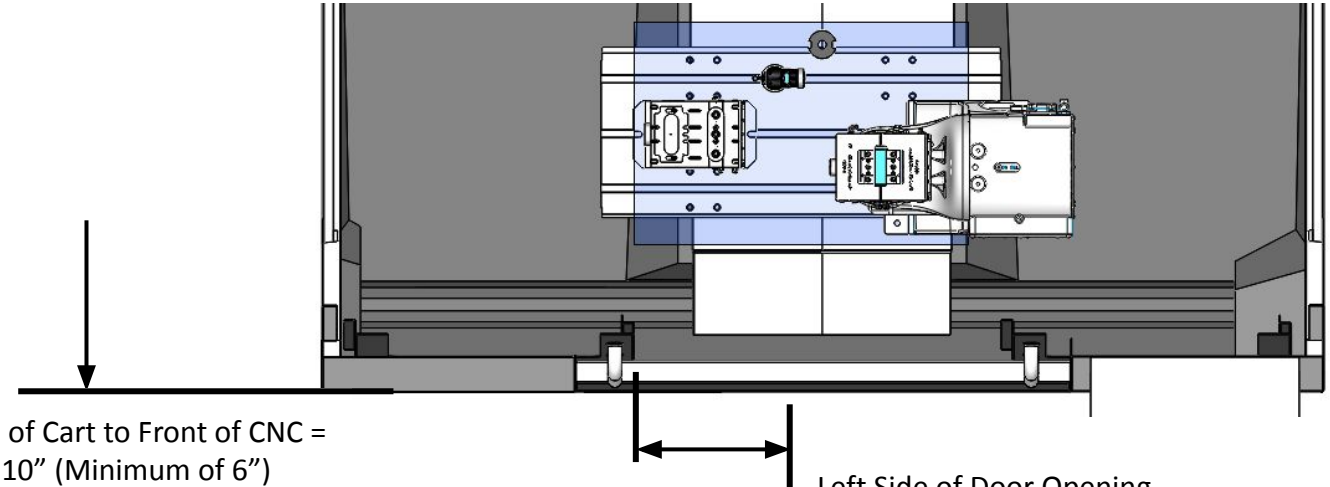
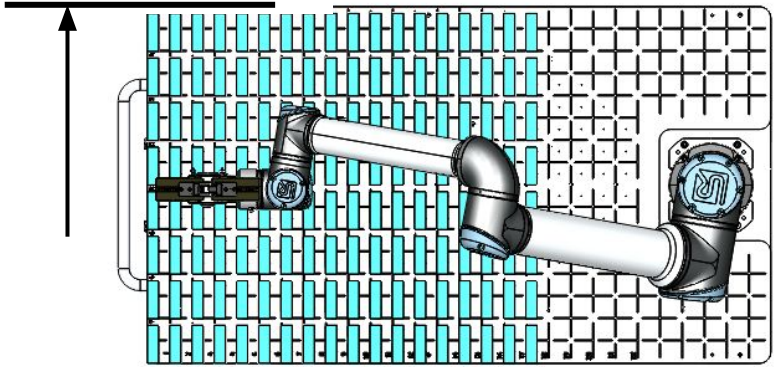
VersaCart to CNC Position (Guidance)



Side of Cart to Front of CNC =
10” (Minimum of 6”)



Left Side of Door Opening
to End of Cart = 10 to 15”
*Balance between access to CNC and reach to both Vises with one table load position

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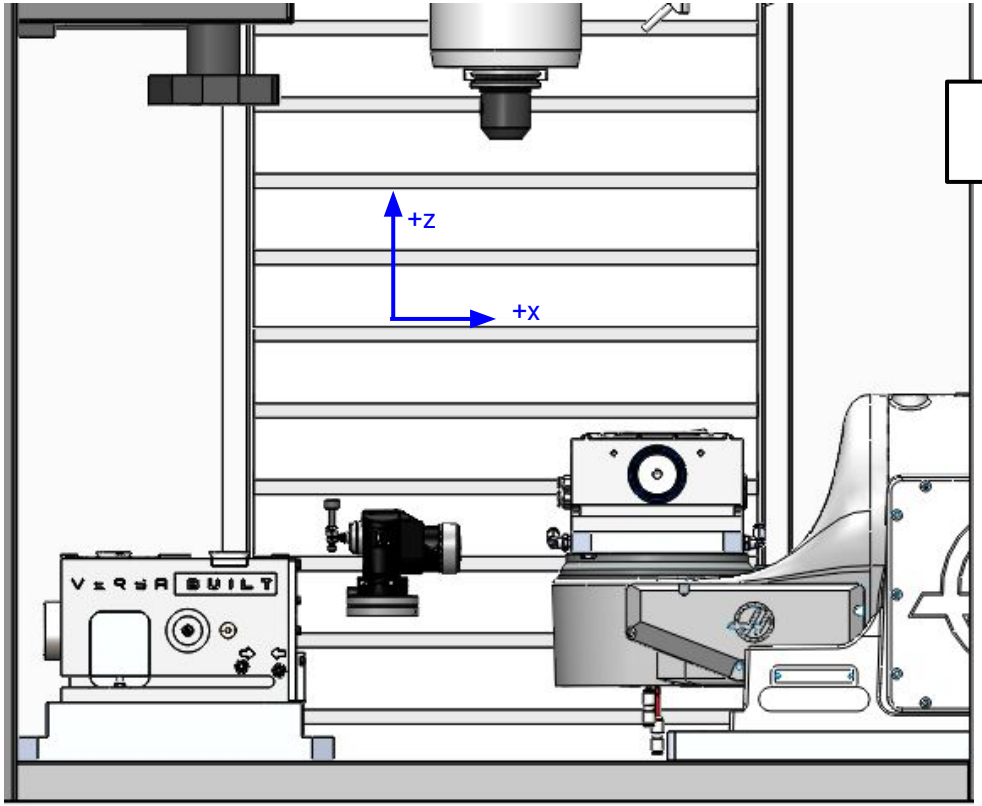
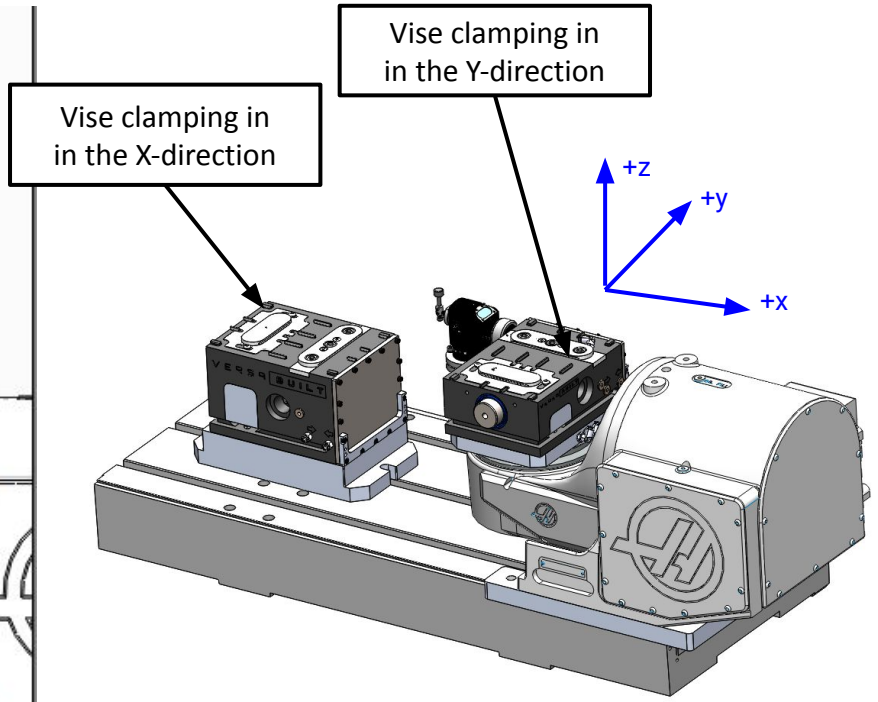
Vise Orientation for DuoGrip Loading (Example)





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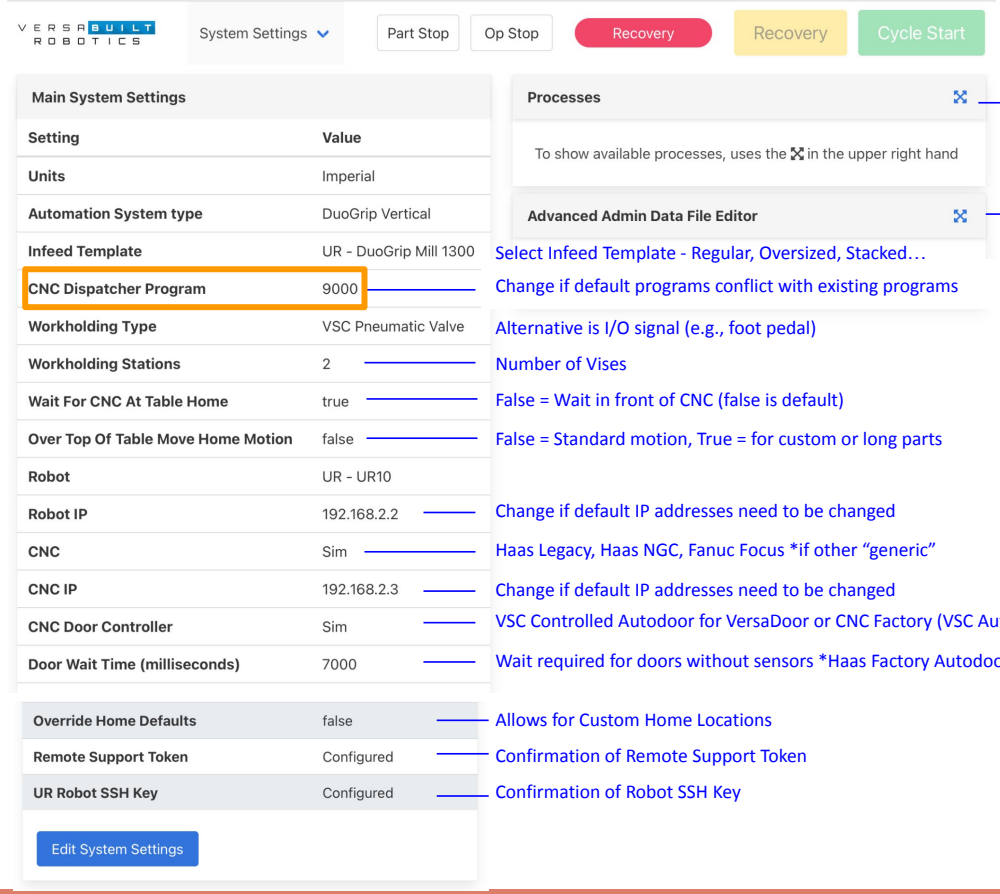
VSC Settings Page



Contact support@versabuilt.com for guidance on Settings changes

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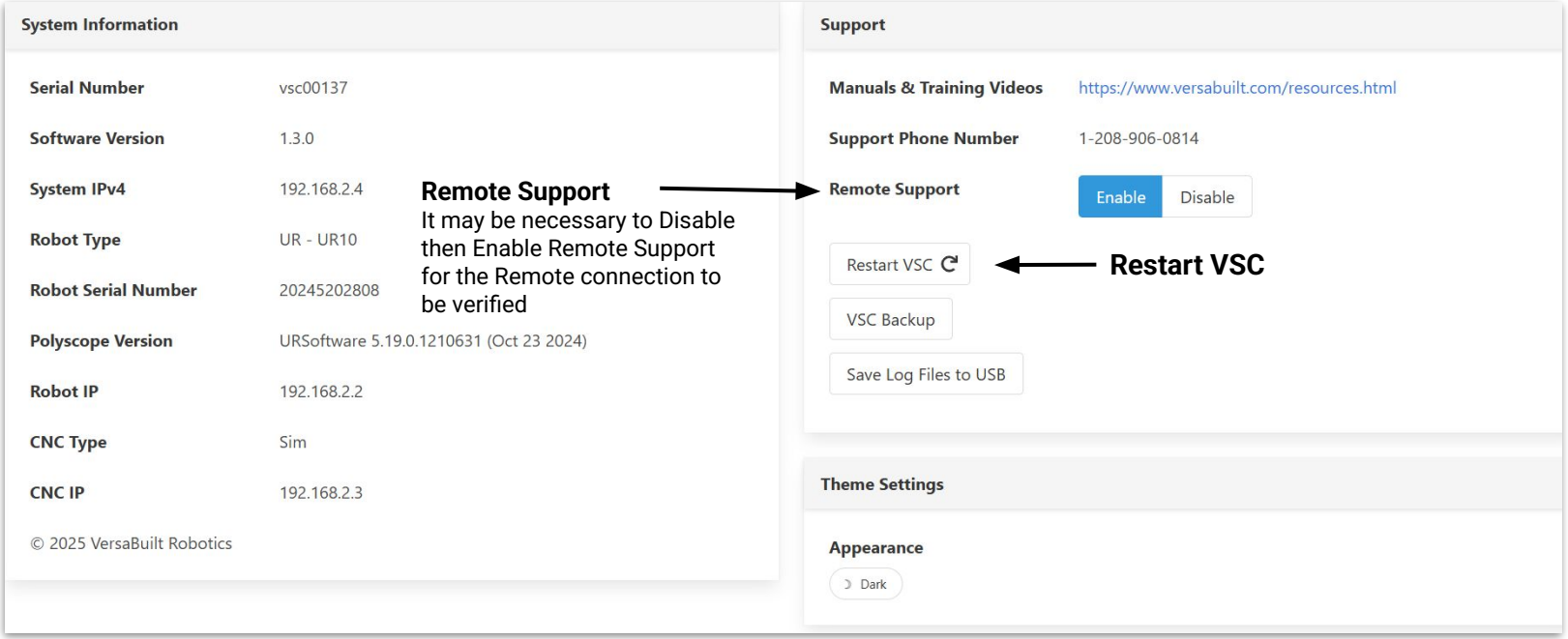
VSC About Page



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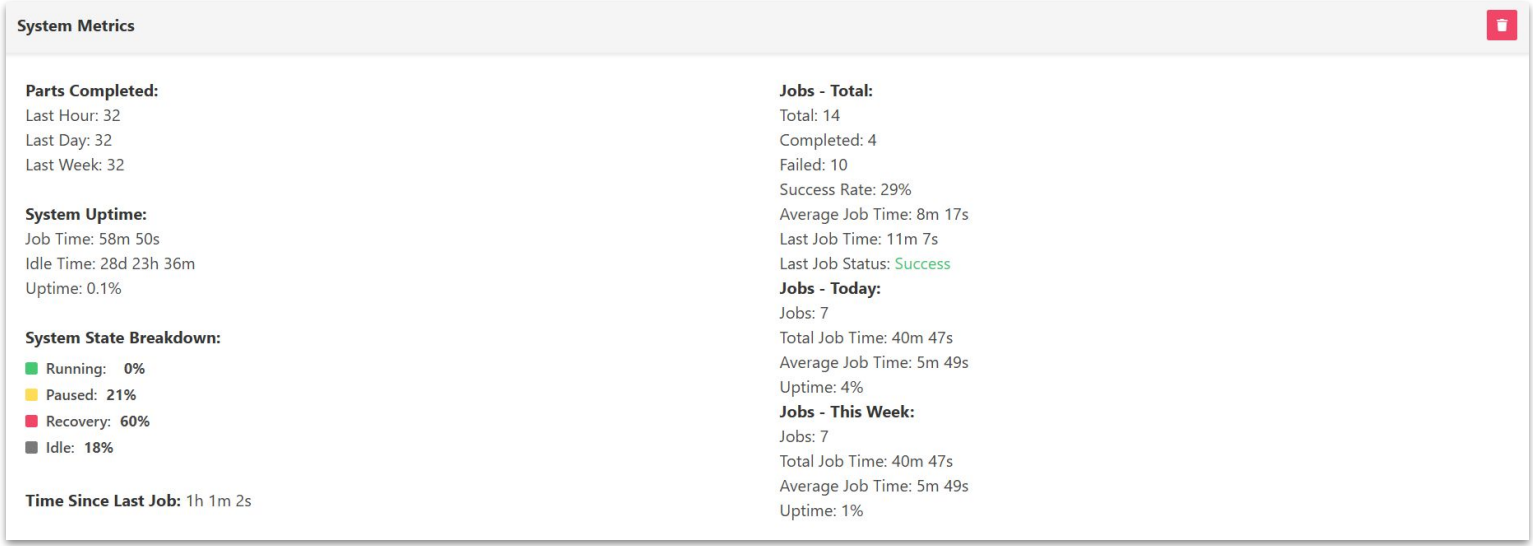
VSC About Page



The System Metrics dashboard serves as a key diagnostic and performance reference for the CNC automation system. It provides real-time and historical data on part production, job completion rates, uptime, and system state distribution. By monitoring these metrics, operators can assess overall equipment effectiveness (OEE), identify bottlenecks, and evaluate system reliability over time.

In particular, uptime and job success trends offer valuable insight into system stability, while the state breakdown (running, paused, recovery, idle) helps determine where operational inefficiencies occur. This information can be used to guide maintenance priorities, refine automation parameters, and support continuous improvement initiatives aimed at maximizing throughput and minimizing downtime.

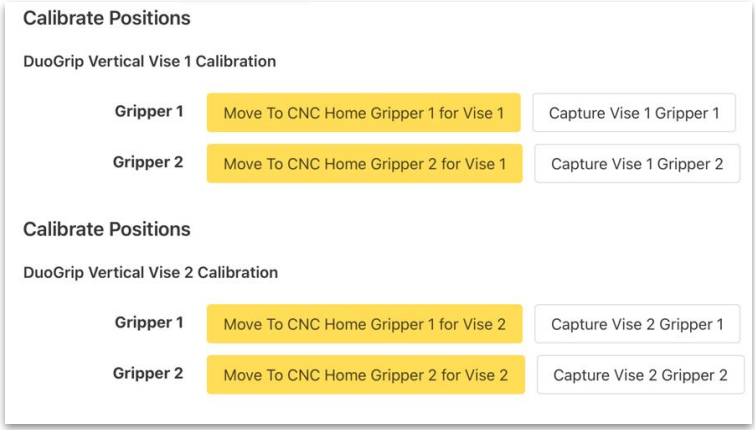
DuoGrip Vertical Vise Calibration

Section 6

DuoGrip Vertical Vise Calibration

Vise Calibration (Centerline) steps:

1. Determine Vise 1 and Vise 2 *typically facing the CNC, left to right is Vise 1, Vise 2, etc.
2. On CNC, use Table Load program or edit Table Load program to position where the robot arm can reach, typically with the table forward in Y and vises nearest the robot in X, without arm interference with the door frame when picking/placing. *preferably all vises on the table can be reached with one program, but not required.
3. With VSC User Interface, Navigate to the Calibration page
4. Using the Recovery buttons, move the robot to CNC Home Gripper 1, *if not already there*.
5. Calibrate Vise part load with Gripper 1:
    a. Place the part to be loaded into the Vise & clamp on the part with the Vise recovery buttons
    b. Use “Move To CNC Home Gripper 1”.
    c. Use the recovery panel to Open / Float the gripper and Enable freedrive and position the robot arm/gripper above the part.
    d. Once centered over the part, close the gripper (done by hand if floated, else use recovery panel to close). Ideal clamping position can be obtained using a level.
    e. The robot is still in freedrive and can shift when clamping. Reconfirm ideal positioning with a level.
    f. Disable Freedrive
    g. “Capture Vise Gripper 1”
    h. Enable Freedrive and move the robot clear of the vises. Use the recovery panel to send the robot to a nearby home position.
6. Repeat steps for Gripper 2, using the Gripper 2 equivalent buttons, with the part to be unloaded with Gripper 2 clamped in the Vise.



Note:

1. Part Specific Vise Calibration is available in the Part Configuration“Vise Calibration Definition” section when “Show Advanced Calibration Definition” is checked.
2. If the vises are in a level position for load/unload, use a level to align the load/unload plane with the vise plane.
3. ‘Float’ is not available for DuoGrip 2000, only ‘Open’ and ‘Close. This makes centering the gripper a bit more timely but has the same process.

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Vise Calibration

Gripper 1 Vise Load Calibration (Calibration Page)

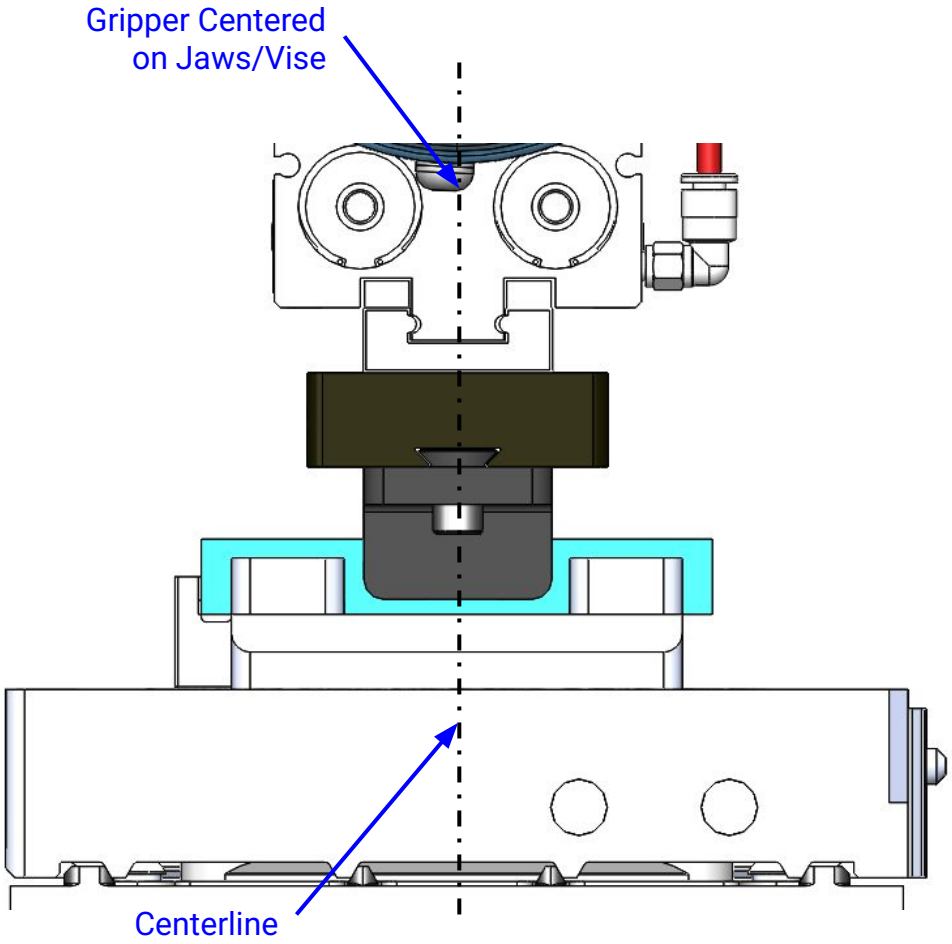
In general, Gripper 1 calibration is done with the gripper centerline aligned with the Vise/Jaws centerline and gripper fingers with equal z-thickness as the standard VersaBuilt Puck Fingers.

Generalized/Centerline Calibration is completed on the Calibration Page of the VSC User Interface.

In addition, positioning the puck fingers flush to the part during calibration is generally preferable to achieve a level capture.

For part specific applications, where loading on center is not possible or not optimal, we recommend either adding load offsets or calibrating a “Get” position in the Vise Load section of the part configuration.

See Part Configuration Section of this manual for details



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Vise Calibration

Gripper 2 Vise Unload Calibration (Calibration Page)

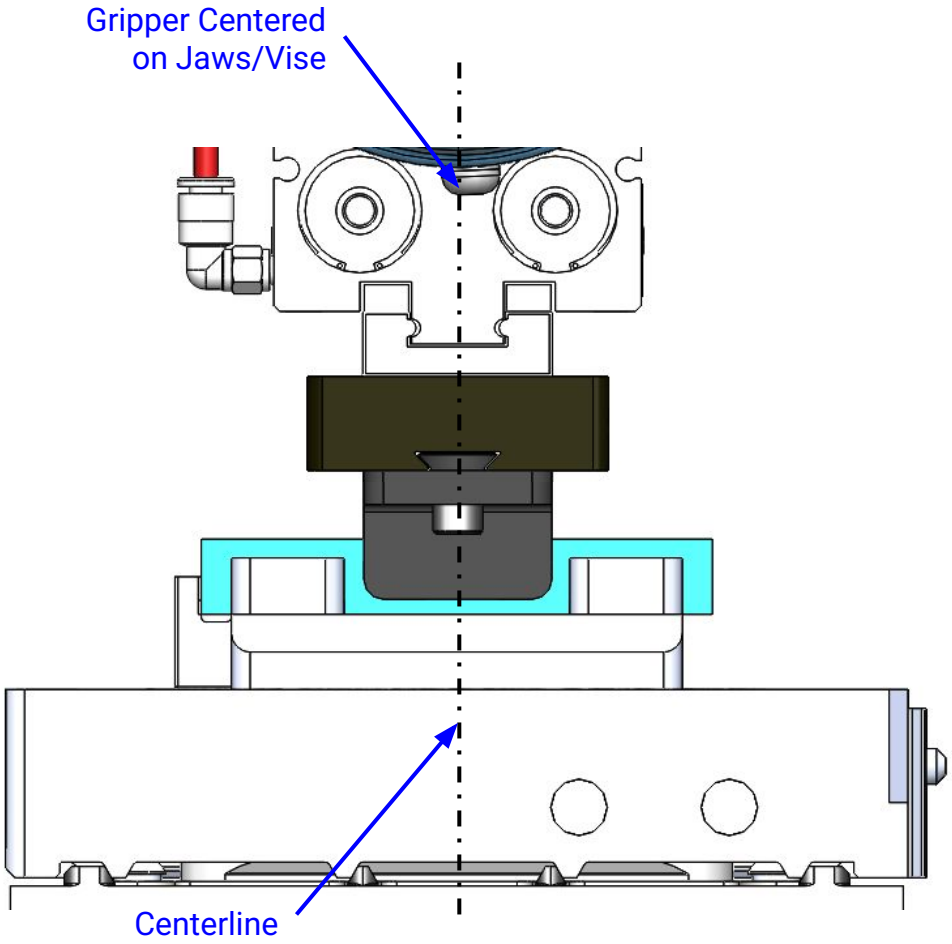
In general, Gripper 2 calibration is done with the gripper centerline aligned with the Vise/Jaws centerline and gripper fingers with equal z-thickness as the standard VersaBuilt Puck Fingers.

Generalized/Centerline Calibration is completed on the Calibration Page of the VSC User Interface.

In addition, positioning the puck fingers flush to the part during calibration is generally preferable to achieve a level capture.

For part specific applications, where unloading on center is not possible or not optimal, we recommend either adding load offsets or calibrating a “Get” position in the Vise Unload section of the part configuration.

See Part Configuration Section of this manual for details



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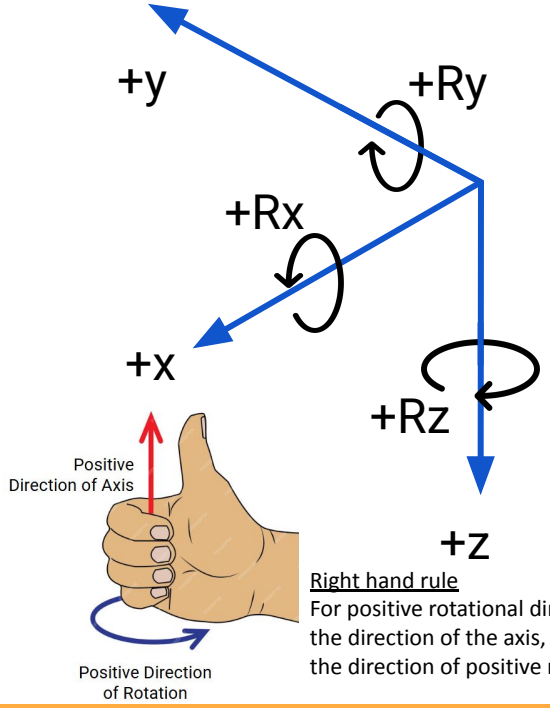
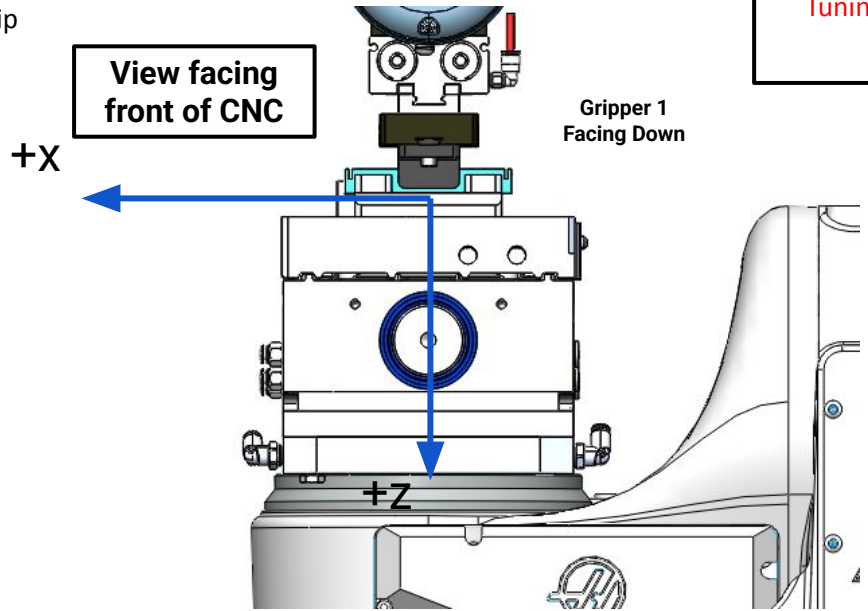
VersaCart Calibration *Load Tuning with Gripper 1

Tuning changes adjust the calculated relationship between the Gripper Face and the Vise

Tuning is not typically required, but available if needed





Right hand rule

For positive rotational direction, align your right thumb in the direction of the axis, then your bent fingers will show the direction of positive rotation

Direction of Axis is relative to the robot wrist

Load Tuning is for Gripper 1 facing down

*Gripper 1 coordinate system is opposite of Gripper 2

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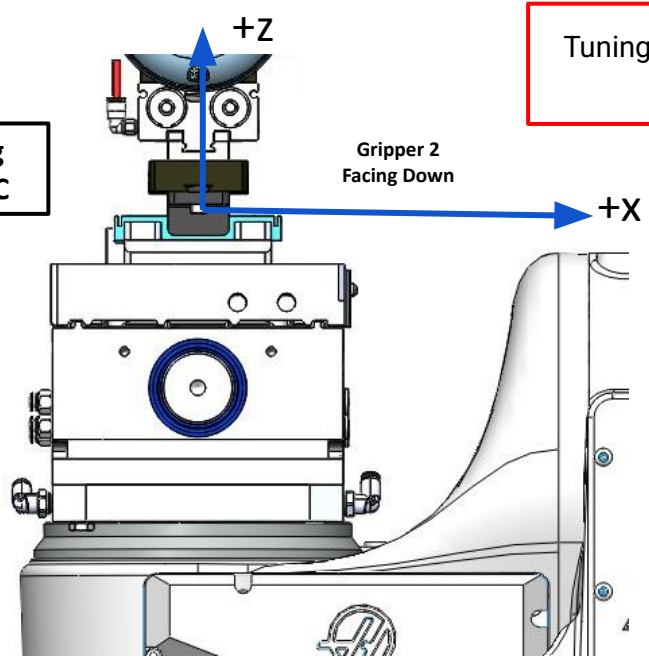
Vise Calibration *Unload Tuning with Gripper 2

Tuning changes adjust the calculated relationship between the Gripper Face and the Vise

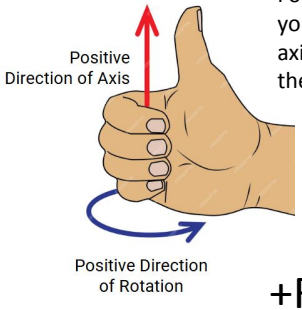
Tuning is not typically required, but available if needed

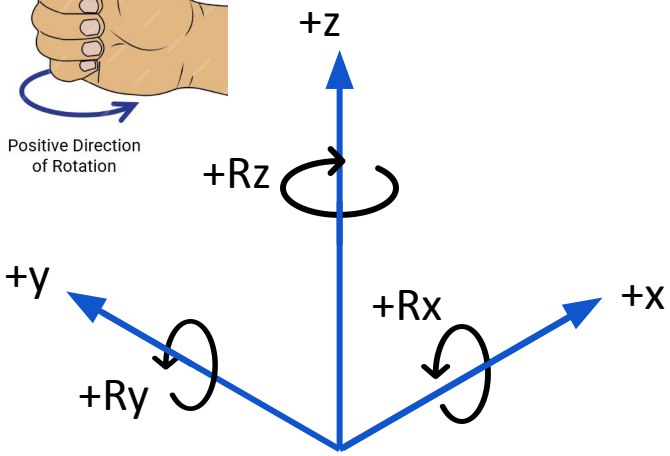
View facing front of CNC



Right hand rule

For positive rotational direction, align your right thumb in the direction of the axis, then your bent fingers will show the direction of positive rotation





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Direction of Axis is relative to the robot wrist

Outfeed Tuning is for Gripper 2 facing down

*Gripper 1 coordinate system is opposite of Gripper 2

Datum Reset or Settle

Section 7

Datum Reset

- To load the part offset from the Y-Datum (if the Y-datum centers the part on vise/jaws) which normally would cause a load interference when placing on the Calibrated Centerline*, there are multiple options available to optimize:
  - Add a vise load offset in the part configuration.
  - Utilize the Part Specific Vise Calibration option in the part configuration.
  - Utilize G-Code Vise Control and CNC tools provided by Versabuilt (Y-Push and Z-Push) to settle the part in the vise after loading. (See following page)

- To minimize the effect of operator placement variation, include the **“Load Datum**” option in the part configuration to find the end of the part before loading

See Part Configuration Section of this manual for details

*Note: We recommend the Calibration completed on the Calibration page to be at the centerline of the vise/chuck.

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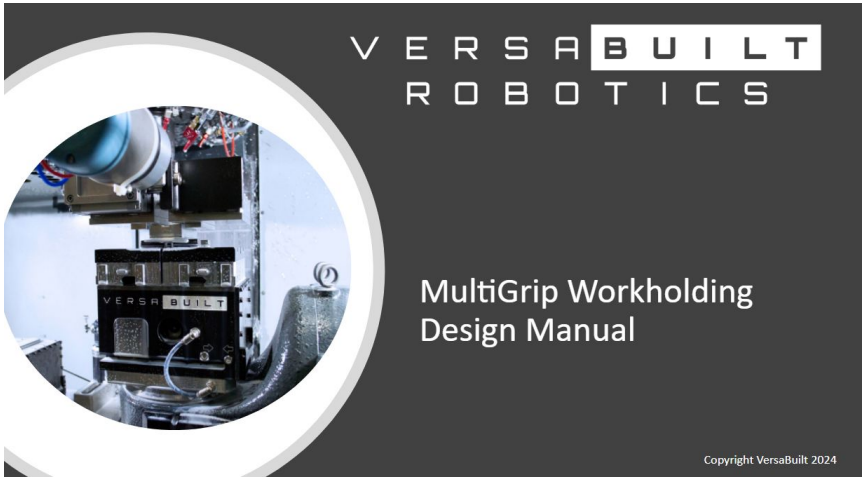
G-Code Vise Control (Haas & Fanuc Focus 2.0 Controls)

Refer to the following manuals for implementation of G-Code vise control for part positioning in the CNC with pneumatic workholding controlled by the VSC.

- MultiGrip Workholding Design Manual
- VSC/CNC Communication, G-Code, and Programming Manual



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G-Code Vise Control (Haas & Fanuc Focus 2.0 Controls)

Example: 5-axis tilt to datum

- At the start of the machining program, utilize the 5-axis to tilt and settle the part against the Y-Datum
- To open and close the vise within the machining program, utilize G-Code Vise control, where the VSC valves controlling the vises can be triggered with G-Code Commands

G-Code Vise Control (Mill Only)

The VSC Macro CNC Driver allows each of the MultiGrip Vises to be opened or closed from within a CNC program using the included CNC subprograms:

- 9002 program is used for vise control
- Call the 9002 program using the G65 command and using D and C parameters:
  - D01. selects vise 1
  - D02. selects vise 2
  - C02. closes the vise
  - C03. opens the vise
  - C06. exhausts pressure from all vises*
  - C07. pressurizes all vises*
- Recommend dwelling 1 second to allow vise to actuate:
  - G04 P1.

EXAMPLES:

- Close Vise 1: G65 P9002 D01. C02.
- Open Vise 1: G65 P9002 D01. C03.
- Close Vise 2: G65 P9002 D02. C02.
- Open Vise 2: G65 P9002 D02. C03.
- *Exhaust Vises: G65 P9002 D01.C06. (Device number doesn't matter, all vises exhaust)
- *Pressurize Vises: G65 P9002 D01.C07. (Device number doesn't matter, all vises pressurized)

Z-push with CNC spindle*

Use exhaust command before spindle push down with z-pushdown tool. After the vise pressure is exhausted, push part down with spindle using the z-pushdown tool. Use pressurized command to pressurize the vises and resume machining operation.

NOTE: decimals after the numeric values shown are important for proper function

Refer to the VSC/CNC Communication, G-Code and Programming Manual

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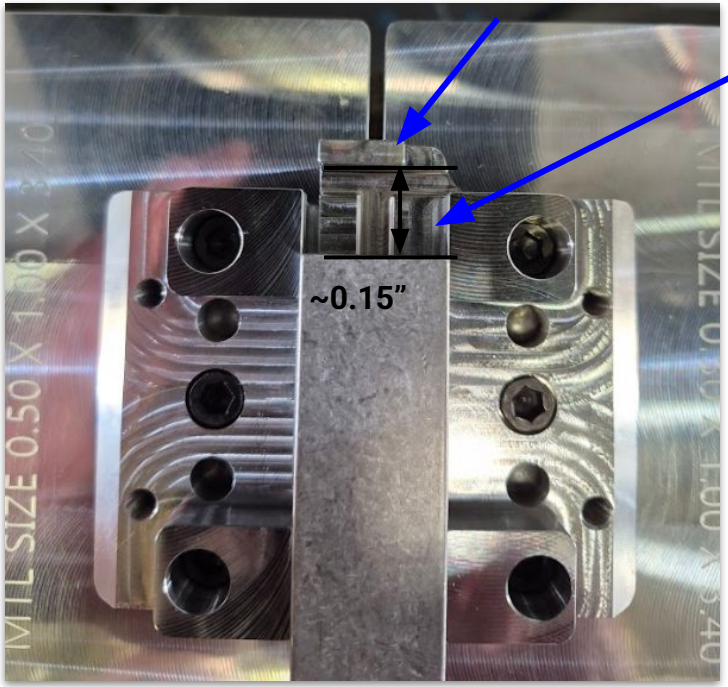
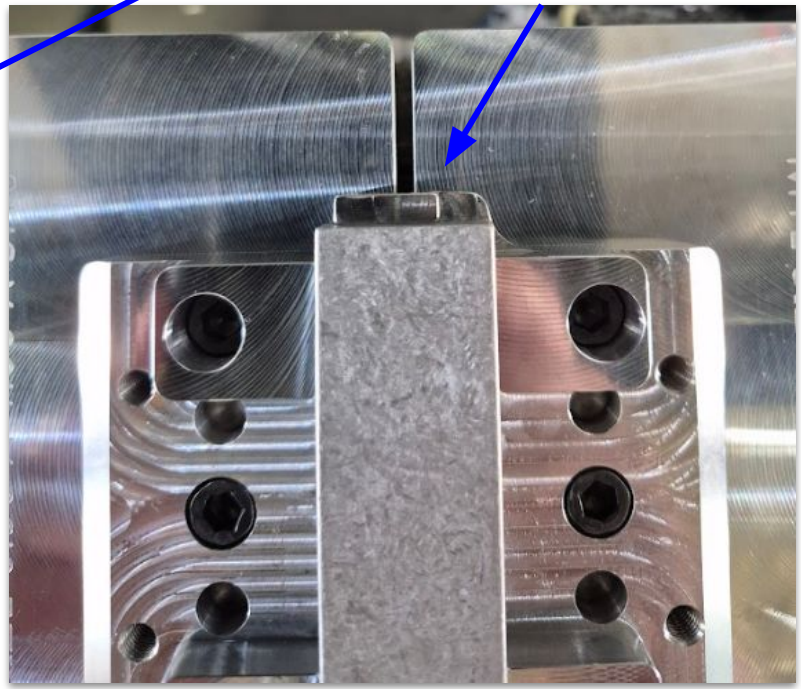
Datum Settle

X Load Vise Offset ± Operator and Robot Accuracy variance



Robot Load Location
Before Y-Settle



After Y-Settle

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User Interface & Part Configuration

Section 8

Part Configuration

The following section includes details for all options available for part configurations. Most common settings are selected by default when adding a new part configuration.

Not all fields are required - use the checkboxes and options best suited for your application. For assistance, please contact support@versabuilt.com

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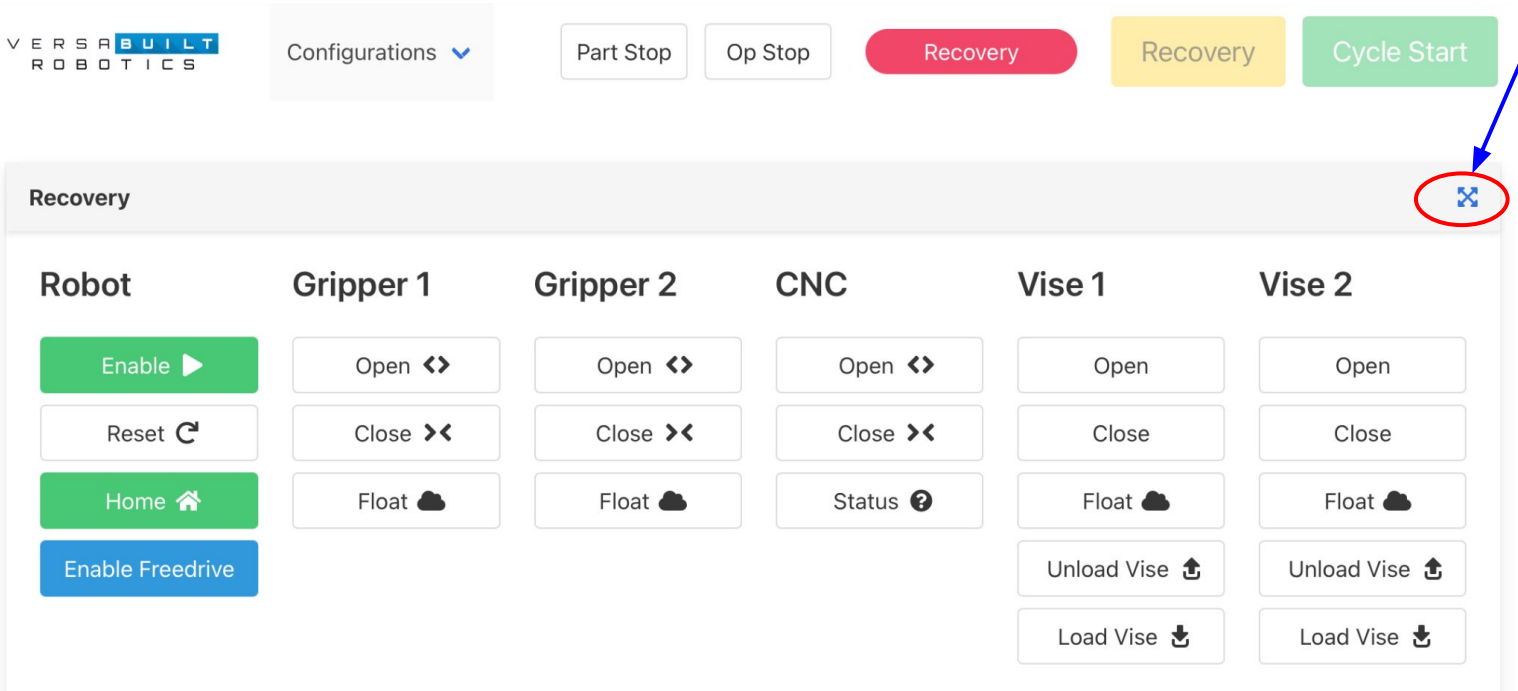
Part Configuration - Recovery Panel

Recovery Panel at the top of the Configuration Page, allowing user to stay on one screen during configuration



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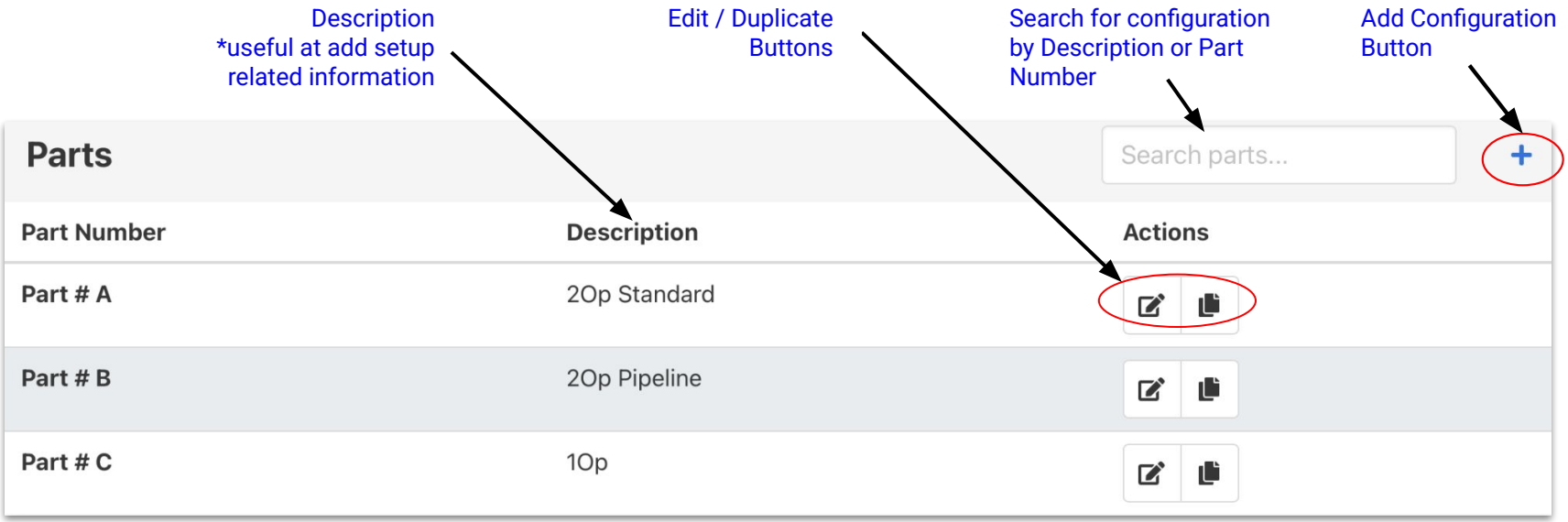
Part Configuration - Parts List

Parts list for adding new, editing or copying/duplicating configurations



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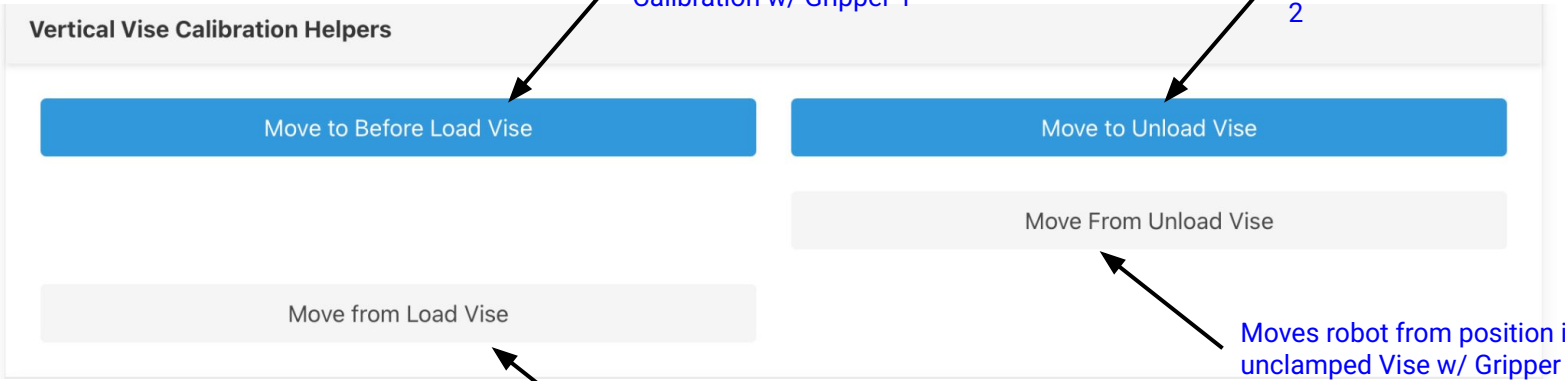
Part Configuration - Helper Buttons

“Helper” buttons to move robot and gripper into positions for part configuration options/calibrations. Helper buttons render in accordance to the configuration selected on the home page. Different configurations render different helper buttons. For example, if the “Part Specific Vise Calibration” selection is checked, the following buttons will appear. See Video on following page.



Moves robot to position and enters Freedrive for Vise Load Calibration w/ Gripper 1

Moves robot to position and enters Freedrive for Vise Unload Calibration w/ Gripper 2

Moves robot from position inside unclamped Vise w/ Gripper 2 back to CNC Home

Moves robot from position inside unclamped Vise w/ Gripper 1 back to CNC Home

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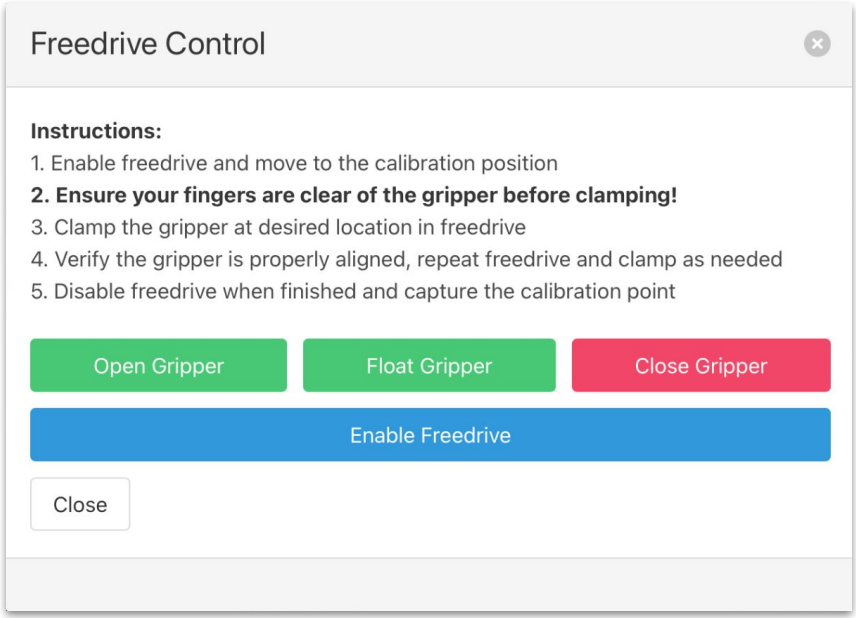
Calibration Window



This window allows for a simple, streamlined process for calibration within the user interface:

- Vise Calibration
- Load/Unload Datum Calibration
- Part Specific Calibration
- Regrip Station Calibration

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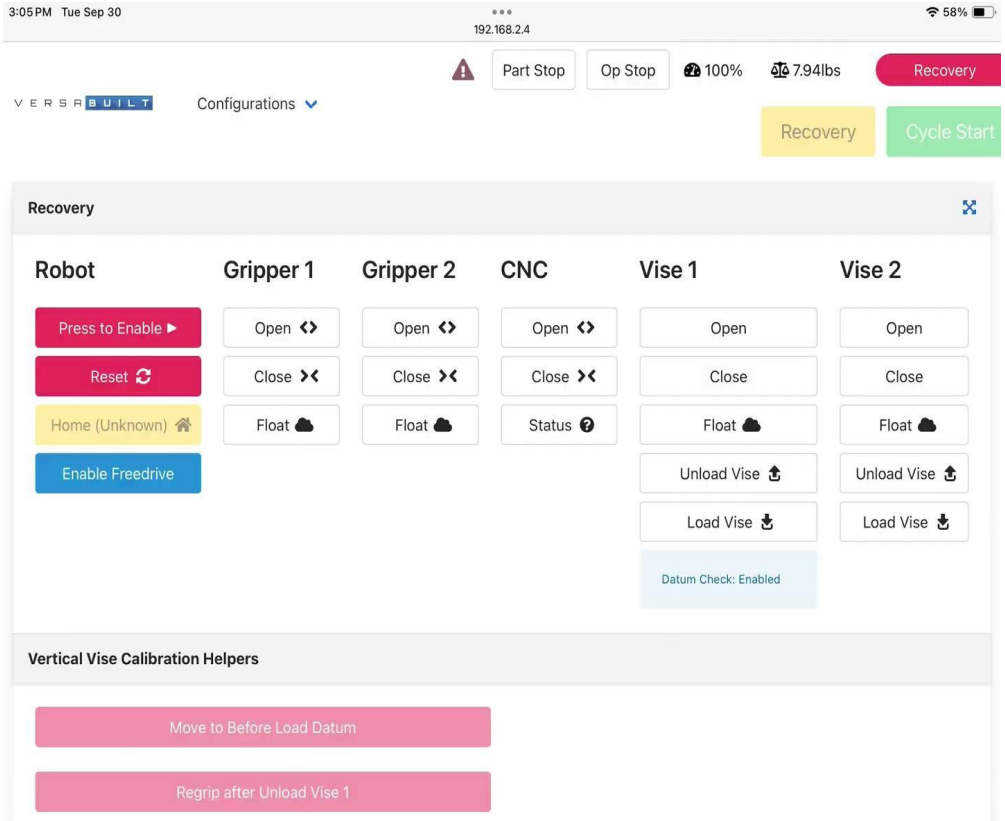
Helper Buttons State Change



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Part Configuration - Initialize Configuration

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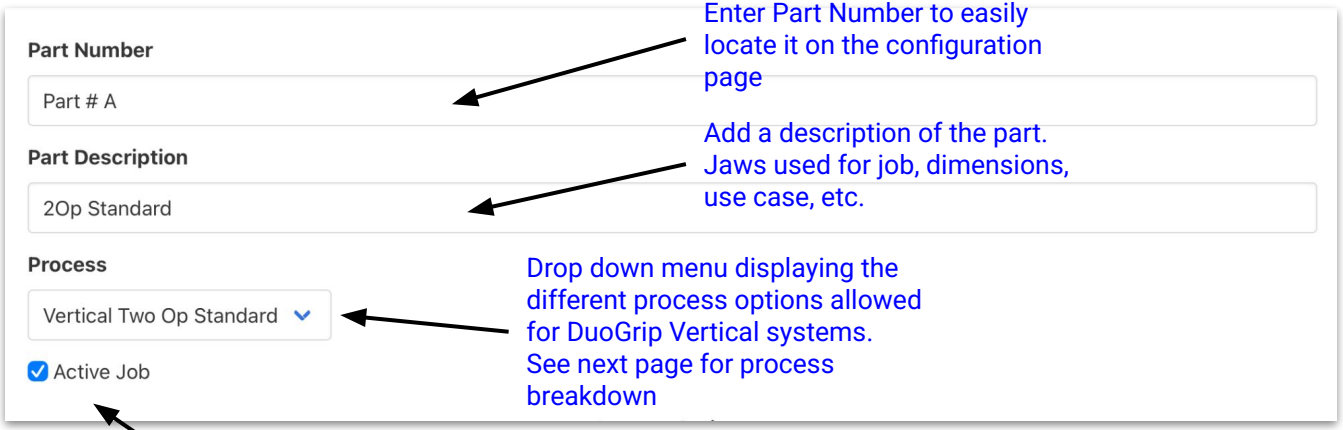

Note: The following slides will describe every option available within a *Vertical Two Op Standard* Process. However this will encompass every option available within all the processes for Vertical Mill with Duogrip

Part Configuration - Processes

Vertical Two Op Standard - machines Two Op parts to completion one at a time.

- Robot picks raw material from the infeed with Gripper 1.
- (Optional) Performs a datum check to confirm correct, centered pick.
- Loads raw material into the Op1 vise (typically Vise 1); material is machined to Op1.
- Robot unloads the Op1 part with Gripper 2.
- Performs a regrip at the regrip station.
- (Optional) Performs a datum check to confirm correct pick.
- Loads the Op1 part into the Op2 vise (typically Vise 2).
- Robot unloads the finished part and places it back on the infeed.
- Repeat cycle.

Vertical One OP- machines One Op parts to completion one at a time.

- Robot picks raw material from the infeed with Gripper 1.
- (Optional) Performs a datum check to confirm correct, centered pick.
- Loads raw material into the Op1 vise (typically Vise 1); material is machined to Op1.
- Robot unloads the finished part and places it back on the infeed.
- Repeat cycle.

Vertical Two Op Pipeline - alternates parts, machines each to Op1, finishing both in sequence once their first operations are complete.

- Robot picks raw material from the infeed with **Gripper 1**.
- *(Optional)* Performs a **datum check** to confirm correct, centered pick.
- Loads raw material into the **Op1 vise** (typically Vise 1); material is machined to **Op1**.
- Robot picks the next raw material with **Gripper 1**.
- *(Optional)* Performs datum check.
- Unloads the first **Op1 part** with **Gripper 2** and loads new raw material into the **Op1 vise** with **Gripper 1**.
- Performs a **regrip** of the first **Op1 part** at the regrip station.
- *(Optional)* Performs datum check.
- Unloads the second **Op1 part** with **Gripper 2** and loads the first **Op1 part** into the **Op2 vise** with **Gripper 1**.
- Performs a **regrip** of the second **Op1 part** at the regrip station.
- *(Optional)* Performs datum check.
- Unloads the first **finished part** with **Gripper 2** and loads the second **Op1 part** into the **Op2 vise** with **Gripper 1**.
- Places the **finished part** back on the infeed.
- Picks another **raw material** with **Gripper 1**.
- *(Optional)* Performs datum check.
- Unloads the second **finished part** with **Gripper 2** and loads new raw material into the **Op1 vise**.
- While the robot places the second finished part on the infeed, the new material is machined to **Op1**.
- Robot repeats the process.

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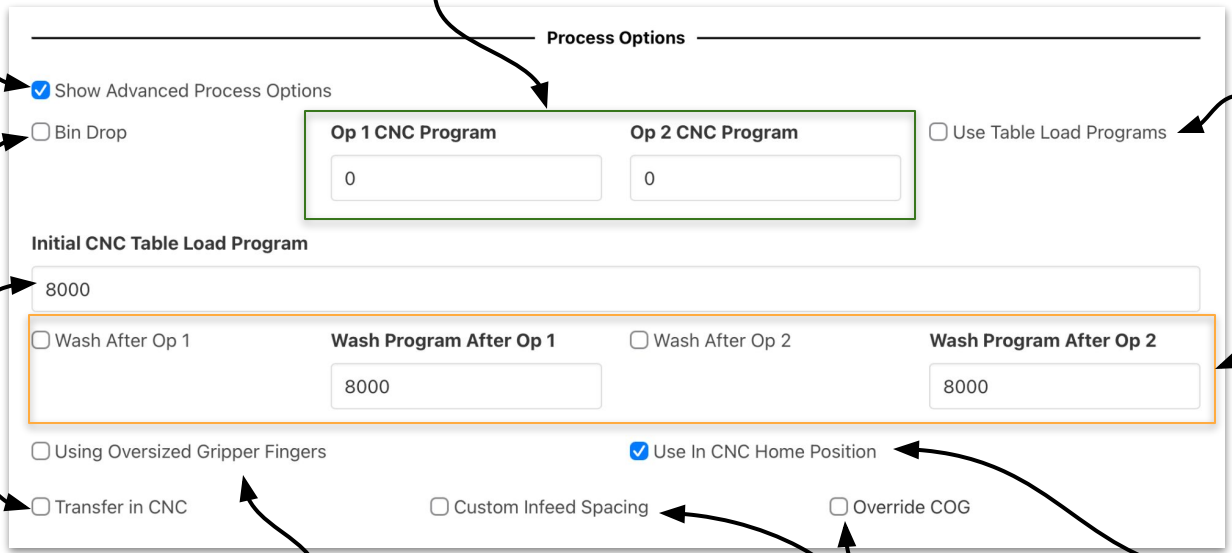
Part Configuration - Process Options



Op1/ Op2 Program numbers that will be selected by the Dispatcher as a subroutine on Haas and Fanuc Focus 2.0 controllers

Select to see all options.

Check to add a subprogram to position the CNC Table before Part Load or Unload, if unload is different than load.

Enable to allow for Bin Drop, calibrated in the Calibration Page

CNC program to position table at calibrated load position

Enable to initialize a CNC table wash programs after Op1/Op2 using the Program number entered in the fields

Enable to allow the robot to rotate while *Inside the CNC.

Note: T: Increases cycle time but requires ample space inside the CNC. CAUTION - collision of tool spindle is possible with this option selected.

Must be Enabled if using Oversized Gripper Fingers to allow robot to compensate the fingers dimensions for successful automation

See following Slides for details on these two options

Allows the robot to move in accordance to a calibrated In CNC Home Position, calibrated on the Calibration page.

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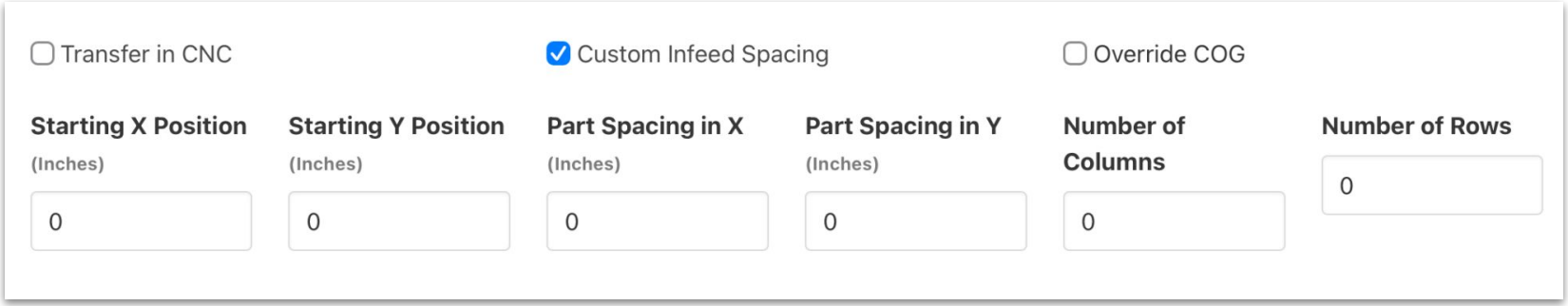
Part Configuration - Custom Infeed Spacing



Custom Infeed Spacing

When selected, the automatic calculation of infeed spacing is overridden and the operator is prompted to enter starting X and Y locations, part spacing in X and Y and the number of rows and columns.

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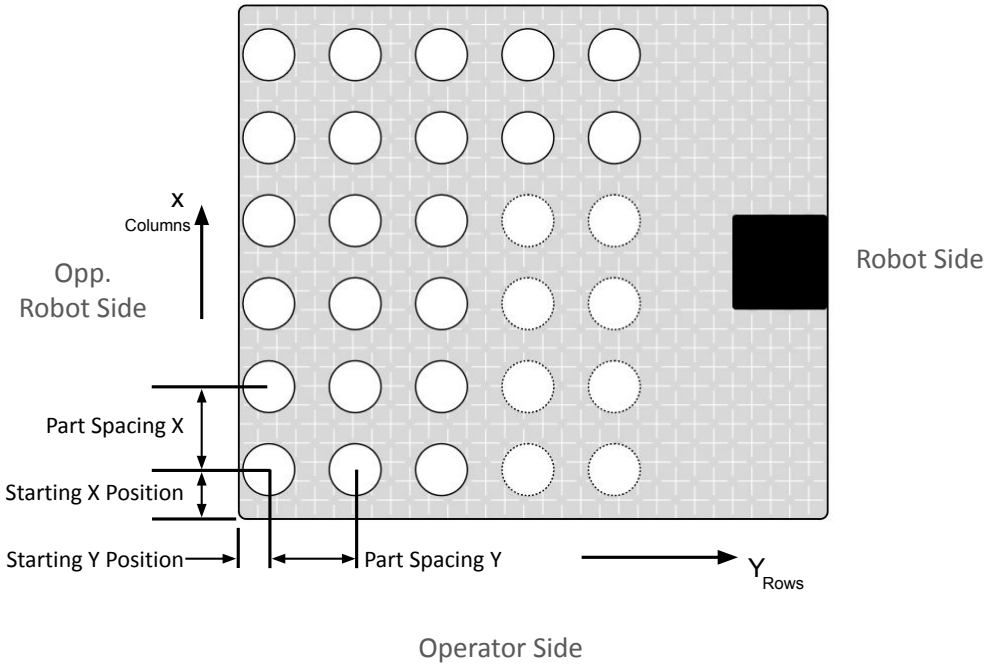
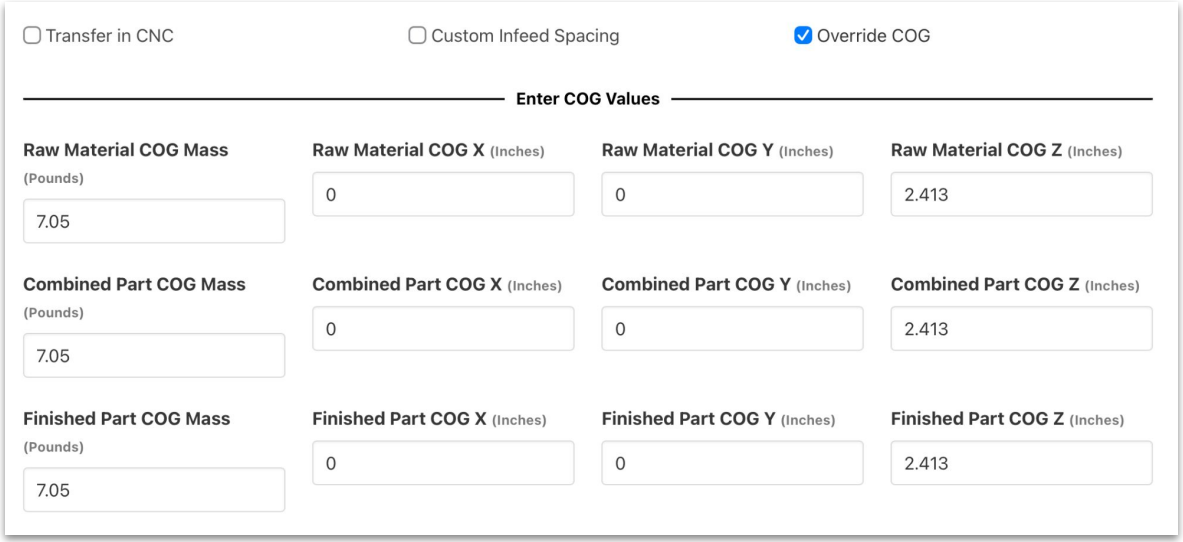
Part Configuration - Custom Infeed

- The Infeed layout can be customized, typically for infeed optimization.
- The custom locations are set in the Part Configuration, with offsets relative to the calibrated Stainless Steel Visual Infeed (refer to calibration manual).
- In the part configuration, the following information is entered:
  - **Starting X Position** = Distance from Edge of Calibrated Infeed (Operator Side) to Center of Part Picking Location
  - **Starting Y Position** = Distance from Edge of Calibrated Infeed (Opposite Robot) to Center of Part Picking Location
  - **Part Spacing in X** = Center to Center distance in X Direction
  - **Part Spacing in Y** = Center to Center distance in Y Direction
  - **Number of Columns** = X-Direction Part Count
  - **Number of Rows** = Y-Direction Part Count
- For custom infeed design, contact VersaBuilt or use 3D models, available at https://www.versabuilt.com/resources/.



Part Configuration - Override COG



Raw Material COG X,Y,Z

Center of mass from the robot wrist of Gripper plus Raw Material in Gripper 1

Combined Part COG X,Y,Z

Center of mass from the robot wrist of Gripper plus Parts in Gripper 1 and Gripper 2

Finished Part COG X,Y,Z

Center of mass from the robot wrist of Gripper plus Finished Part in Gripper 2

Override COG (Center of Gravity)

****Not selected for most applications****

By default, the COG for each part is calculated automatically, as a uniform mass based on length x width and height of the part, at the different states of operation.

If needed, the COG definition for each process step can be entered manually, as shown on this page

COG definition can be calculated using CAD with downloaded Gripper files, or using available robot COG processes. COG is needed for Part in Gripper 1 only, Part in Gripper 2 only, and Part in both Grippers

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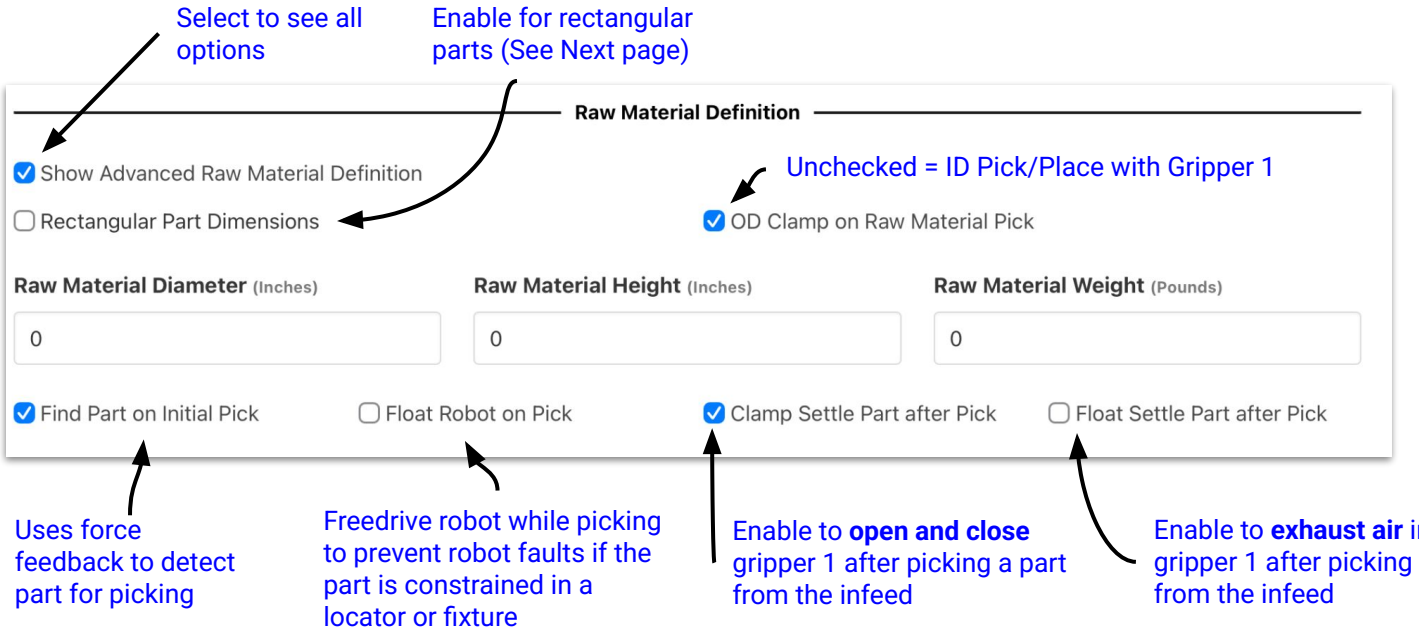
Part Configuration - Circular Raw Material Definition



Note: *Clamp Settle and Float Settle* allow a part to settle in Z. *Clamp Settle* is useful for lighter parts. However, *Float Settle* is generally sufficient for parts heavier the approx 4 pounds.

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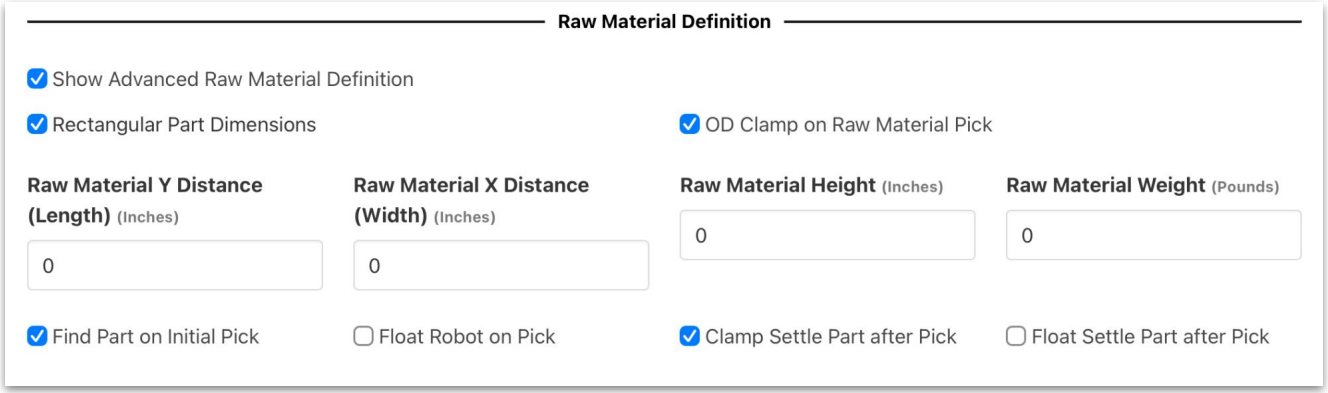
Part Configuration - Rectangular Raw Material Definition

With Rectangular Part Dimensions enabled, the fields for entering dimensions change to the above image.



The Raw Material Definition section is directly related to how the robot picks a piece of material. However, custom Puck Fingers can impact this process. See Appendix for further details regarding Pick Height Calculations.

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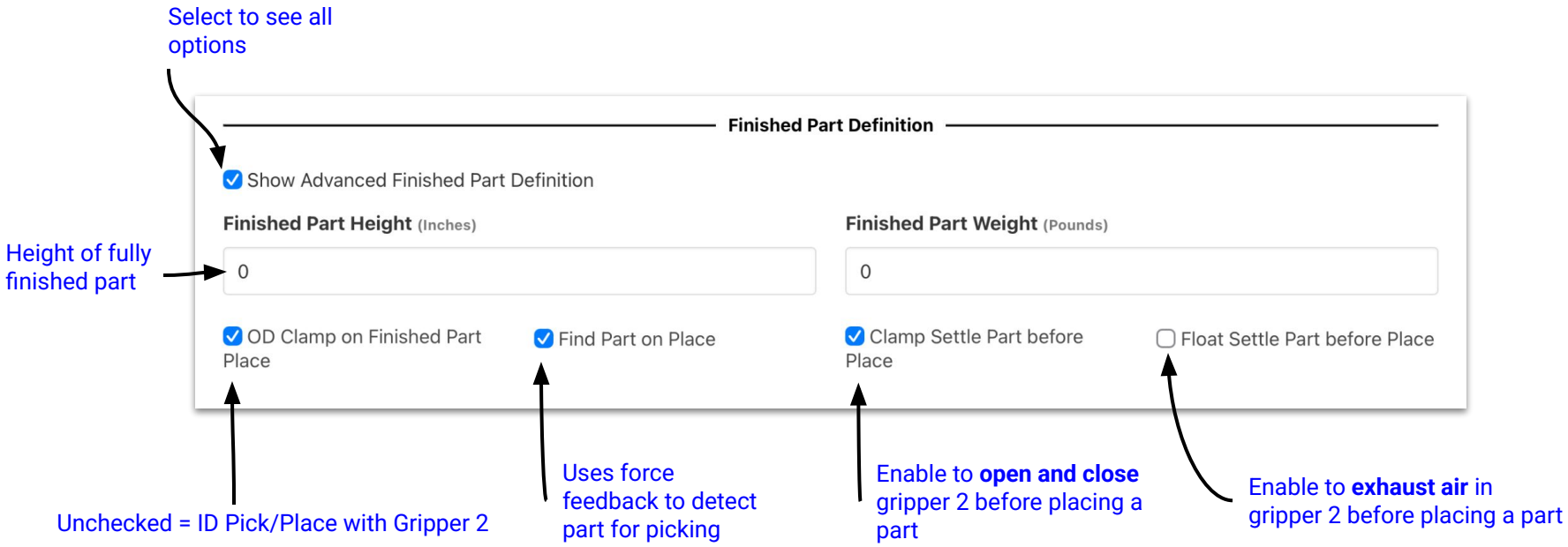
Part Configuration - Finished Part Definition



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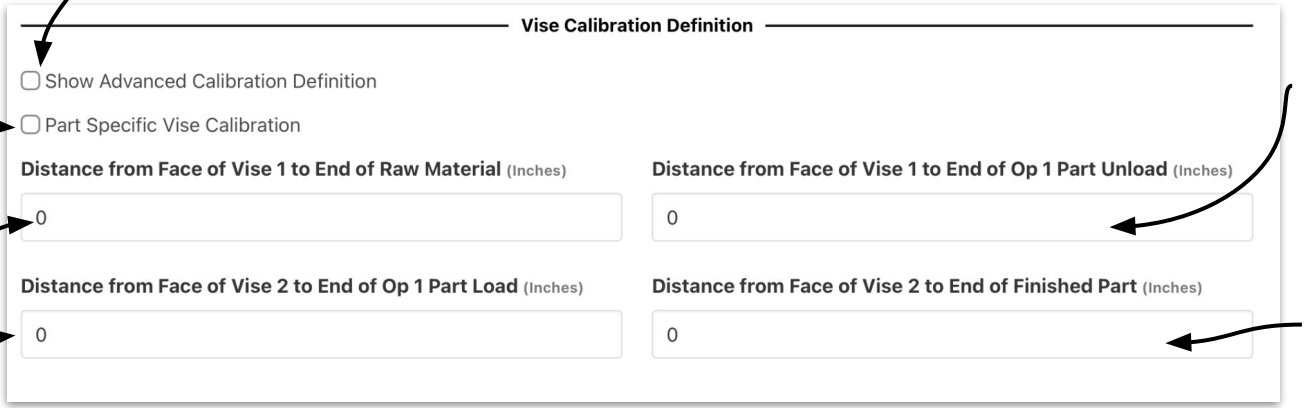
Part Configuration - Vise Calibration Definition



The two fields on the left represent numbers used for Loading a part. The two fields on the right represent numbers used for unloading a part.

Notice all the fields have the key words *End of*. In most cases, loading and unloading can be done with the Grippers Puck fingers flush to the part. Thus, the *End of Raw Material*, *End of Op1*, etc.. However, if a shallow pick / load is desired, the distance between the part and the Puck Fingers needs to be accounted for. In addition, if a shallow unload / place is desired, this distance also needs to be accounted for. In essence, the fields can universally be thought of as the distance from the *Face of Vise to Face of the Puck Fingers*. **Reminder**: Bolts are attached to the Puck Fingers - attached to the Base Fingers - attached to the gripper actuators.

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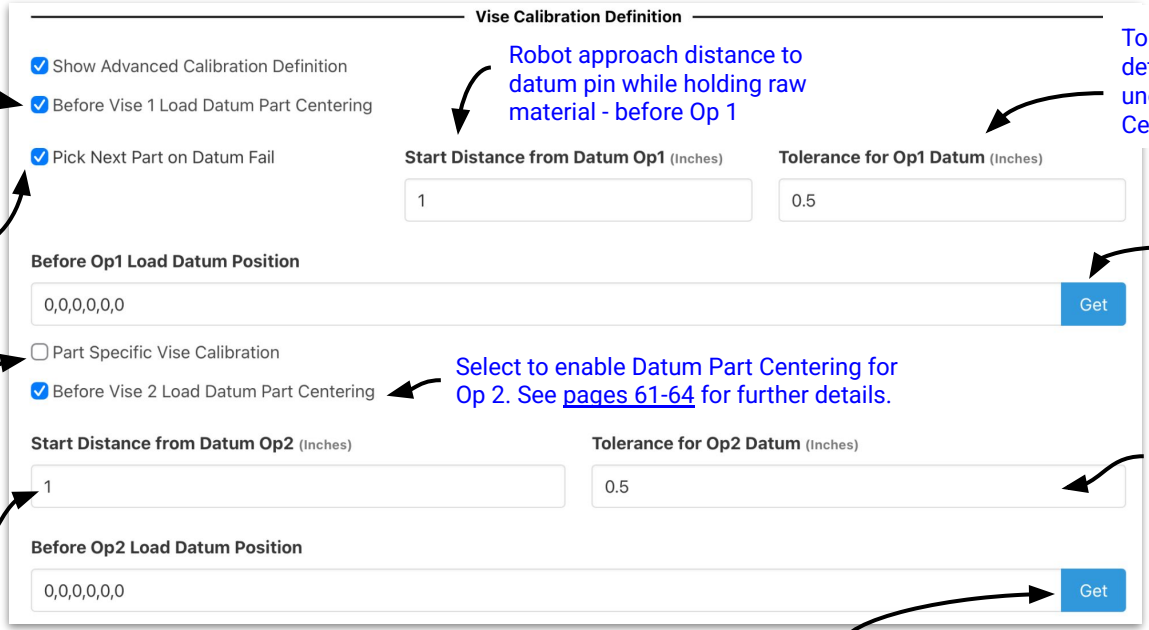
Part Configuration - Vise Calibration Definition (Advanced)



Select to enable the Datum Part Centering process for Op 1. See pages 61-64 for further details

Select to enable picking the next part on the infeed in the case of a datum check failure

Select to enable Part Specific Vise Calibration. See pages 65-67 for further details

Robot approach distance to datum pin while holding Op 1 part - before Op 2

Robot approach distance to datum pin while holding raw material - before Op 1

Select to enable Datum Part Centering for Op 2. See pages 61-64 for further details.

Tolerance allowed in inches to determine failure marker when undergoing the Datum Part Centering process before Op 1

Calibrated Datum Position while Gripper 1 holds raw stock - before loading Op 1. **6 numbers are automatically filled after 'Get' is clicked**

Tolerance allowed in inches to determine failure marker when undergoing the Datum Part Centering process before Op 2

Calibrated Datum Position while Gripper 1 holds Op 1 Part - before loading Op 2. **6 numbers are automatically filled after 'Get' is clicked**

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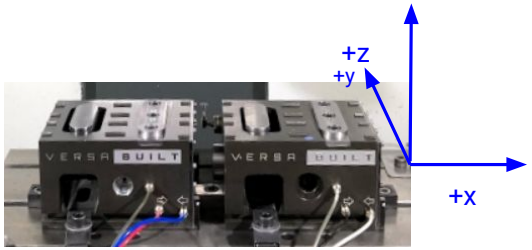
Part Configuration - Vise Load Options

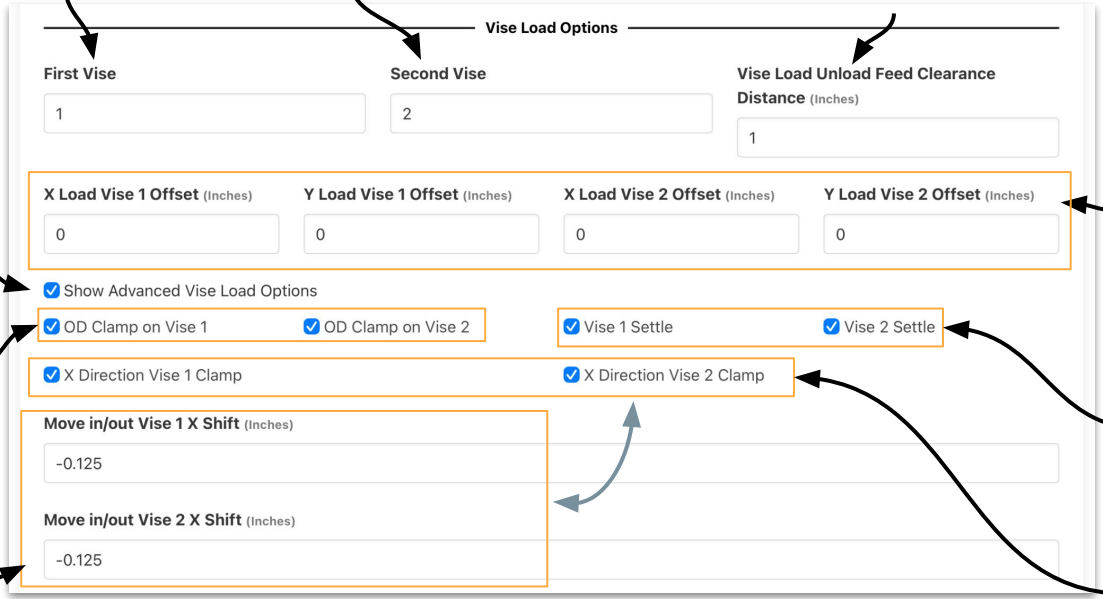


Front of CNC
(+x to the right, +y to the back)

Enter '1' to use Vise for Op 1

Enter '2' to use Vise for Op 2

Approach and Retreat distance for robot before a load / unload. Allow ample clearance of CNC tool spindle



Offset options in x,y,z while Loading a part. **Part will be loaded offset from calibrated position**. Useful when used in combination with G-Code Vise control / CNC Tools

Select to see all options

Enable for 'Outside Dimension' Clamping per vise. **If unselected, assumes ID**, 'Inside Dimension', clamping

Enable to allow selected vise to open and close after a load to allow a part to 'settle' in the vise

When disabled, Y Direction is enabled. Specifies vise orientation when clamping. **Fields below work in tandem with these options**

Enter desired amount to shift in X/Y while loading **to a calibrated position**. (depending on if X Direction is enabled).

Note: this **does not change the calibrated loading position. It simply allows the robot path to shift in/out during a load. **Use X/Y Load Vise Offset above for changing the calibrated position****

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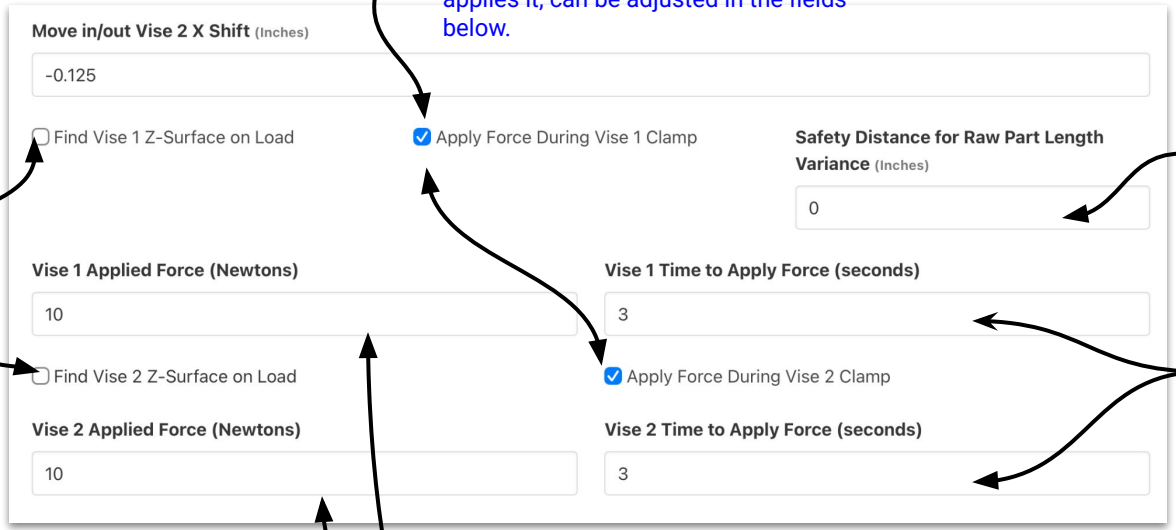
Part Configuration - Vise Load Options (Apply Force)

Enable to allow the robot to 'apply force' while loading a part **per vise** selected.. The amount of force it applies, and how long it applies it, can be adjusted in the fields below.

Enable to utilize the robots force feedback while loading, **per vise**, to find the Z-Surface, which in turn signals the robot to release the part. Similar to find part while picking



Enter the amount of variance between the shortest and tallest part. Mitigates protective stop of the robot if part length variance is high. 'Find Vise on Load' eliminates this issue entirely

Enter amount of time to apply force **per vise**

****Important****
While Apply Force is selected, the 'Float Robot on Load Vise' is no longer available. This works both ways. If 'Float Robot' is selected, 'Apply Force' is no longer available. **See next page for explanation of the Float Robot features.**

If apply force is selected, enter force value required to properly load the vise

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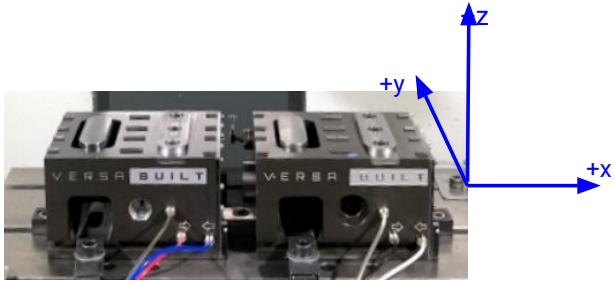
Part Configuration - Vise Load Options (Robot Float)

Float Robot on Load is way to enable the robots freedrive feature at the moment of vise / chuck actuation. In certain cases, the actuation of a vise can cause the robot to shift and consequently protective stop.

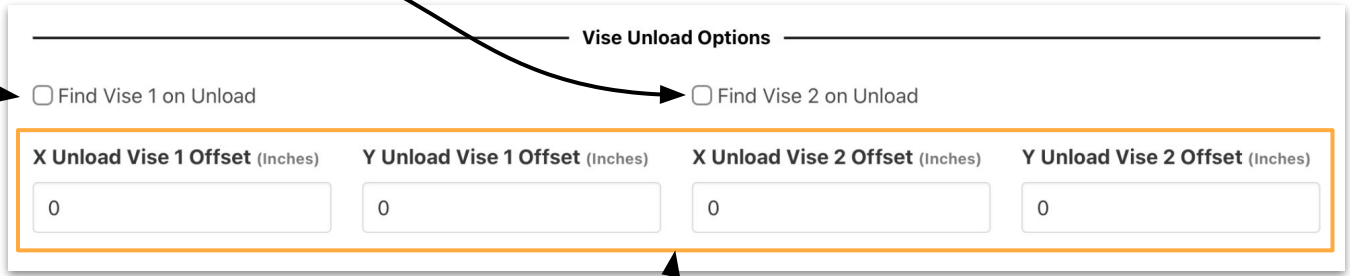
This feature is especially useful for applications involving **high part variance** or **heavy workpieces**. When part dimensions vary, it can be challenging for automation to precisely center the part within the workholding. By activating the *Float* feature, the robot can move freely during clamping, allowing it to automatically compensate for dimensional variations.

Note: *Float* and *Apply Force* are contradictory features, in that the robot cannot apply force while freedrive is enabled. If *Float* is enabled, *Apply Force* will be hidden in the configuration, and vise versa.

Part Configuration - Unload Options



Select to use force feedback for part unloading **per vise** (to find Z-surface)



Unload offset from the calibrated position in the X/Y-direction (avoid datum)

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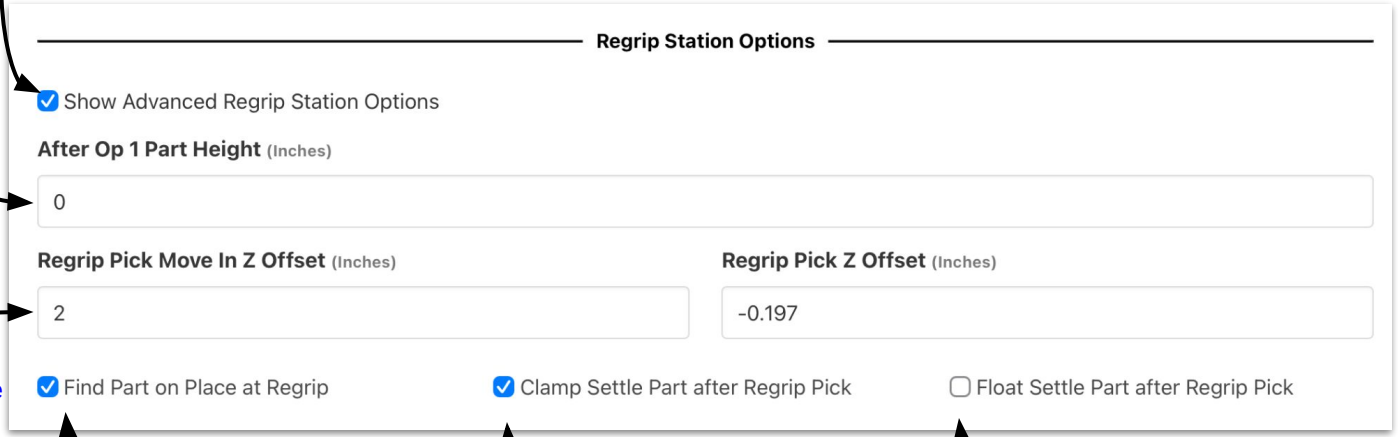
Part Configuration - Regrip Station Options

Select to see all options

Enter Op 1 Part Height

Clearance distance of the robot relevant to the regrip station while moving towards the pick position



Uses force feedback to detect surface while placing part at the Regrip Station

Enable to **open and close** gripper 1 after picking a part from the regrip station. Allows part to settle in Z.

Enable to **exhaust air** in gripper 1 after picking a part from the regrip station. Allows part to settle in Z.

Note: *Clamp Settle* is useful for lighter parts. However, *Float Settle* is generally sufficient for parts heavier the approx 4 pounds.

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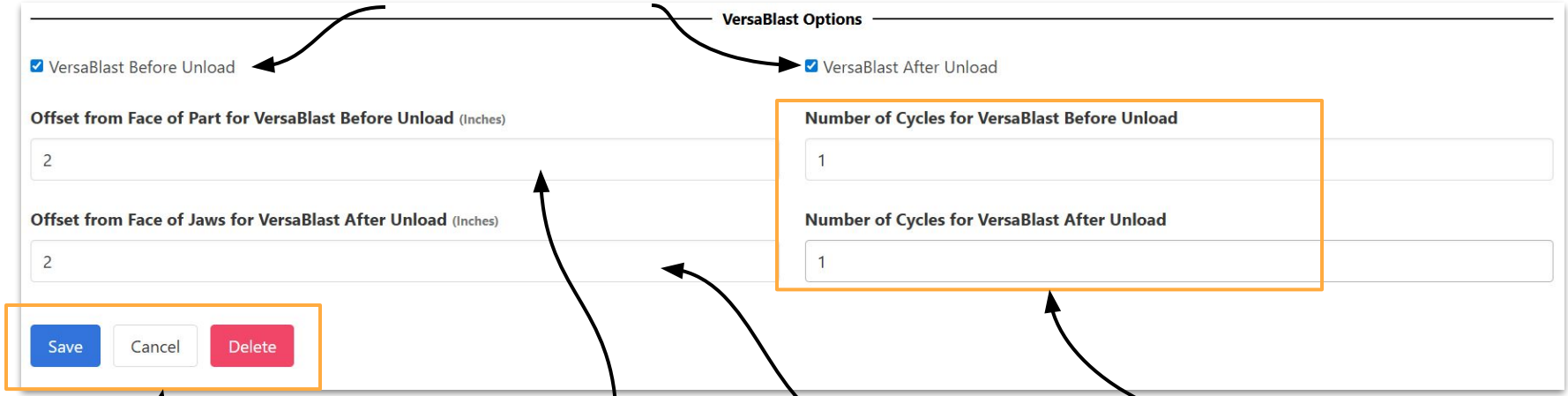
Part Configuration - VersaBlast Options

Note: When deciding # of cycles, a balance of cycle time and sufficient chip maintenance should be considered.

Select to enable the Versablast to before / after an Unload



Save, Cancel or Delete the current configuration

Distance between air amplifier and part **before** and unload

Distance between air amplifier and empty jaws **after** and unload

How many iterations of the VersaBlast motions the robot will perform **before/after** unload

Note: When deciding on Offset fields, ensure coolant does not splash to heavily on the robot and gripper actuators

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Before Op 1 / Op 2 Load Datum Position

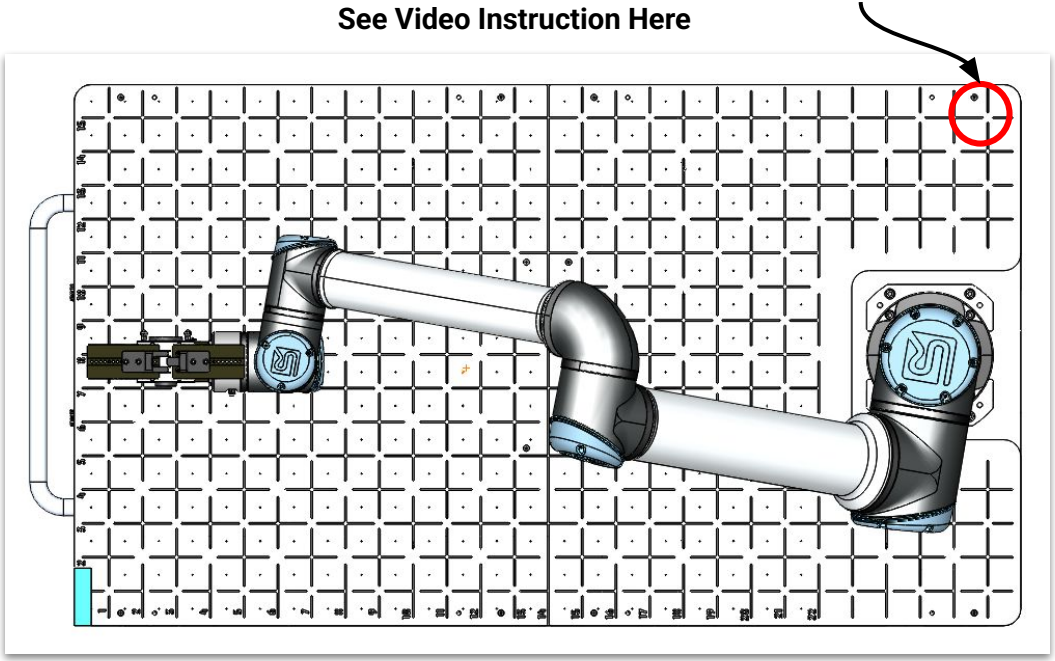
Load Datum location

Before Op1 / Op2 Load Datum
When selected, prior to moving to the InCNC position for vise loading, the robot moves to a position at the corner of the cart nearest the CNC door opening, then indexes against a 25mm spacer bolted to the cart top to find the “actual” end of part location, relative to the gripper. If the checkbox is selected, an option for calibrating “Get” a position for the index becomes available.

Op1 Load Datum Position vs Op2 Load Datum Position

- The Op1 Datum calibration is done via picking a part from the infeed and moving to the datum for capture.
- The Op2 Datum calibration is done via unloading an Op1 part from the workholding and moving to the datum for capture.

See Video Instruction Here



Load Datum Parts:

- VersaBuilt P/N 5013191 - ALUMINUM SPACER, UNTHREADED, 5.3 ID X 10 OD x 25mmL (McMaster-Carr #94669A093)
- QTY: 1 - VersaBuilt P/N 5000790 - M4x0.8 SHCS x 35mm L (McMaster-Carr #91290A182)

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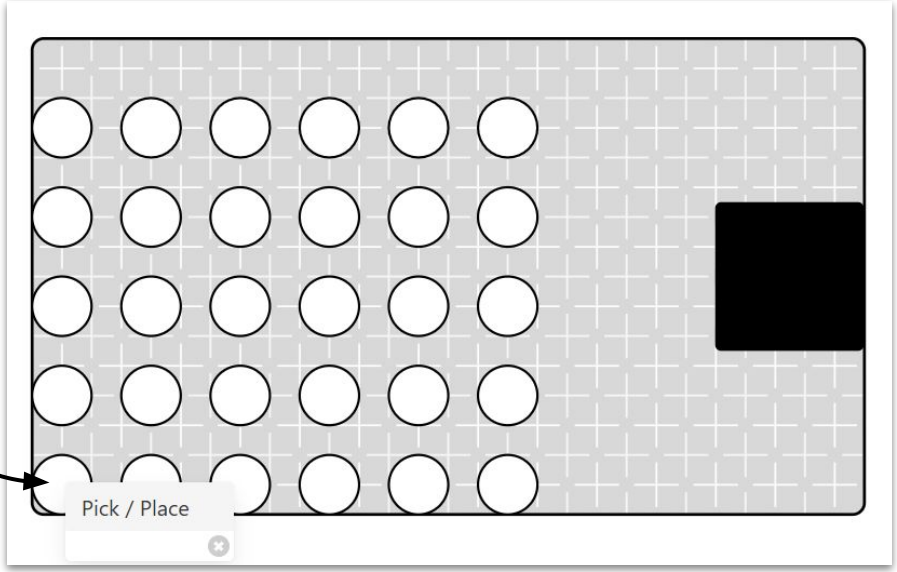
Before **Op1** Load Datum Position

*Before **Op 1** Load Datum Position* Calibration Instruction:

- Start and Save the Part Configuration to add the “Before Vise Load Datum” option
- Go to Home Screen > Recovery. Select the configuration to be edited from the “Job” pull down menu
- Place the representative part or raw material in a slot (typically slot 1)
- Click on the slot on the Home page infeed visualization & select “Pick”
- After Picking, robot will move to Table Home Gripper 1
- Go to the Configuration Page



See Following page for further calibration instruction

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Before **Op1** Load Datum Position

*Before **Op 1** Load Datum Position* Calibration Instruction:

- Helper buttons (image below) are made available after having selected the corresponding configuration on the home page.
- Use the Helper function, “Move to Before Load Datum”, commanding the robot to move to a CNC Home Gripper 1 position, **automatically** entering Freedrive
- Manually move the robot to a position where the end of the part is touching the datum bar (see image here). *Use a level to roughly align the gripper with the cart top
- Disable Freedrive from the recovery panel, or helper button section, and open the configuration to edit.

See Following page for further calibration instruction

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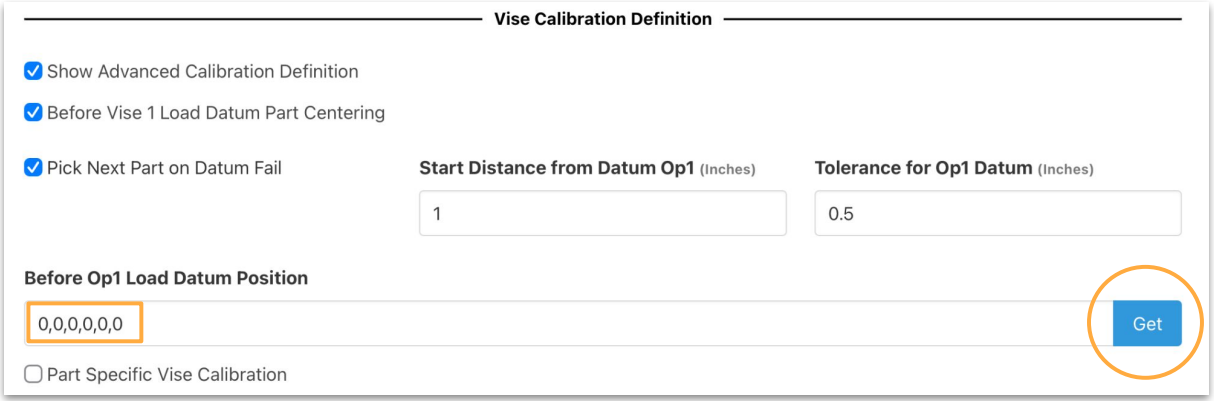
Before **Op1** Load Datum Position

*Before **Op 1** Load Datum Position* Calibration Instruction:

- Navigate to the “Vise Calibration Definition” section, click **“Get”** for the *Before Op1 Load Datum* field & verify the **values** change
- Scroll to the bottom of the configuration and click Save.
- Using the recovery panel, send the robot to “CNC Home Gripper 1”
- If using Part Specific Vise Calibration, keep the part in the gripper. Do not remove. Where the robot *picks the part is exactly where it needs to be for calibration of the **Vise 1/2 Load Position** (depending on which vise holds responsibility for Op1)**.**
- See the following pages for *Before Op2 Load Datum Position* Instructions



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Before **Op2** Load Datum Position

Capturing the Before Op2 Load Datum Position, unlike Op1, requires the following to be completed prior:

- Vise Calibration
- Regrip Station Calibration
- If using Part Specific Vise Calibration, this also needs to be completed beforehand.

The robot will need to go through an Unload and Regrip process before this position can be captured. After a successful regrip with the Op1 Part in Gripper 1, the following pages can guide a user through the process of capturing the datum position.

Note: Vise Calibration and Regrip Station Calibration need not be done on a part-to-part basis, as is anything captured on the calibration page. Only the Part Specific Vise Calibration is done on a part-to-part basis.

See Following page for calibration instruction of *Before Op2 Load Datum Position*

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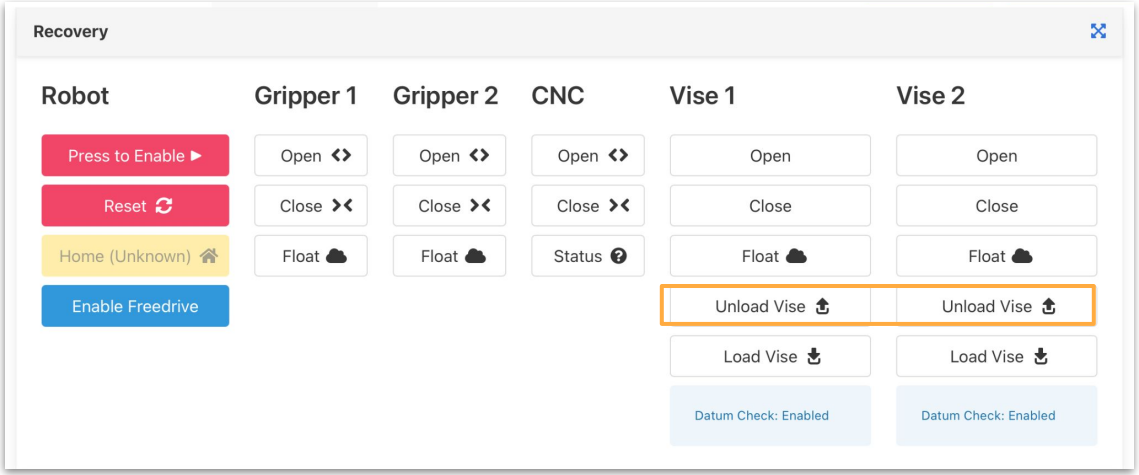
Before **Op2** Load Datum Position

*Before **Op 2** Load Datum Position* Calibration Instruction:

- Building off the procedure for Op 1 Load Datum Position calibration (see previous slides), ensure the correct configuration is selected on the home page, and **navigate to the configuration page**.
- An Op1 part will need to be loaded into a vise, in the orientation in which it was machined from raw material to and Op1 part.
- Ensure the CNC table is in the **table load position.**
- Using the recovery panel at the top of the configuration page, initiate an Unload command by clicking the “Unload Vise” button.
- The robot will move to unload the selected vise (Vise 1 or Vise 2) with Gripper 2, retreating to CNC Home once complete.



See Following page for further calibration instruction

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Before **Op2** Load Datum Position

*Before **Op 2** Load Datum Position* Calibration Instruction:

- With an Op1 part in Gripper 2, click the “Regrip after Unload Vise” button. A window will appear asking to confirm a part in Gripper 2. Click Yes to initiate the regrip process. (This regrip process takes into account the configuration selected on the home page)
- With a part now in Gripper 1 - Use the Helper function, “Move to Before Load Datum”, commanding the robot to move to a CNC Home Gripper 1 position, **automatically** entering Freedrive
- Manually move the robot to a position where the end of the part is touching the datum bar (see image here). *Use a level to roughly align the gripper with the cart top
- Disable Freedrive from the recovery panel, or helper button section, and open the configuration to edit.

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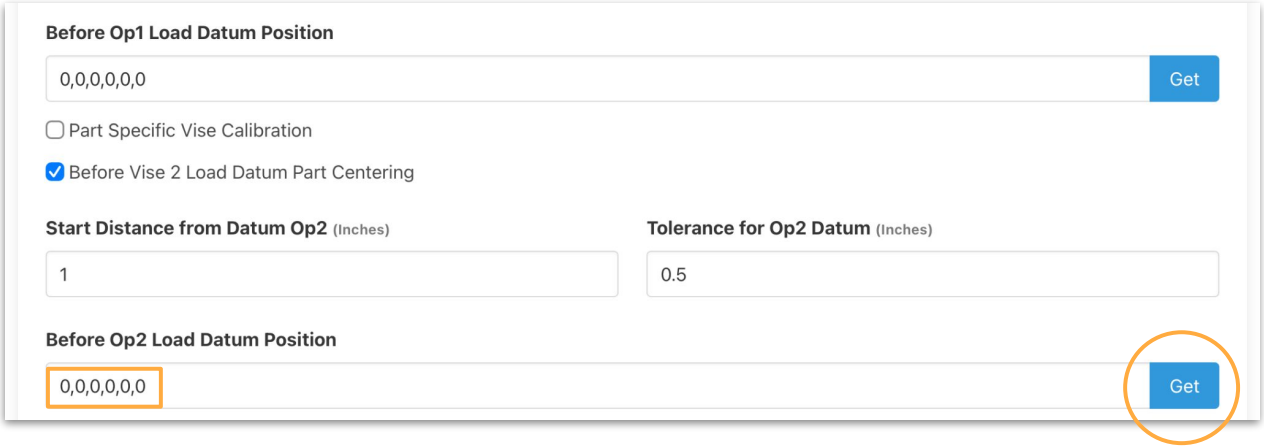
Before **Op2** Load Datum Position

*Before **Op 2** Load Datum Position* Calibration Instruction:

- Navigate to the “Vise Calibration Definition” section, click **“Get”** for the *Before Op2 Load Datum* field & verify the **values** change
- Scroll to the bottom of the configuration and click Save.
- Using the recovery panel, send the robot to “CNC Home Gripper 1”
- If using Part Specific Vise Calibration, keep the part in the gripper. Do not remove. Where the robot *picks the part is exactly where it needs to be for calibration of the **Vise 1/2 Load Position** (depending on which vise holds responsibility for Op2)**.**



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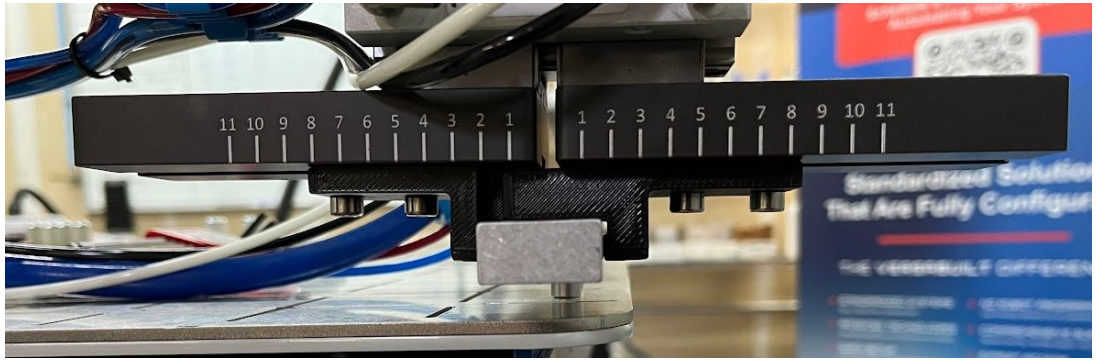
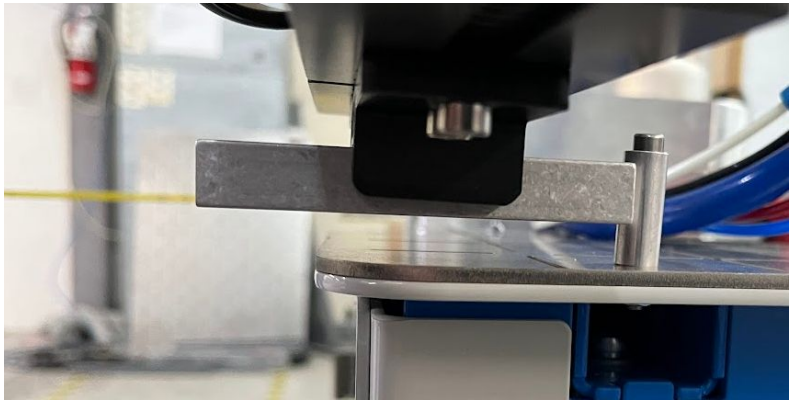
Before Load Datum Position

Before Vise 1 Load Datum - Calibration Location, holding part with Gripper 1



Before Vise 1 Load Datum - View from End of Cart, Robot Side



Before Vise 1 Load Datum - View from CNC Side

Vise Calibration Definition

☑ Before Vise 1 Load Datum Part Centering

Before Op1 Load Datum Position

-387.96032,114.79394,-42.85196,-127.12183,124.05188,-1.45447 Get

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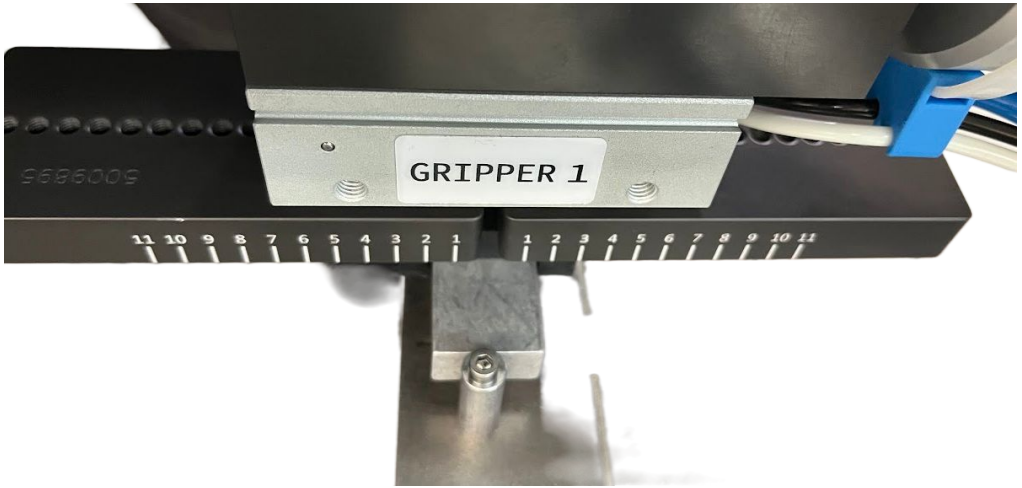
Before Load Datum Position

Before Vise 1 Load Datum - Calibration Location, holding part with Gripper 1



Before Vise 1 Load Datum - Top View

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Part Specific Vise Calibration

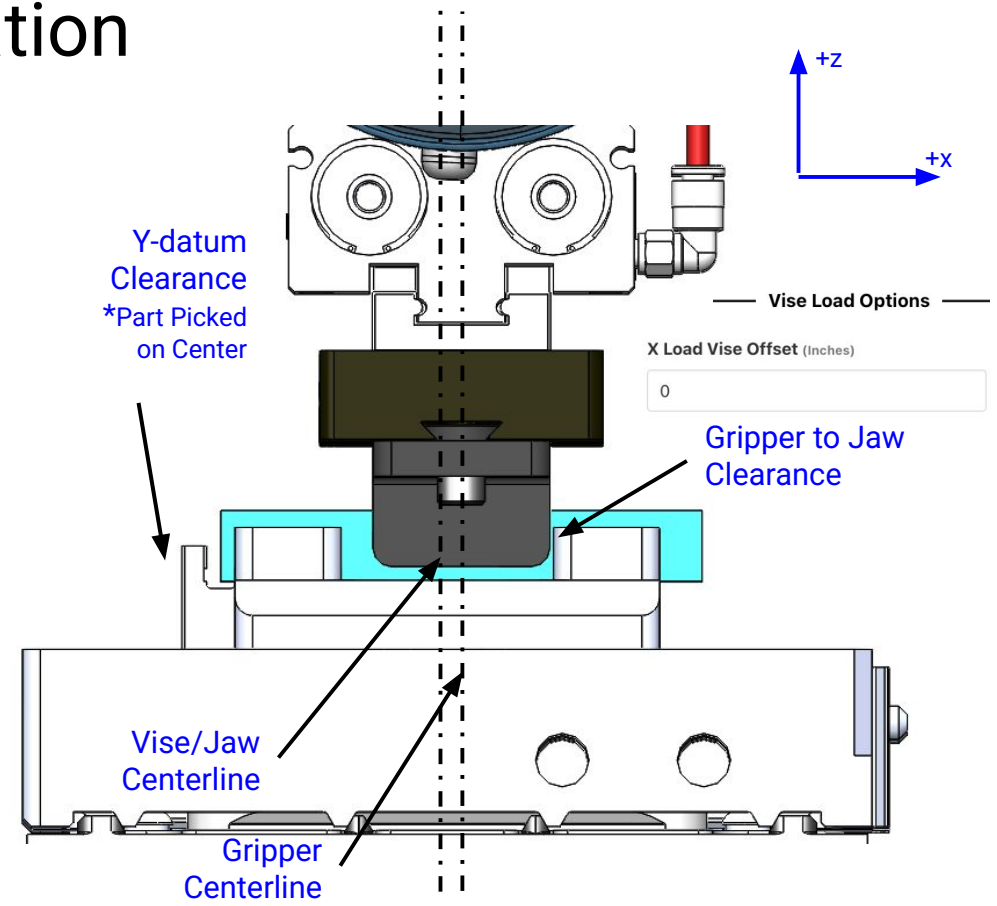
Gripper 1 Vise Load Calibration (Part Configuration Specific)

Part specific vise calibration is available as an alternative to the otherwise global Vise Calibration via the “Calibration Page”, calibrating gripper centerline aligned with the Vise/Jaws centerline.

The “Part Specific Vise Calibration” option in each part configuration is a useful tool for applications such as the example shown on the right: Loading Jaws with Y-datum. Alternatively, the user could use centerline calibration and add an Y/X-Offset in the Vise Load Options section of the part configuration. However, take into account the **Gripper to Jaw Clearance** in the image to the right. This limits the allowance of an offset.

Used with “Before Vise 1/2 Load Datum Part Centering”, the relationship between the gripper and the end of the part will be determined prior to placing in the jaws, eliminating any error from operators loading the table.

After calibrating the Load Datum, **leave the part in the gripper**, then calibrate the Part Specific Vise Calibration Load Position (following page)



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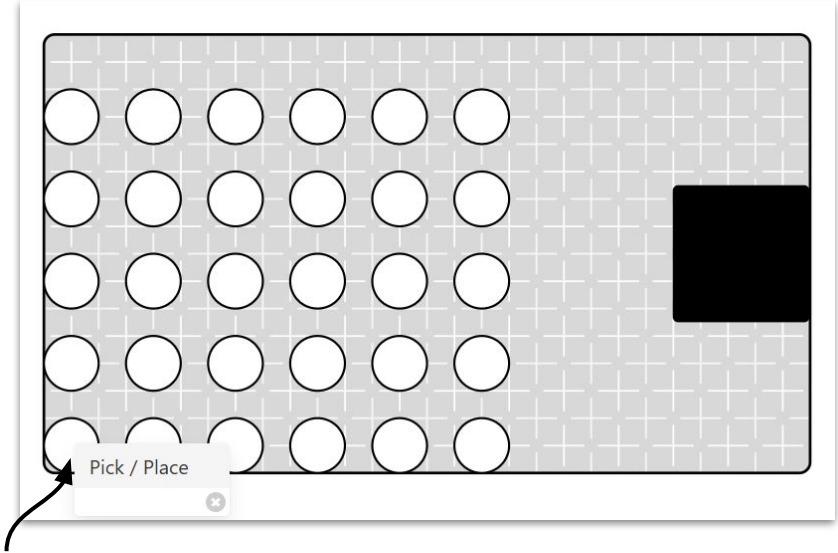
Part Specific Calibration - Vise 1(Op1) Load Position

The following instructions are specific towards capture of **Vise 1,** starting from picking raw material. Vise 2 can also be used for Op1, but in the following instructions, Vise 1 is the Op1 Vise. Instruction for capture of Vise 2, Op1, are nearly identical, however require a regrip after unload from the Regrip Station for proper placement in Gripper 1.

Part Configuration Specific Vise 1 (Op1) Load Calibration Steps:

- If calibrating after "Before Vise Load Datum" described on the previous pages, see next page, with the **raw part still clamped in Gripper 1.**
- If calibrating without "Before Vise Load Datum": Start and Save the Part Configuration to add the "Part Specific Vise Calibration" option
- Go to Home Screen > Recovery. Select the configuration to be edited from the "Job" pull down menu
- Place the representative part or raw material in a slot (typically slot 1)
- Click on the slot on the Home page infeed visualization & select "Pick"
- After Picking, robot will move to Table Home Gripper 1
- Go to the Configuration Page
- Ensure the robot is at CNC Home
- Using the helper functions at the top of the configuration screen, select "Freedrive for Load Vise".



For best results, calibrate Vise after Load Datum calibration.

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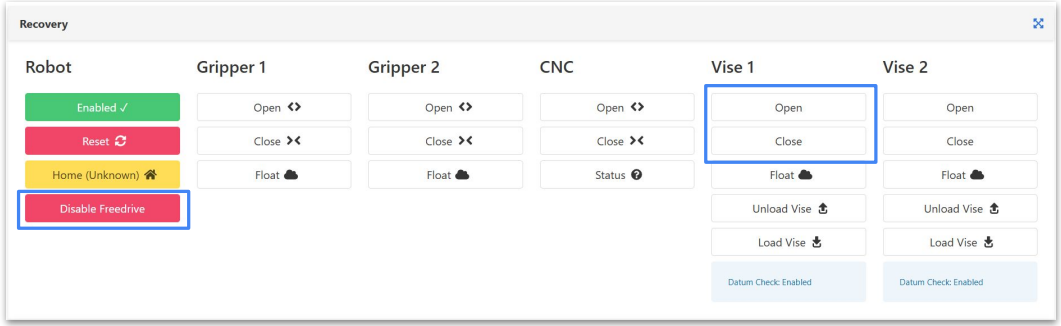
Part Specific Calibration - Vise 1(Op1) Load Position

Part Configuration Specific Vise 1 (Op1) Load Calibration Steps:

- Using the helper functions at the top of the configuration screen, select “Freedrive for Load Vise”.
- Manually position the part in Gripper 1 into Vise 1 as intended for load.
- Use a level to align Gripper 1 with the vise (if the vise is in a level position)
- Using the available Recovery Buttons at the top of the screen: Open/Close Vise engaging the part in the “Clamped Position”
- Disable Freedrive via the recovery panel



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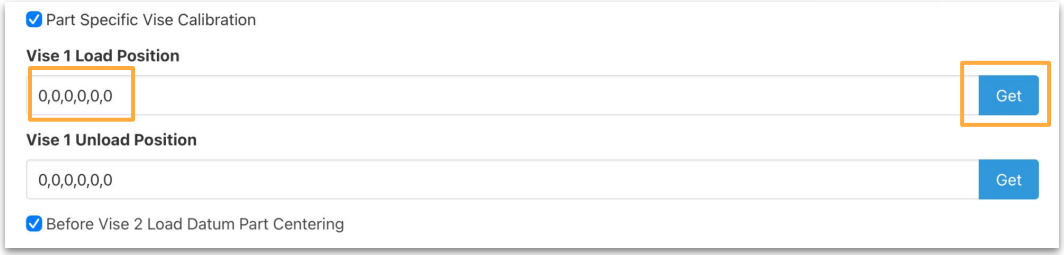
Part Specific Calibration - Vise 1(Op1) Load Position

Part Configuration Specific Vise 1 (Op1) Load Calibration Steps:

- Open the Part Configuration to Edit > Select “Part Specific Vise Calibration”
- Click on the “Get” button for “Vise 1 Load Position” to save the calibrated position. *verify the values change in the Get window
- Save Configuration
- Using the helper functions at the top of the configuration screen, select “Move from Vise Load Position”. Robot will retreat.
- Validate a successful load by:
    - Environment - Vise Open, no part
    - Home Page
        - configuration selected
        - pick a part from the infeed graphic
    - Recovery Panel - Load Vise
- Continue to following page for Vise Unload Calibration, which will be an identical process for both Vise 1 and Vise 2



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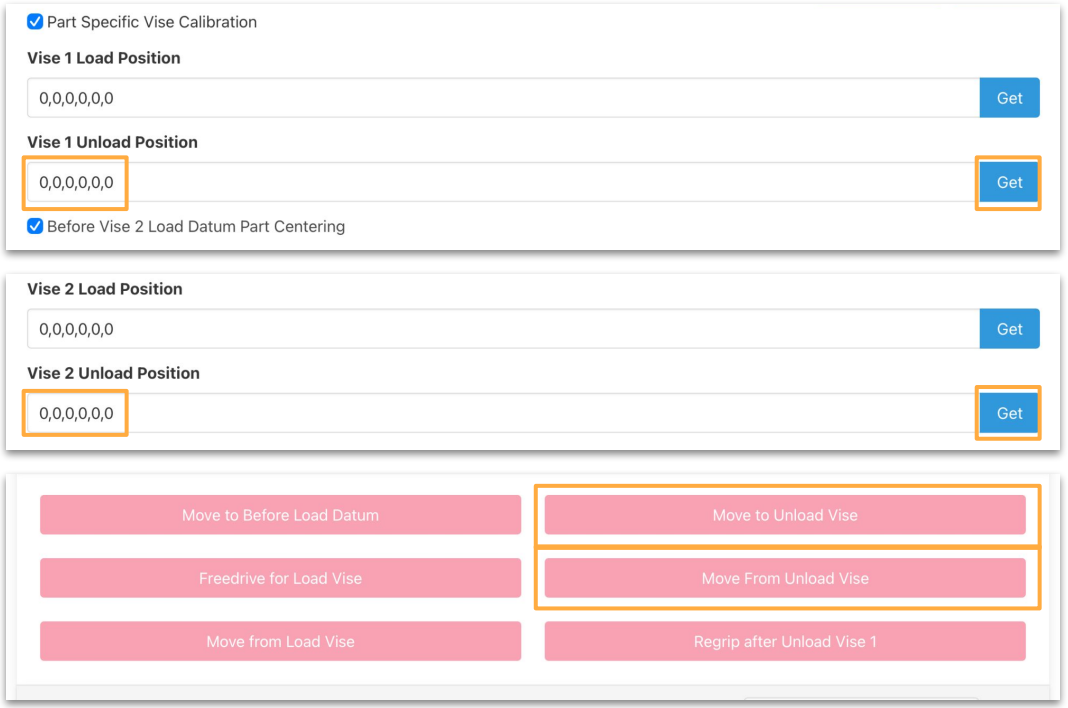
Part Specific Calibration - Vise 1/2 Unload Position

Part Configuration Specific Vise 1/2 Unload Calibration Steps:

- Place a machined (Op1 / Op2) part in the vise in the position/orientation as machined to account for any dimensional changes.
- Using the helper functions at the top of the configuration screen, select “Move to Unload Vise”. The robot will enter freedrive.
- Manually position the part in Gripper 2 into Vise 1/2 as intended for unload.
- Close Gripper, clamping onto the part.
- Disable Freedrive
- Open the Part Configuration and click on the “Get” button for “Unload Position” to save the calibrated position for Vise Unload. *verify the values change in the Get window
- Save Configuration
- Using the helper functions at the top of the configuration screen, select “Move from Unload Vise”. Robot will retreat.
- Validate a successful unload by:
    - Environment - part clamped in vise
    - Home Page - configuration selected
    - Recovery Panel - unload Vise
- Continue to next page for Vise 2 (OP2) Load Position



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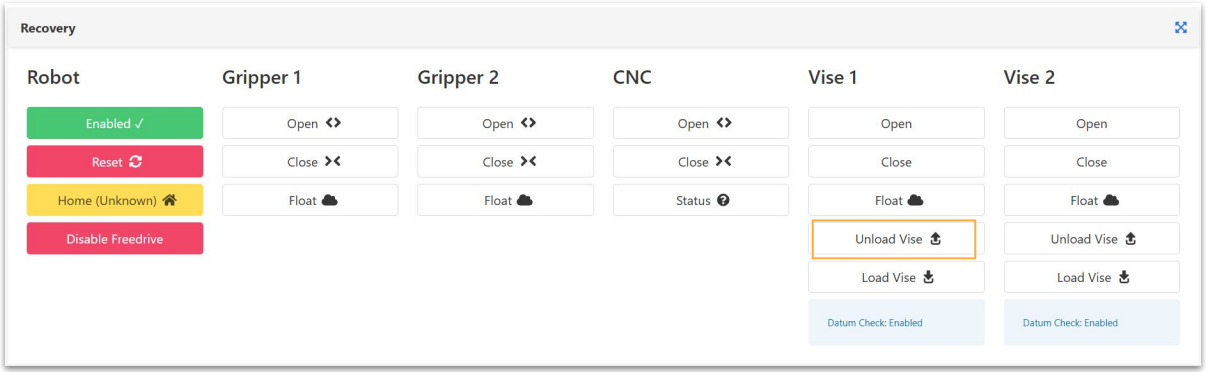
Part Specific Calibration - Vise 2(Op2) Load Position

The Op2 Load Position must be captured using a part picked from the regrip station. This will ensure that the load position is captured based on how the part is oriented in Gripper 1 after being regripped. Please see the **Calibration Manual** for calibration / process documentation. The regrip station calibration is global and need not be done on a part-to-part basis.

Part Configuration Specific Vise 2 (Op2) Load Calibration Steps:

- Place a machined (Op1 / Op2) part in the vise in the position/orientation as machined to account for any dimensional changes.
- Ensure the desired configuration is selected on the home page.
- Unload the part using the 'Unload Vise' button via the recovery panel at the top of the Configuration Page.
- With the part now in Gripper 2, use the helper functions at the top of the configuration screen, select 'Regrip after Unload Vise'. The robot will move to regrip the part at the Regrip Station.



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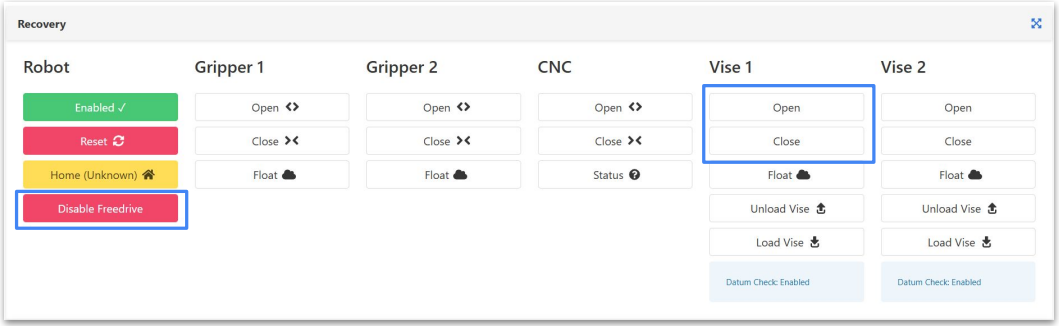
Part Specific Calibration - Vise 2(Op2) Load Position

Part Configuration Specific Vise 2 (Op2) Load Calibration Steps:

- With the part now in Gripper 1, use the helper functions at the top of the configuration screen, select “Freedrive for Load Vise”.
- Manually position the part in Gripper 1 into Vise 2 as intended for load.
- Use a level to align Gripper 1 with the vise (if the vise is in a level position)
- Using the available Recovery Buttons at the top of the screen: Open/Close Vise engaging the part in the “Clamped Position”
- Disable Freedrive via the recovery panel



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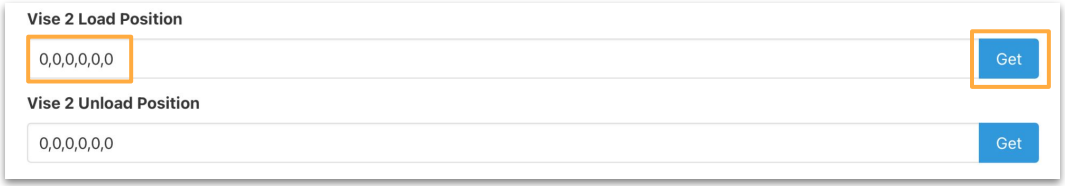
Part Specific Calibration - Vise 2(Op2) Load Position

Part Configuration Specific Vise 1 (Op1) Load Calibration Steps:

- Open the Part Configuration to Edit > Select “Part Specific Vise Calibration”
- Click on the “Get” button for “Vise 2 Load Position” to save the calibrated position. *verify the values change in the Get window
- Save Configuration
- Using the helper functions at the top of the configuration screen, select “Move from Vise Load Position”. Robot will retreat.
- Validate a successful load by:
    - Environment - Vise Open, no part
    - Home Page
        - configuration selected
        - pick a part from the infeed graphic
    - Recovery Panel - Load Vise



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Regrip Station

Refer to the [Calibration Manual] for Regrip Calibration

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Appendix

Custom Finger Pick Height Calculation

Raw Material Height (Inches)

0.5

Pick Height Note:

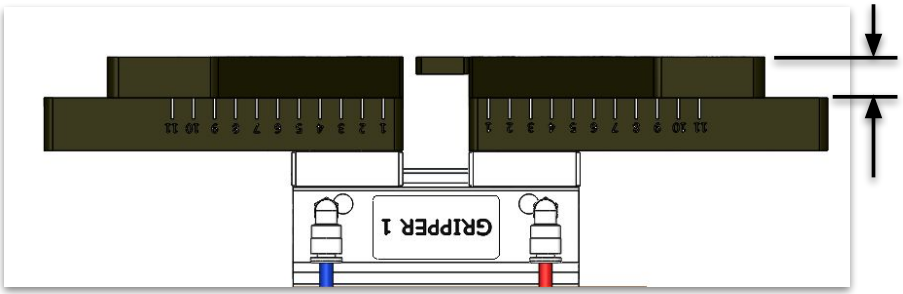
- The VersaCart surface is calibrated with Base Fingers (without standard Puck Fingers attached)
- Part Picking logic assumes the custom finger thickness is equal to the standard Puck Finger thickness.
- Steps:
  - Measure custom finger thickness (T_c)
  - Calculate difference from standard, $\Delta = T_c - 0.48$
  - Subtract difference from the "Actual" Raw Material Height
  - Enter new value in "Raw Material Height" field in part configuration
- Vise Calibration:
  - With custom fingers, either calibrate on the calibration page with the custom fingers or complete a part configuration specific calibration

Example 1:
Tc = 0.75 inches
Measured Material Thickness = 1.00

- $\Delta = Tc - 0.48 = 0.27$
- "Raw Material Height" = 1.00 + 0.27 = 1.27

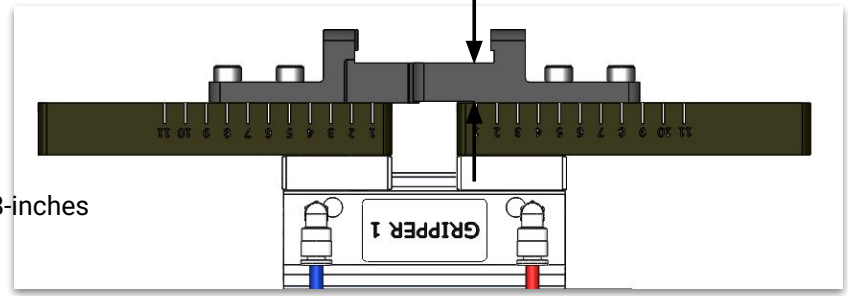
Example 2:
Tc = 0.40 inches
Measured Material Thickness = 0.50

- $\Delta = T_c - 0.48 = -0.08$
- "Raw Material Height" = 0.50 + (-0.08) = 0.42



Standard Puck Finger Thickness

Custom Thickness, T_c



Custom Finger Thickness

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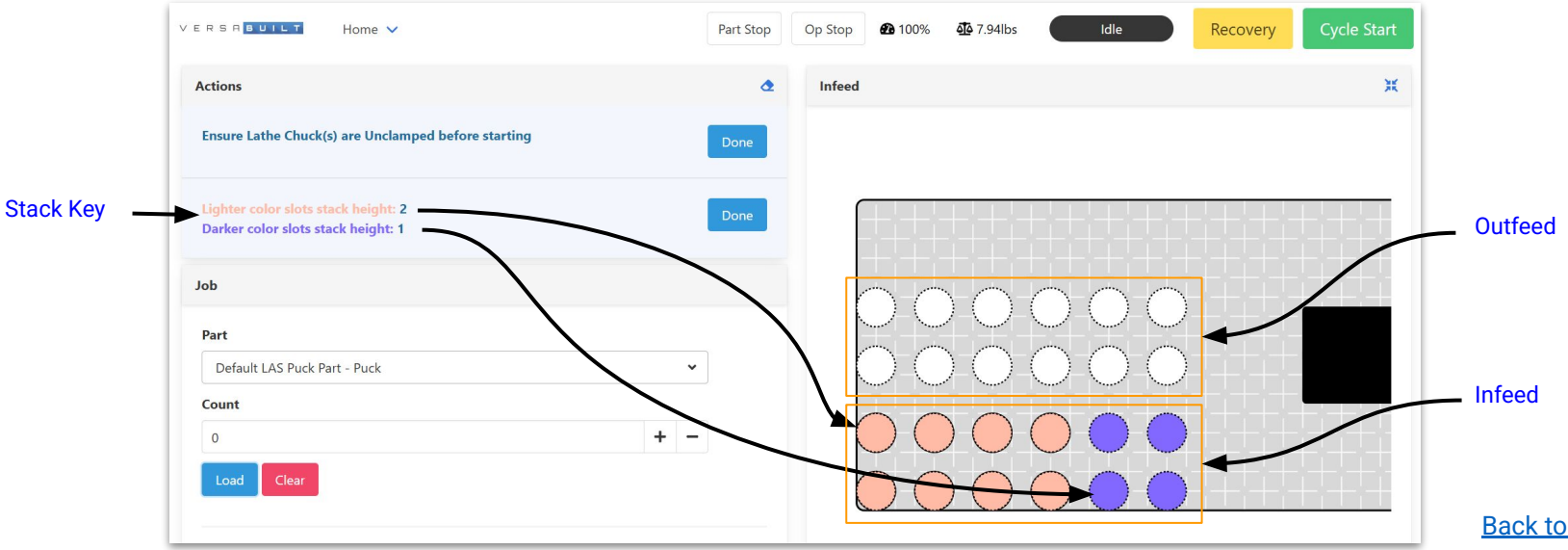
DuoGrip Mill Stacked Infeed

- The option for stacked infeed can be enabled via the System Settings Page in the dropdown menu for Infeed Template. (See system page here).
- The fundamental change this implements is the ability to stack parts on the VersaCart Infeed.
- This change is reflected in the User Interface Home Page
    - Color coordinated stack height and dot borde
- When loading parts, half the table will be used for Infeed, the other half will be used for outfeed.
- Configurations will remain exactly the same, and do not need adjustments to compensate for a change of infeed template (unless using a custom infeed, in which case the number of rows and columns change)
- When loading parts, adding additional parts once already loaded is not supported. A user must clear parts in the UI, then reload desired quantity.



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VERSA BUILT
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