

VERSABUILT ROBOTICS



DuoGrip Shaft Configuration Parametric Programming Manual

Software Version 1.2.5 Copyright VersaBuilt 2024

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.

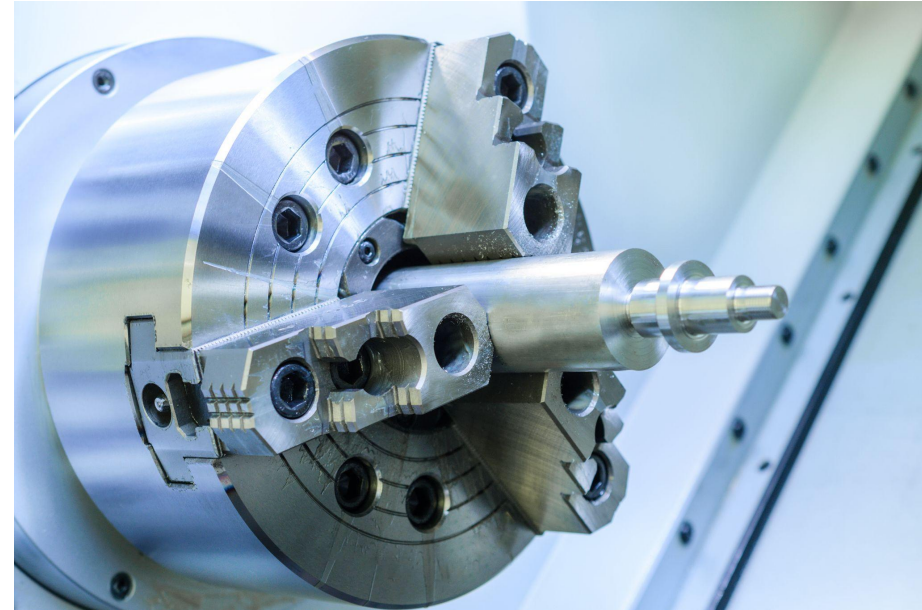
Before deploying VersaBuilt industrial machine tool automation components, a safety risk assessment must be completed in accordance with local, state and/or federal requirements.

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

Read and understand the VersaBuilt Automation System Safety Manual before proceeding

Prove Out The CNC Process First

- Prior to automating a new part, prove out the CNC process using hand-loading
- Validate that after the part is removed from the CNC, that no chips will interfere with the next part loaded into the chuck
 - If chips are present that would interfere with the next load, add or improve the wash motion at the end of the cycle
 - If the wash program can't remove all of the chips, develop a separate wash program to wash the chuck after the part is removed; verify the program adequately removes all the chips from the critical chuck surfaces
 - The separate program will be used in for the “Wash Chuck after Unload” option in the part configuration
 - If an air nozzle blast of compressed air is required to free the chips, use the VersaBlast option in the configuration (*if the Lathe Automation System is equipped with the optional VersaBlast components*)



Shaft Process Overview

The shaft process is designed to maximize efficiency by using the Duo Grip Gripper to minimize the time spent exchanging parts. The process works as follows:

1. Robot picks part from infeed using Gripper 1
2. Robot loads part into chuck
3. Robot closes CNC door and begins CNC turning cycle
4. Robot moves back to infeed and picks the next part with Gripper 1
5. When CNC turning cycle completes, the robot unloads the completed part with Gripper 2 and loads the new part with Gripper 1
6. Robot closes the CNC door and begins CNC turning cycle
7. Robot places the completed part in the infeed with Gripper 2
8. Robot picks the next part from the infeed using Gripper 1
9. System goes back to step 5 and repeats until all parts are complete



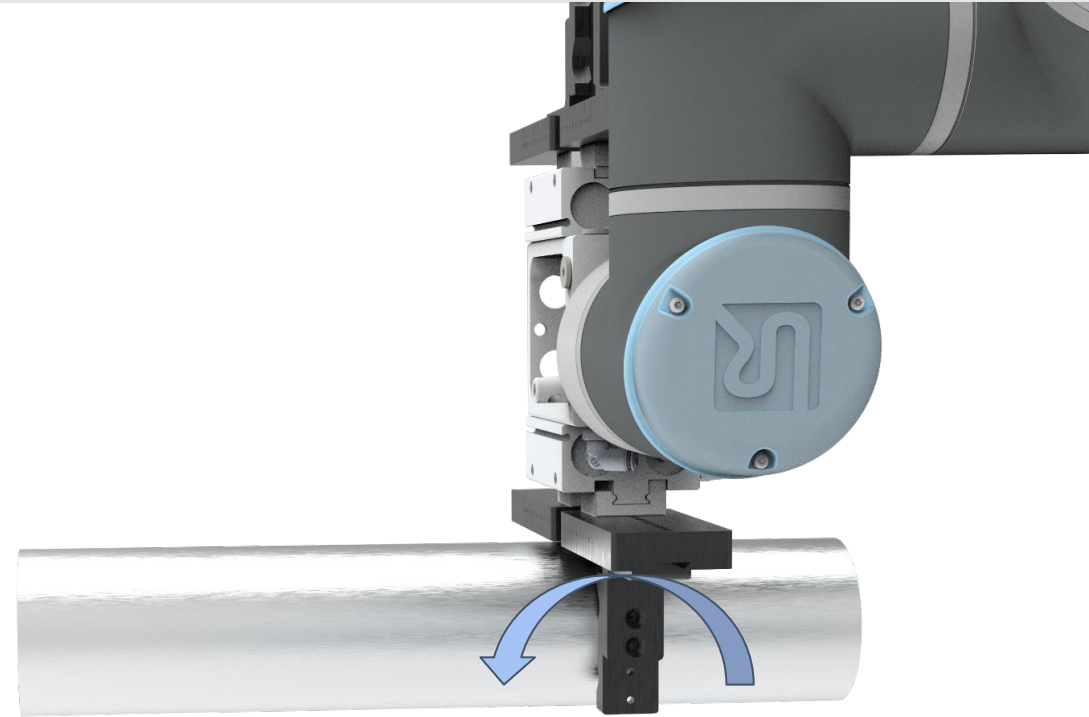
Shaft Part Configuration - Pick Positions

Picking on the Center of the Part

Using the standard gripper fingers, designed for a range of sizes, VersaBuilt recommends picking the shaft near the center of the part; especially for parts weighing more than 1 pound and/or parts longer than 6". A part that is off center places a rational load on the gripper fingers. If the part is heavy enough and off-center enough, the load could cause the part to droop, and cause premature wear on the gripper fingers. Optionally the use of a custom gripper fingers with a diameter matching that of the part, can handle significantly more offset load. Contact VersaBuilt for the details of your application.

Why Pick Off-Center?

Off-center picking in the infeed may be necessary if the shaft needs to be pushed deep into the chuck during load. Off-center picking of the shaft during chuck unload may be necessary if the part is buried deep in the chuck.



Shaft Infeed - Part Layout

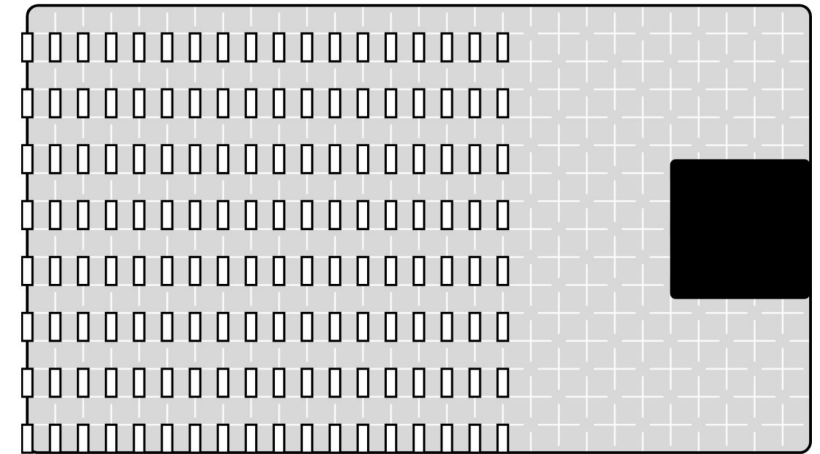
Although pattern shown on the VSC display is the recommended alignment in the infeed, it is not required to precisely align the parts as shown by the VSC. In fact, for some shaft shapes and sizes, the infeed layout allocated by the VSC will not work.

Because the pick and place locations are calibrated, the robot will move through the infeed by the spacing shown on the infeed but starting at the calibrated pick and place locations.

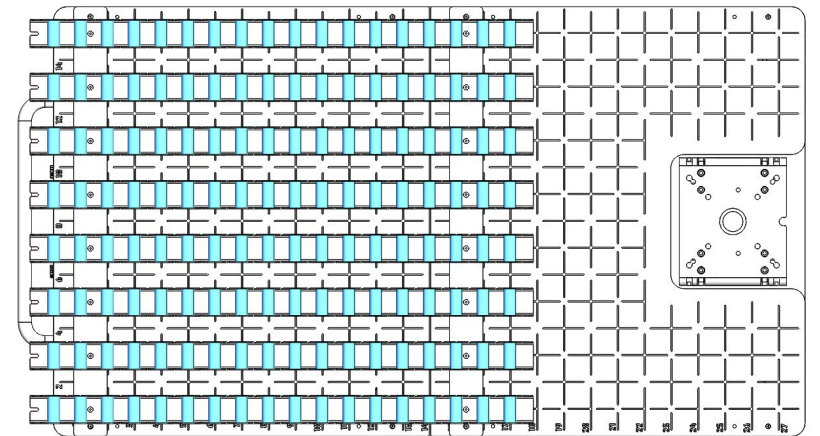
If it is not convenient to align the parts in the infeed as shown on the VSC, align the first part in the infeed near the allocated position, but aligned as required by the shaft geometry or to make it easy for the operator to align the parts in the infeed. The remaining parts will need to be spaced the same distance apart as shown on the screen.

In the example shown, a 2" long part is aligned by the VSC starting at the left edge of the table but the machinist chose to align the part so that it is centered over the channel, the remaining parts spaced the same distance apart, 4" from the left edge of one part to another part.

Note: be sure to document exactly where the parts must be aligned in the infeed in the setup sheet for the operator



VSC Shaft Allocation



Actual Shaft Allocation

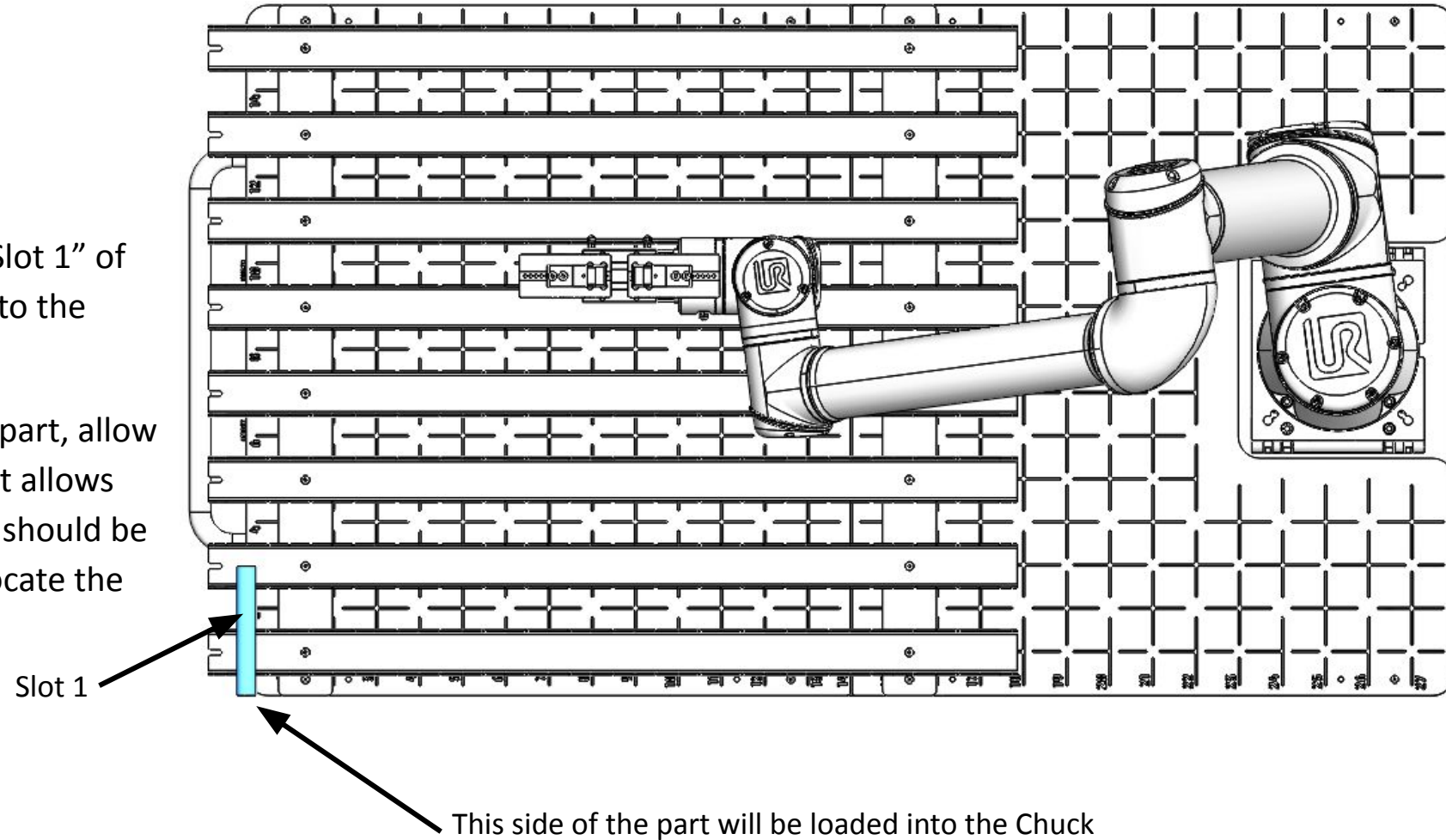
Shaft Infeed - Part Layout

Configuring Shafts requires two positions to be calibrated

1. Pick from Infeed
2. Place to Outfeed

Start process by loading raw material in “Slot 1” of the Shaft Infeed (slot shown in the image to the right).

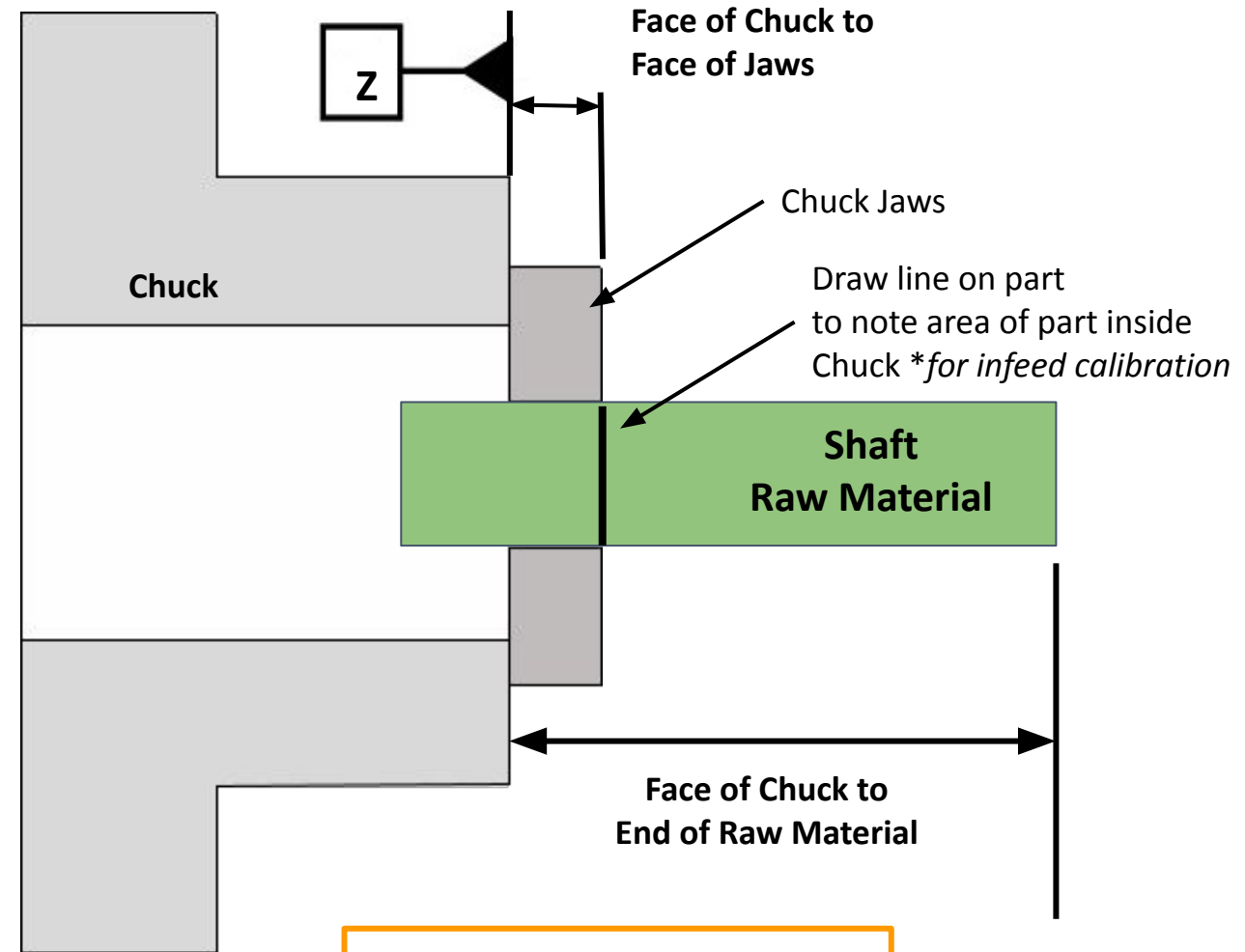
This position selected should support the part, allow the robot to grip the part in a position that allows the part to be pushed into the chuck, and should be a repeatable position for an operator to locate the part in the infeed.



Shaft Part Configuration - Chuck Load Dimensions

Step 1: Measure Raw Material in Chuck

1. Place Raw Material in Chuck, as intended for loading part for machining
2. Draw line on part to note dept of part in chuck (to aid pick and place gripper location)
3. Measure and note the following dimensions, shown in the image to the right (referencing Chuck Datum found in Shaft Centerline Calibration):
 - a. Distance from Face of Chuck to End of Part (Load)
 - b. Distance from Face of Chuck to Face of Jaws (Load)
4. Enter Values for B & C in the Part configuration for part in the **"Chuck Load Options"** section.



Distance from Face of Chuck to Face of Jaws (Inches)

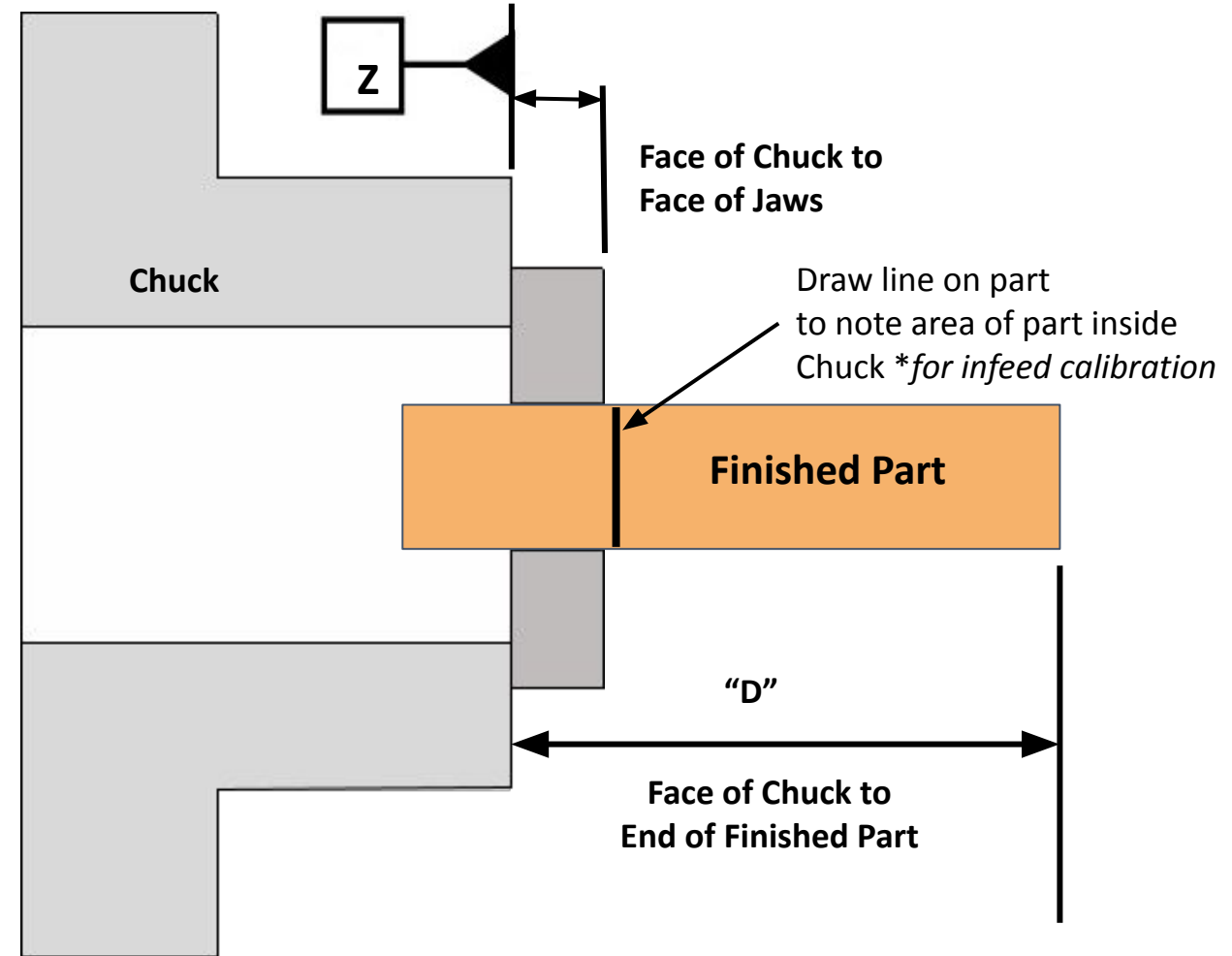
Distance from Face of Chuck to End of Raw Material (Inches)

Save Part Configuration often

Shaft Part Configuration - Chuck Unload Dimensions

Step 2: Measure Finished Part in Chuck

1. Place Finished Part in Chuck, as it would be completed following the final operation
2. Draw line on part to note dept of part in chuck (to aid pick and place gripper location)
3. Measure and note the following dimensions, shown in the image to the right (referencing Chuck Datum defined in Shaft Centerline Calibration):
 - a. Distance from Face of Chuck to End of Part
 - b. Distance from Face of Chuck to Face of Jaws
4. Enter Values in the Part configuration for part in the **"Chuck Unload Options"** section
5. **Save the Part Configuration** to avoid losing changes



Distance from Face of Chuck to Face of Jaws (Inches)

Distance from Face of Chuck to End of Raw Material (Inches)

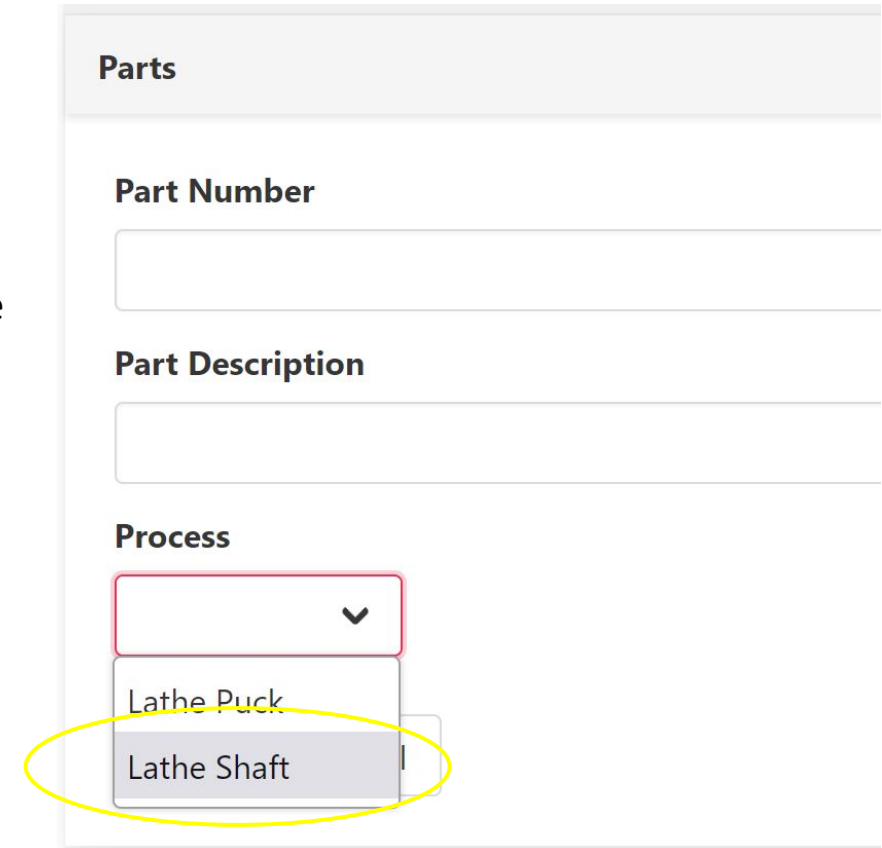
Part Configuration - Shaft

To Configure a Part, go to the VSC “Configuration” page

- VSC default page is “Home”
- Click on pulldown menu in the upper left corner of the screen and select Configuration
- On the configuration page, click on the + symbol in the upper right of the screen to add a part

Part Information

- Part Number - Enter identifiable internal part number
- Part Description - Enter a description of the part
- Select Process
 - Lathe Shaft
- Enter part and process specific data described on the following pages



The screenshot displays the 'Parts' configuration form in the VSC interface. It includes input fields for 'Part Number' and 'Part Description', and a 'Process' dropdown menu. The dropdown menu is open, showing two options: 'Lathe Puck' and 'Lathe Shaft'. The 'Lathe Shaft' option is highlighted with a yellow circle, indicating it is the selected process for this configuration.

VSC Process Scripts - DuoGrip Shaft Systems

VSC Process Script Overview

VSC Process Scripts drive how the Automation System moves parts through the automation process. VSC Process scripts include parameters entered in the part configuration and how the VSC uses those parameters to coordinate robot motion, IO and CNC processing.

The Automation Systems include standard scripts. If you're automation application has special requirements, contact VersaBuilt for a quote on a custom Process Script.

Standard Scripts for Puck Processing are:

- **Lathe Shaft**
- **Lathe Shaft unload only**
- **Lathe Shaft Single Gripper**

VSC Process Scripts - DuoGrip Systems

- **Lathe Shaft** (Macro Version and Standard Driver (generic handshake) Version)
 - Used for 1 operation parts on a single vise or chuck.
- **Lathe Shaft Unload Only** (Macro Version and Standard Driver (generic handshake) Version)
 - Used for parts that are presented to the machine through other means (e.g., bar feeder) and only require the robot to unload the finished parts and place them on the cart or to the bin drop location.
- **Lathe Shaft Single Gripper**
 - Used for parts that exceed the total robot payload when holding parts in both Gripper 1 and Gripper 2 during transfer from one part to the next. Gripper 2 is empty when loading with Gripper 1 and Gripper 1 is empty when Gripper 2 is unloading. This is less efficient than the standard processes, but allows for heavier parts to be processed.

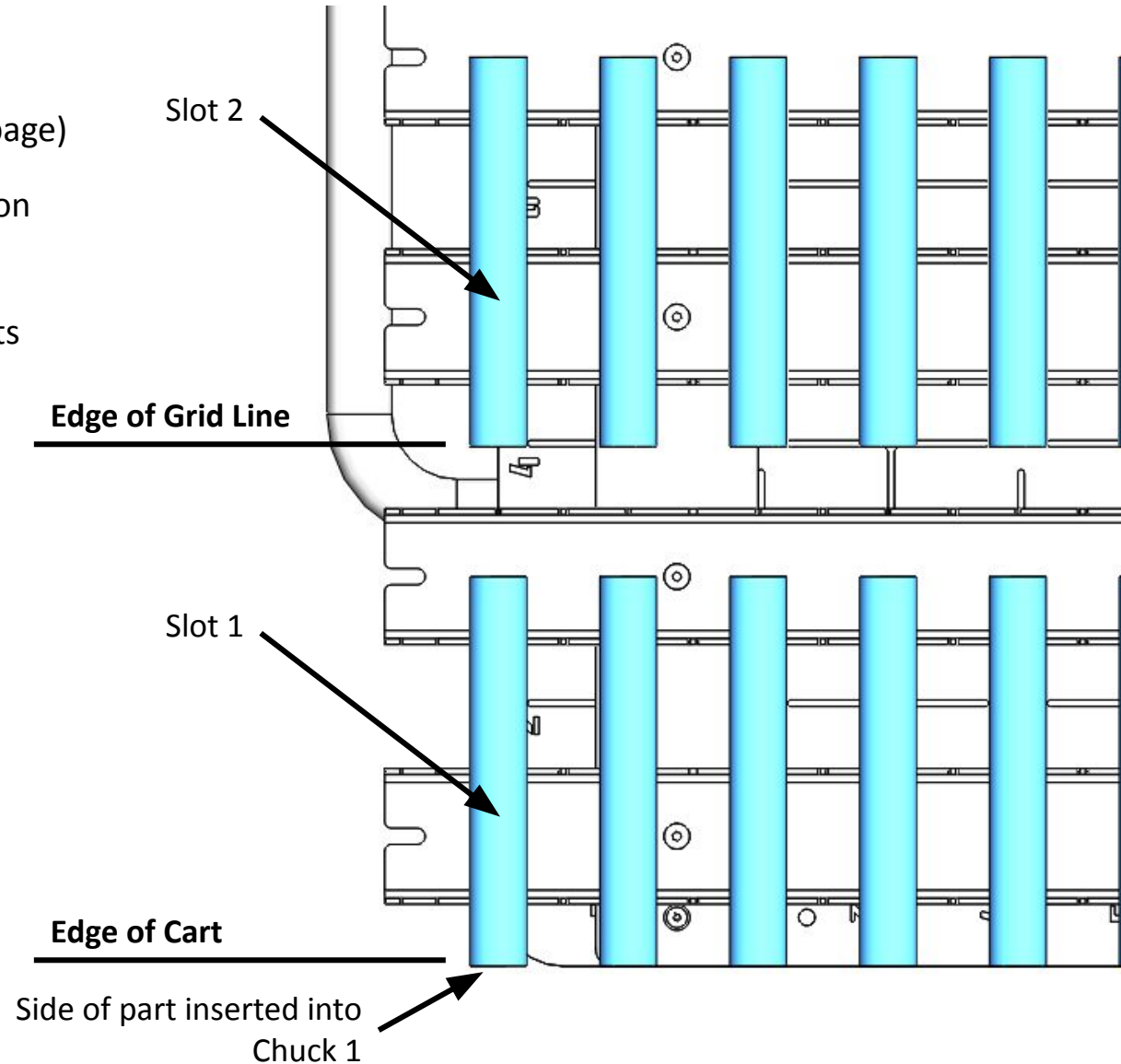
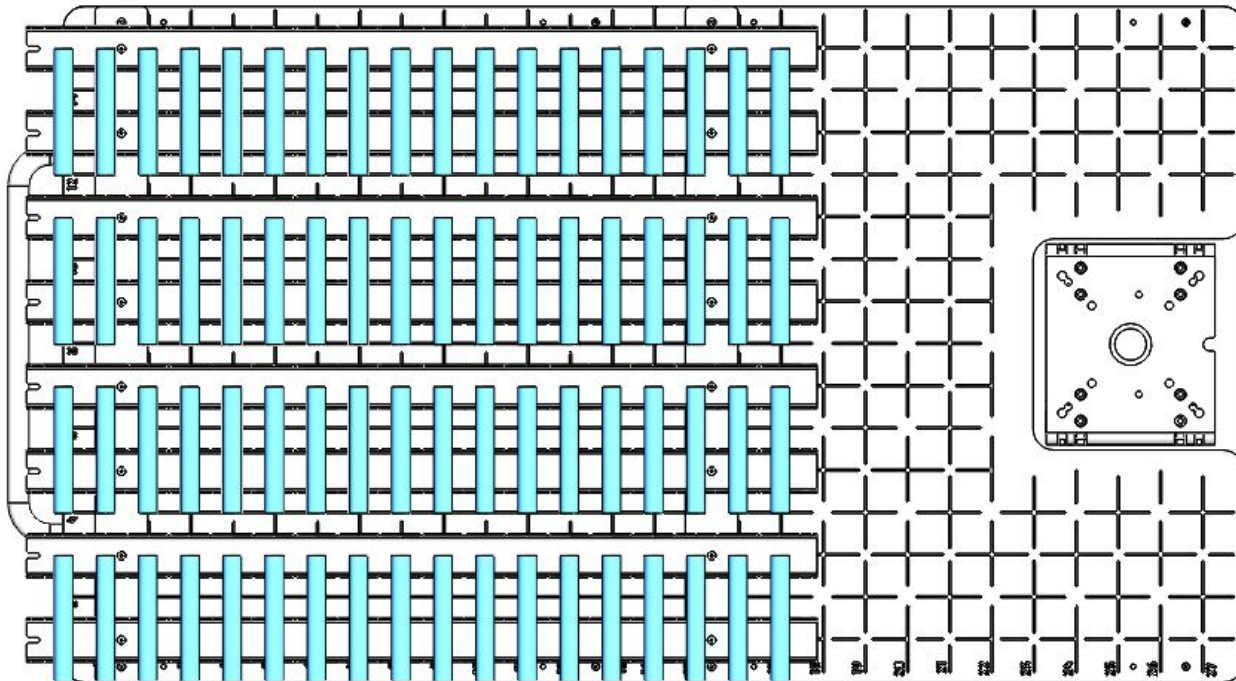
Shaft Part Configuration - Infeed Alignment

Step 3: Determine Infeed Alignment

Parts are aligned with the edge of the table or the edge of a grid line on the Visual Infeed (there are exceptions to this rule, described on the following page)

This alignment is shown when a part is configured and a quantity is loaded on the Home page of the VSC.

An example shown below and to the right, shows 6-inch long part, with parts placed in the default position.



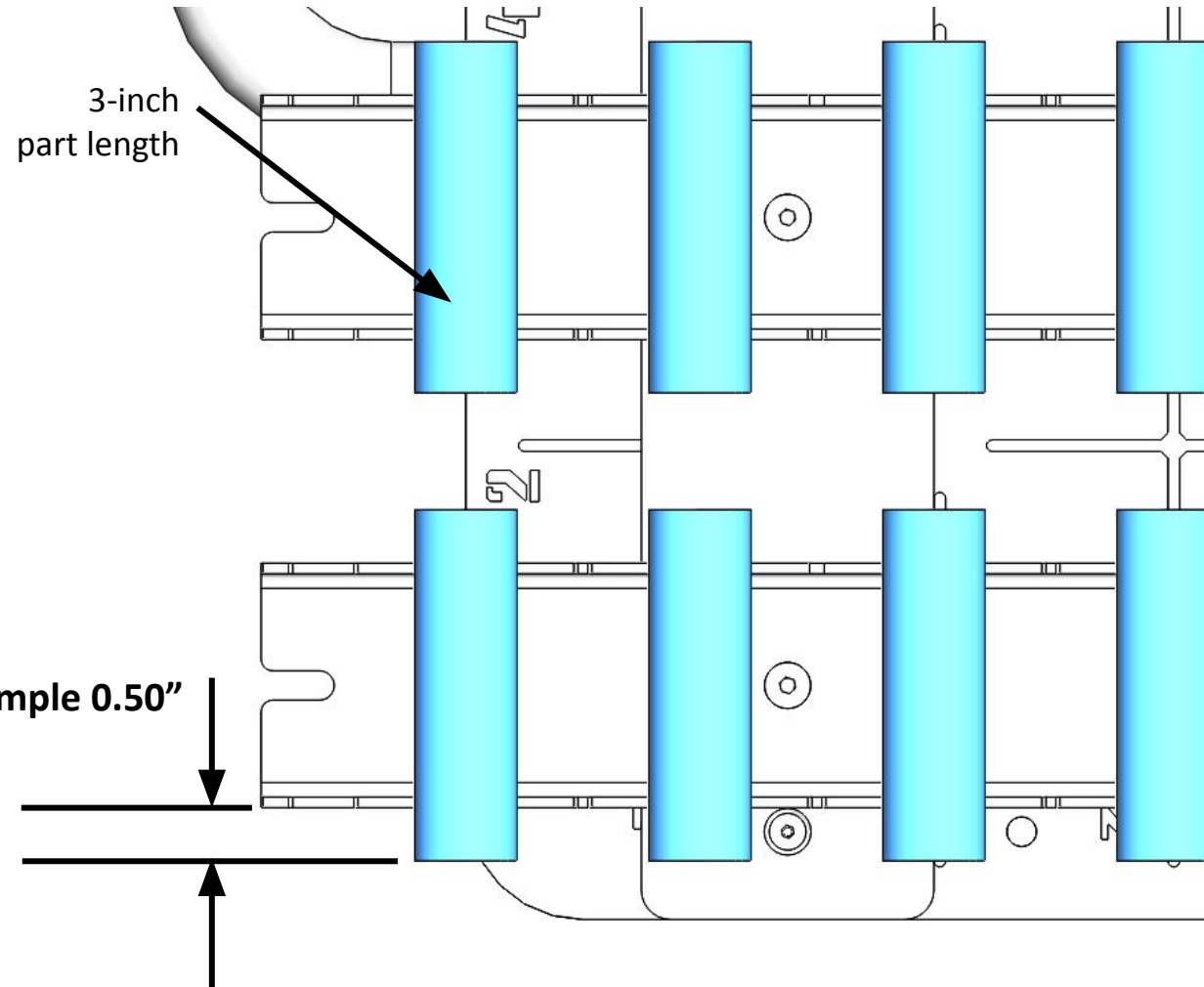
Shaft Part Configuration - Infeed Alignment

Step 4: Determine Infeed Alignment (continued)

Exceptions to the rule:

- Parts may need to be aligned on the infeed in a non-standard way (not aligned with the cart edge or grid lines) Example situations are:
 - Part length is less than 3-inches
 - Non-uniform part (for example, Op2 part setup)
- Note the part alignment for Operator setup (e.g., setup sheet, picture).
- **An example** shown to the right is a 3-inch part, centered over the U-channel with 0.50" of the part hanging over the outside of the U-channel (inside channel width = 2.0")

Note: The actual infeed alignment is not stored in the VSC, rather it must be documented in the part setup sheet so the operator can load **Example 0.50"** the parts in the infeed as required by the configuration.

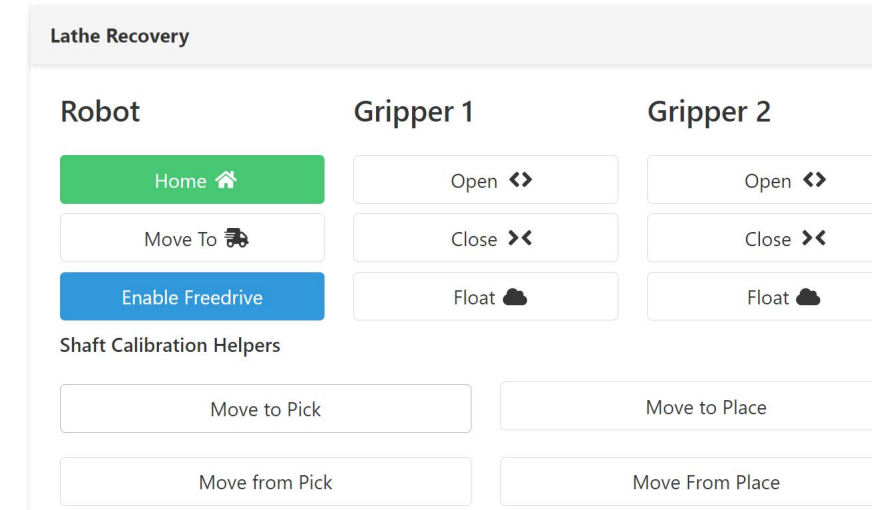


Shaft Part Configuration - Calibrate Infeed Pick

Step 5: Calibrate Infeed Pick

(Note: these steps are for loading main spindle, see next page for loading sub-spindle)

1. Place Raw Material in Shaft Infeed in Slot 1, in a preferred loading position, noting setup relative to infeed channels and how deep the raw material is to be loaded into the chuck. **See images on previous 2 pages and on the following pages for reference.**
2. Verify proper Shaft Fingers on DuoGrip Gripper #1 corresponding to the raw material diameter
3. Navigate to the "Configuration Page"
4. Add or Edit part configuration
5. Select "Move to Pick" button in the Lathe Recovery panel at the top of the Configuration page - *robot automatically enters Freedrive with Gripper 1 Open*
6. With robot in Freedrive, gently drag robot near to the position for picking the raw material from the infeed, with fingers inside or between the U-channels, and positioned so that the part can be loaded into the chuck **the gripper should be in a vertical position*
7. Select "Stop Program" on Teach Pendant to Exit FreeDrive
8. Close Gripper 1 from the recovery panel at the top of the page **this will clamp on the part*
9. Select Freedrive **with empty gripper*
10. Gently reposition Robot such that the clamped part is resting on the "V" grooves of the Shaft Infeed and aligned in the infeed as required
11. Select "Stop Program" on Teach Pendant to Exit FreeDrive
12. In the Part Configuration:
 - a. Press the **"Get"** button for the Infeed Pick Position
 - b. Enter **Distance From Edge of Gripper Finger to Edge of Raw Material** in the **"Raw Material Definition"** section **refer to images on following pages.*
13. Save Configuration **Make note of the required position of the part for a part setup sheet*
14. Select Gripper 1 Open and "Move from Pick" - gripper will release part and move home

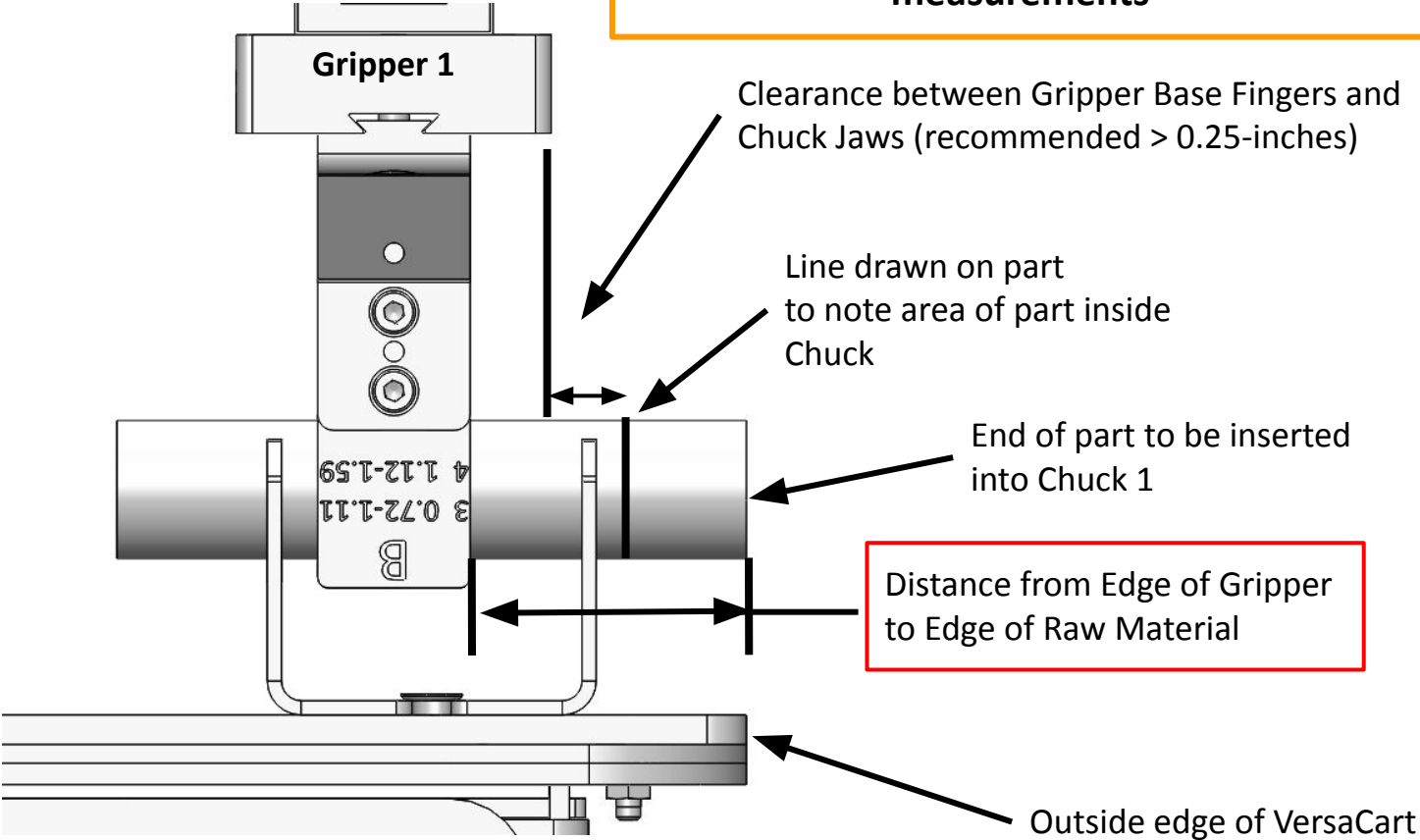


Save Part Configuration often

Shaft Part Configuration - Calibrate Infeed Pick - Main Spindle

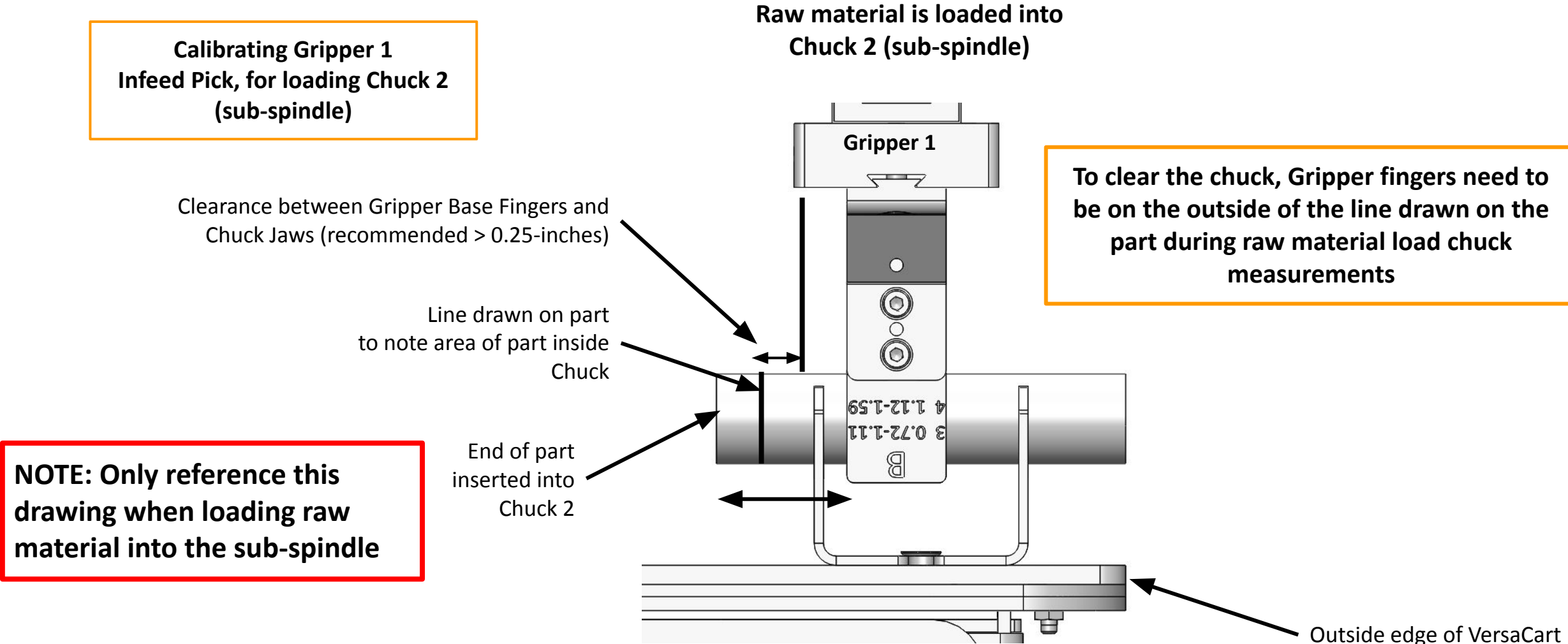
Calibrating Gripper 1
Infeed Pick, for loading Chuck 1
(main spindle)

To clear the chuck, Gripper fingers need to be on the outside of the line drawn on the part during raw material load chuck measurements



Gripper Finger location at Infeed Calibration can be inside U-channels or between U-channels

Shaft Part Configuration - Calibrate Infeed Pick - Loading Sub-spindle



Shaft Part Configuration - Calibrate Outfeed Place

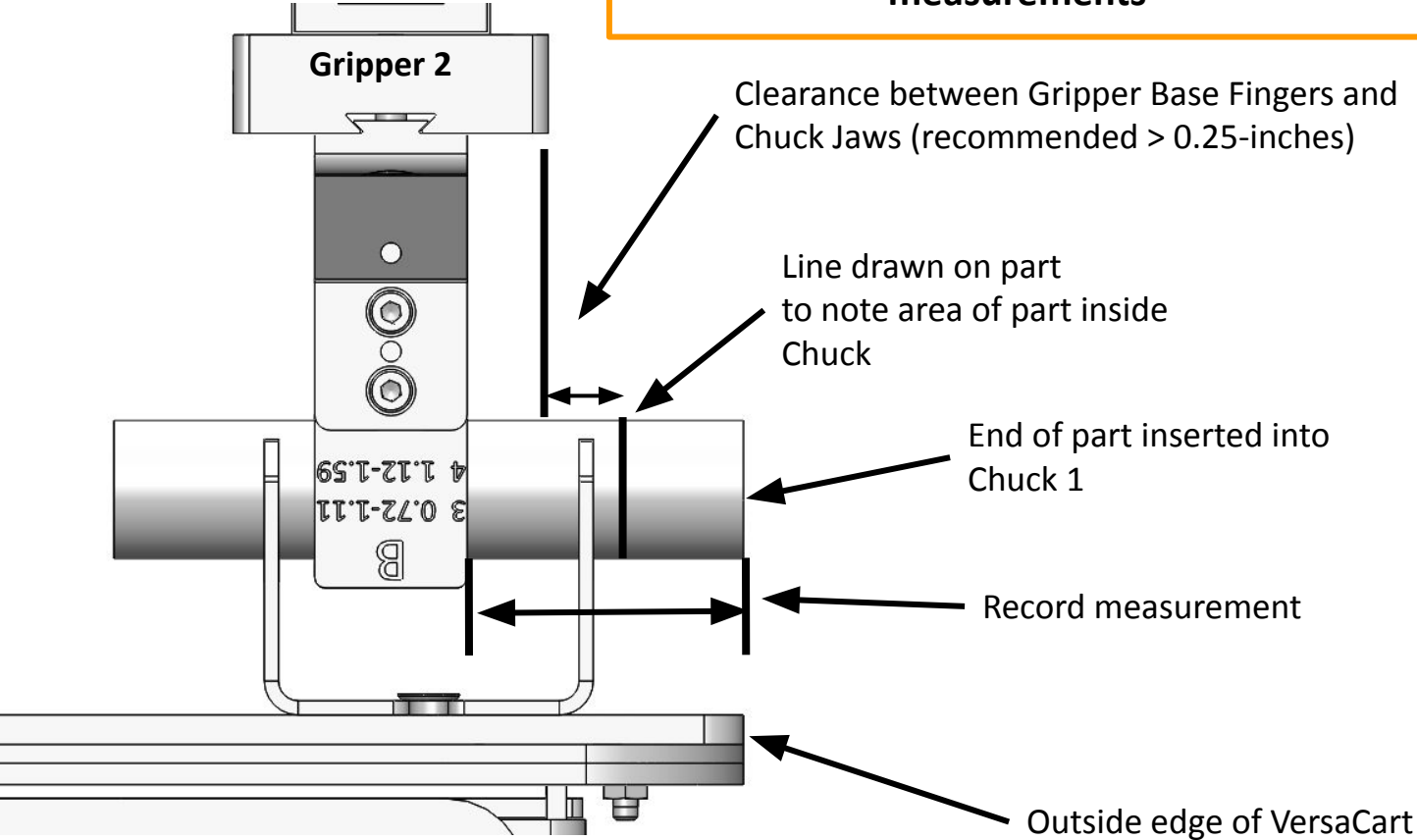
Step 5: Calibrate Outfeed Place

1. Place the Finished Part in infeed slot 1 outfeed location, positioning the part so it will not interfere with adjacent parts in the outfeed (next slot is raw material loaded as shown in Step #1 and the gripper will not interfere with the U-channels when it is clamped on the part). **See images on following 2 pages.**
2. Verify proper Shaft Fingers on DuoGrip Gripper #2 corresponding to the finished material diameter
3. Navigate to the "Configuration Page"
4. Add or Edit part Configuration
5. Select "Move to Place" - *robot automatically enters Freedrive with Gripper 2 Open*
6. With robot in Freedrive, drag robot to a position for placing the finished part in slot 1
7. Select "Stop Program" on Teach Pendant to Exit FreeDrive
8. Close Gripper 1 from the recovery panel at the top of the page **this will clamp on the part*
9. Select Freedrive **with empty gripper*
10. Gently reposition Robot such that the clamped part is resting on the "V" grooves of the Shaft Infeed and aligned as needed to not interfere with adjacent parts
11. Select "Stop Program" on Teach Pendant to Exit FreeDrive
12. In the Part Configuration:
 - a. Press the **"Get"** button for the Outfeed Place Position
 - b. Enter **Distance From Edge of Gripper Finger to Edge of Finished** in the **"Finished Part Definition"** section **refer to images on following pages.*
13. Save Configuration
14. Select Grippe 2 Open and "Move from Place" - gripper will release part and move home

Shaft Part Configuration - Calibrate Outfeed Place - Main Spindle

Main Spindle (Chuck 1) Unload

To clear the chuck, Gripper fingers need to be on the outside of the line drawn on the part during raw material load chuck measurements



Gripper Finger location at Infeed Calibration can be inside U-channels or between U-channels

Shaft Part Configuration - Calibrate Outfeed Place - Unloading Sub-spindle

Sub-Spindle (Chuck 2) Unload

Finished part is unloaded
from Chuck 2 (sub-spindle)

Clearance between Gripper Base Fingers and
Chuck Jaws (recommended > 0.25 -inches)

Line drawn on part
to note area of part inside
Chuck

Gripper fingers need to be on the outside of
the line drawn on the part during raw
material load chuck measurements

**NOTE: Only reference this drawing
when unloading finished part from
the sub-spindle**

End of part
inserted into
Chuck 2

"E"

Outside edge of VersaCart

Gripper Finger location at Outfeed Calibration can be inside U-channels or between U-channels

Part Configuration - Shaft

Process Options

☐ Show Advanced Options

☐ Bin Drop

CNC Turning Program

0

Raw Material Definition

Raw Material Diameter (Inches)

0

Raw Material Length (Inches)

0

Raw Material Weight (Pounds)

0

Infeed Pick Position ?

0,0,0,0,0,0

Get

Distance From Edge of Gripper Finger to Edge of Raw Material (Inches) ?

0

Finished Part Definition

Finished Part Length (Inches)

0

Finished Part Weight (Pounds)

0

Outfeed Place Position ?

0,0,0,0,0,0

Get

Distance From Edge of Gripper Finger to Edge of Finished Part (Inches) ?

0

Chuck Load Options

Load Chuck Number

1

Distance from Face of Chuck to Face of Jaws (Inches) ?

0

Distance from Face of Chuck to End of Raw Material (Inches) ?

0

Chuck Unload Options

Unload Chuck Number

1

Distance from Face of Chuck to Face of Jaws (Inches) ?

0

Distance from Face of Chuck to End of Finished Part (Inches) ?

0

VersaBlast and VersaWash Options

☐ VersaBlast Before Unload

☐ VersaBlast After Unload

☐ VersaWash Before Place

End Part Configuration

Shaft Configuration Parameters - Part Options

Process Options

☐ Show Advanced Options☐ Bin Drop

CNC Turning Program
0

Raw Material Definition

Raw Material Diameter (Inches)
0

Raw Material Length (Inches)
0

Raw Material Weight (Pounds)
0

Infeed Pick Position ⓘ
0,0,0,0,0,0

Get

Distance From Edge of Gripper Finger to Edge of Raw Material (Inches) ⓘ
0

Finished Part Definition

Finished Part Length (Inches)
0

Finished Part Weight (Pounds)
0

Outfeed Place Position ⓘ
0,0,0,0,0,0

Get

Distance From Edge of Gripper Finger to Edge of Finished Part (Inches) ⓘ
0

Show Advanced Options

Selecting this checkbox will show many additional options in each section of the form. Most applications do not need to use the advanced options. Descriptions of the the advanced options follow this section

Bin Drop

When selected, the system will drop the part in the calibrated Bin Drop location instead of placing the part back on the VersaCart table
Bin Drop location is pre-calibrated, but can be repositioned in the Calibration process, shown in the Installation Manual

CNC Turning Program

The CNC Program to machine the part during the automation process

Raw Material Diameter

Diameter of the raw material before processing

Raw Material Length

The length of the raw material before processing

Infeed Pick Position

Calibrated pick position of first part in the infeed

Distance From Edge of Gripper Finger to Edge of Raw Material

From the calibrated pick position, measure the distance from the end of the part to be loaded into the chuck to the edge of the gripper finger

Finished Part Length

Length of the finished part

Finished Part Weight

Weight of the finished part

Outfeed Place Position

Calibrated place position of first part in the outfeed

Distance From Edge of Gripper Finger to Edge of Finished Part

From the calibrated place position, the distance from the end of the part to then edge of the gripper finger

Shaft Configuration Parameters - Chuck Options

Chuck Load Options

Load Chuck Number	Distance from Face of Chuck to Face of Jaws (Inches) ?	Distance from Face of Chuck to End of Raw Material (Inches) ?
1	0	0

Chuck Unload Options

Unload Chuck Number	Distance from Face of Chuck to Face of Jaws (Inches) ?	Distance from Face of Chuck to End of Finished Part (Inches) ?
1	0	0

VersaBlast and VersaWash Options

☐ VersaBlast Before Unload	☐ VersaBlast After Unload	☐ VersaWash Before Place
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End Part Configuration

Load/Unload Chuck Number

Chuck number to load part into, main spindle is Chuck 1, sub-spindle is Chuck 2

Distance from Face of Chuck to Face of Jaws (Load and Unload)

See previous pages for picture and description

Distance from Face of Chuck to End of Raw Material/Finished Part

See previous pages for picture and description

VersaBlast Before Unload

When selected, the robot will blast coolant off of the end of the part

VersaBlast Before After Unload

When selected, the robot will blast coolant off of the empty chuck after the part has been unloaded

VersaWash Before Place

Wash the part before placing the part back in the outfeed

Shaft Configuration Parameters - Advanced Options

Transfer in CNC

If equipped with a sub-spindle, the LAS will move directly from the main spindle to the sub-spindle, without exiting to the CNC Home position during load/unload process

Override COG (Center of Gravity)

By default, the center of gravity (COG) for each part is calculated assuming a uniform distribution of mass along the length of the part, at the different states of operation. If needed, the COG definition for each process step can be entered manually.

COG definition can be calculated via UR Robot process (see UR manual) or via CAD. COG is needed for Part in Gripper 1 only, Part in Gripper 2 only, and Part in both Grippers

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

Long Part Optimized Motion

When selected, the robot moves between home locations in a way to support long parts

Validate Load Position During Apply Force

If selected, the system will validate the part gets into the chuck at the specified position within the Max Load Position Error

Distance from Face of Jaws to Apply Force

Relative to the Face of Jaws, the distance relative to that position to begin applying force. Generally it is best practice to begin applying force with the part partially engaged in the jaws before applying force requiring this to be a **NEGATIVE number**.

Applied Force (Newtons)

The force the robot will apply during apply force in Newtons; there are approximately 4.5 newtons per pound of force

Time to Apply Force

The amount of time the robot will apply force before issuing a clamp chuck command, the longer the distance the robot must move during apply force, the longer this time should be

Max Load Position Error using Apply Force

When selected, robot will validate the position reached after applying force. If the robot is not within the specified distance (plus and minus the specified distance) the robot will generate an error and stop the process

OD Clamp on Load Chuck

When selected, the part is OD clamped in the chuck, otherwise part is ID clamped in the chuck

Puck Configuration Parameters - Advanced Options

Find Chuck on Load

When selected, robot will use its force sensor to determine when the Z surface of the chuck is reached

OD Clamp on Load Chuck

When selected, the part is OD clamped in the chuck, otherwise part is ID clamped in the chuck

Apply Force During Chuck Clamp

If selected, will run the CNC program in the **Wash Program** field after unloading parts to clear chips from the chuck

Additional Distance for Part Length Variance

Add additional distance away from chuck during the load process to prevent a collision if part is slightly oversized

Chuck Jaw Z Clearance Distance

During the approach of the part to load in the chuck, the distance away from the chuck jaws to position the part on the chuck centerline

Offset from Calibrated Chuck Position

Offset from the calibrated position of the chuck in Z. Useful for sub-spindles that need to be positioned differently than the calibration position during unload

Wash Chuck After Unload

If selected, will run the CNC program in the **Wash Program** field after unloading parts to clear chips from the chuck

Shaft Configuration Worksheet

Part Name:	
CNC Program:	
Chuck Load (chuck 1 or 2)	
Chuck Unload (chuck 1 or 2)	
Dimension	Measured Value
Raw Material Diameter	
Raw Material Length	
Raw Material Weight	
Distance from Edge of Gripper Finger to Edge of Raw Material	
Distance from Edge of Gripper Finger to Edge of Finished Part	
Finished Part Weight	

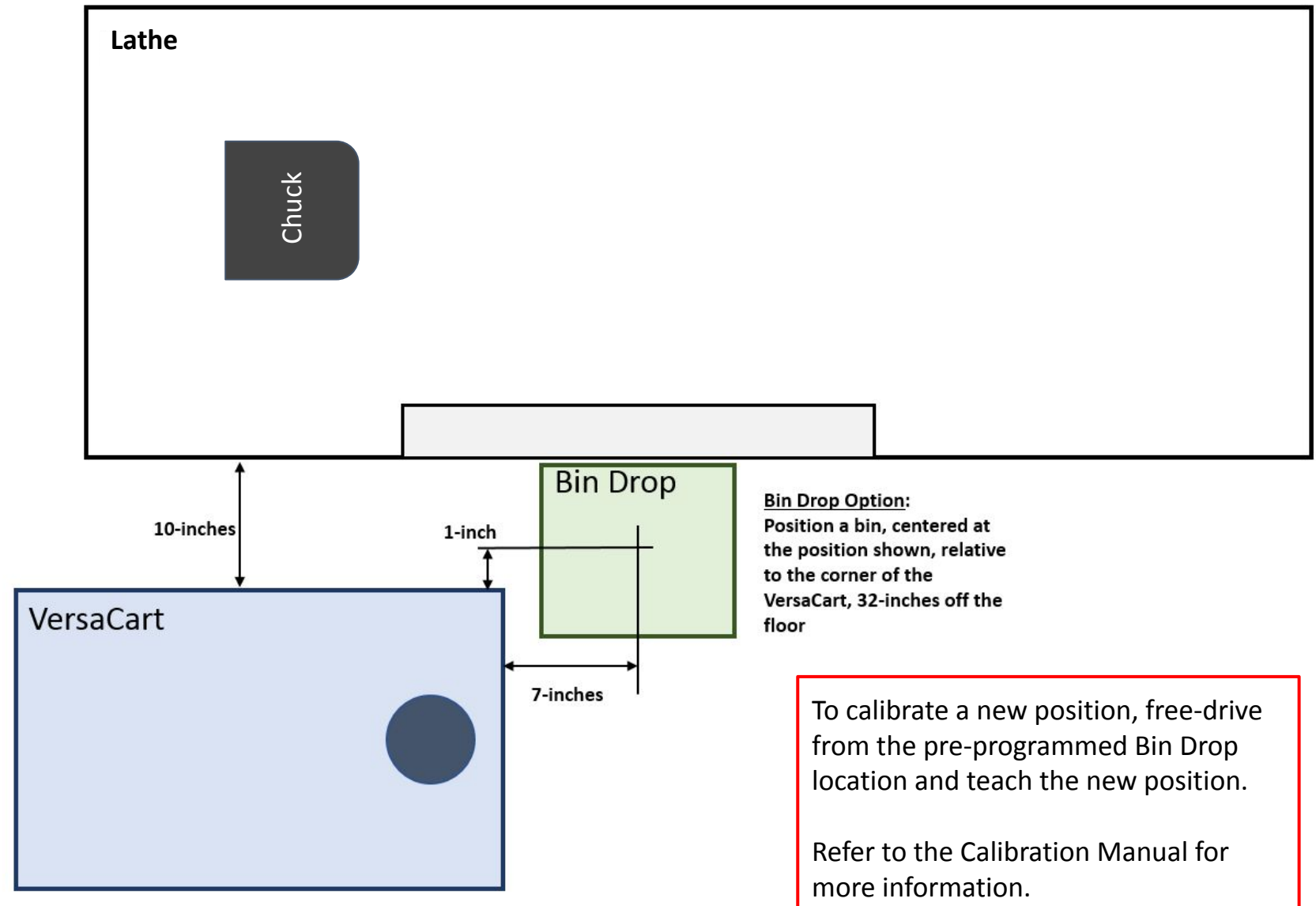
Dimension	Measured Value
Face of Chuck 1 to End of Raw Material	
Face of Chuck 1 to End of Finished Part	
Face of Chuck 1 to Face of Jaws	
Face of Chuck 2 to End of Raw Material	
Face of Chuck 2 to End of Finished Part	
Face of Chuck 2 to Face of Jaws	

Chuck 2 measurements are used for CNC's with a sub-spindle

Options	Option (yes/no)
Bin Drop *calibrate Bin drop position	
Transfer in CNC *option with sub-spindle Lathes	
Find Chuck on Load	
Apply Force During Chuck Clamp	
OD Clamp on Chuck Unload *if unselected, the part will be unloaded via ID hold	
Find Chuck on Unload	
Wash Chuck on Unload *calls 8001 program, unless otherwise specified	
VersaBlast Before Unload *optional equipment	
VersaBlast After Unload *optional equipment	
VersaWash Before Place *optional equipment	

Bin Drop Option

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



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