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Summary

The purpose of this manual is to:

1. Introduce users to an overview of the VBXC Configuration Screen.
2. Provide guidance and review options in the Jaw and Part Definition sections.
3. Include examples for using CNC G-Code routines in coordination with the VBXC part configuration to provide all the required process automation.

The Configuration and Process Control Manual provides background for Machinists, Manufacturing Engineers and Process Engineers to define, run and fine-tune the processing of parts using a VBXC controlled system.

Overview of Configuration Screen

The VBXC Configuration screen is composed of 3 sections:

1. Data Import
2. Jaw Definitions – to define a vise jaw to be used in the handling of a part.
3. Part Definitions – to define the steps for processing a part.

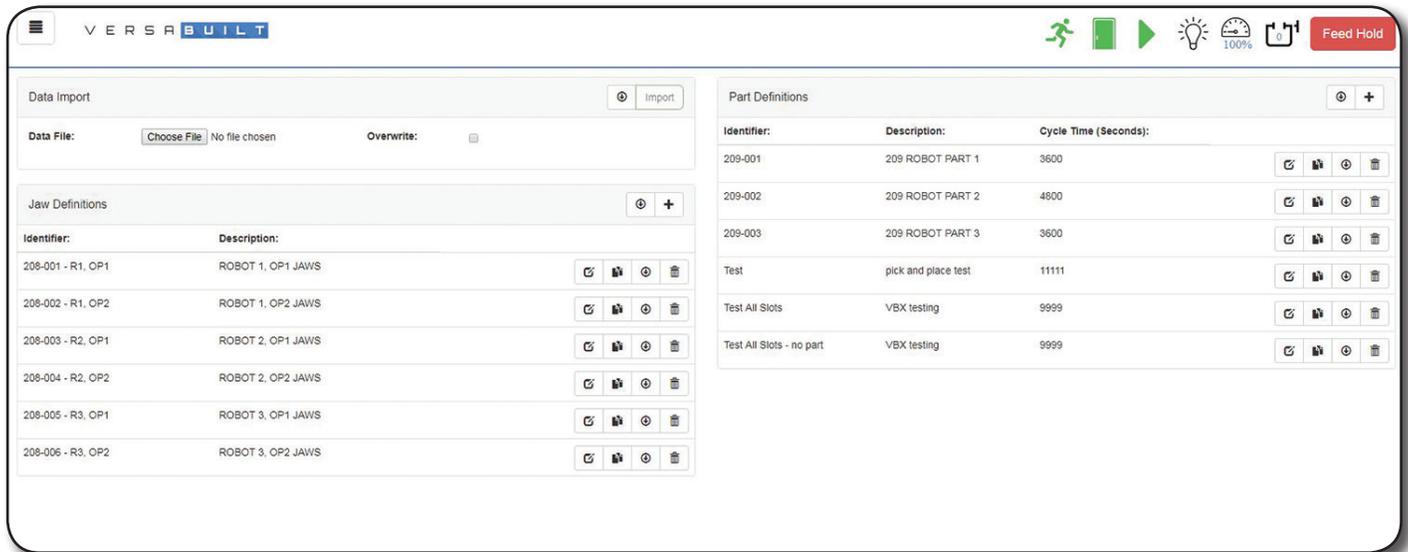


FIGURE 1. VBXC CONFIGURATION SCREEN

Data Import

Data Import is used to either back up or import saved data from a VBXC configuration. The export icon in the Jaw or Part Definitions can be used to export the Jaw Definitions, Part Definitions, individual Part or Jaw definitions. The “Choose File” button allows users to navigate to a previously saved VBXC configuration file. After selection of the file, click the “Import” button and the data will load.

Jaw Definitions

The Jaw Definitions section is used to add new, edit or delete MultiGrip™ Jaws to the VBXC configuration. Defining jaws requires the following:

1. MultiGrip™ Jaw Part Number
 - Recommend a unique part number for the jaws that can also be machined, etched or labeled on the MultiGrip™ Jaws to match the VBXC user interface when an Operator is prompted to find and use the jaws.
2. MultiGrip™ Jaw Description
 - Recommend making this descriptive for operators that may not have complete familiarity with the part.

Example: OP2 Jaws for XYZ Part, ID Jaws

3. Select OD or ID jaws
 - This selection is not only descriptive but will direct proper function of robot motion and component actuation.

Part Definitions

The Part Definitions section is used to add new, edit or delete parts to or from the VBXC Configuration. The definition of parts and the meaning of the selections is detailed in the section below, with a number of possibilities of processing a part with a VBXC system. The general purpose of the part definition is to name a part and define the steps required to process the part, from pick-from-shelf (Infeed) to place-back-on-shelf (Outfeed) with the CNC processes in-between.

Part Introduction Checklist

1. It is critical for successful introduction of robot tending to first prove out good parts with manual loading.
2. Are the MultiGrip™ Jaws defined and proven, if used, when manual machining?
 - *VersaBuilt Robotics recommends engraving or labeling each jaw with an unique numbering system or name to minimize operator error during job set-up.
3. If using MultiGrip™ Vises, has the vise pressure range been defined for each machining operation? Reference Table 1.

Notes: *VBX-160 systems use plant air regulated to ≤ 110 psi
 **Vise Pressures >110 psi are available with VBX-160 Pressure Doubler
 1 Vise System - P/N 5002212
 2 Vise System - P/N 5003419
 3 Vise System - P/N 5003420

AIR PRESSURE	CLAMPING FORCE (IBF)
10	344
20	689
30	1033
40	1378
50	1722
60	2067
70	2411
80	2756
90	3100
100	3444
125	4306
150	5167
175	6028
200	6889
225	7750

TABLE 1. VISE PRESSURE TO CLAMPING FORCE VALUES

4. Does the part have defined shelf locator's or a known shelf template (picks per shelf)? Reference Table 2.

PICKS PER SHELF	PART SPACING	MAX PART WIDTH/DIA.
3	12.2125	10.5
4	9	8
5	6	5
6	4.5	3.5
8	3	2.5
18	2.5714	2

TABLE 2. STANDARD LOCATOR OPTIONS

5. Do the MultiGrip™ Jaws include clearance to avoid interference with neighboring parts during shelf picking?

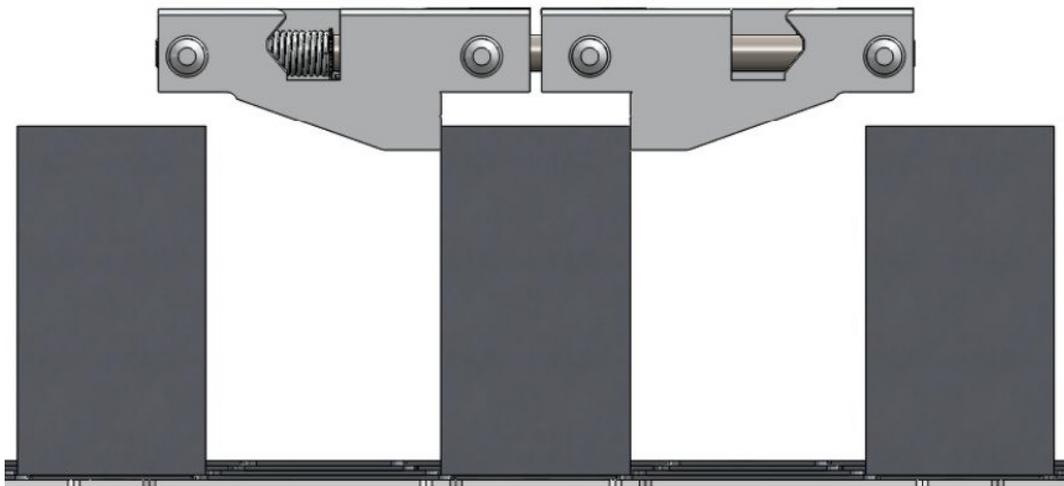


FIGURE 2. JAWS IN PROXIMITY TO NEIGHBORING PARTS ON SHELF

6. What is the Infeed Height? Infeed height consists of **First Operation Jaw + Raw Material + Shelf Locator thickness.**

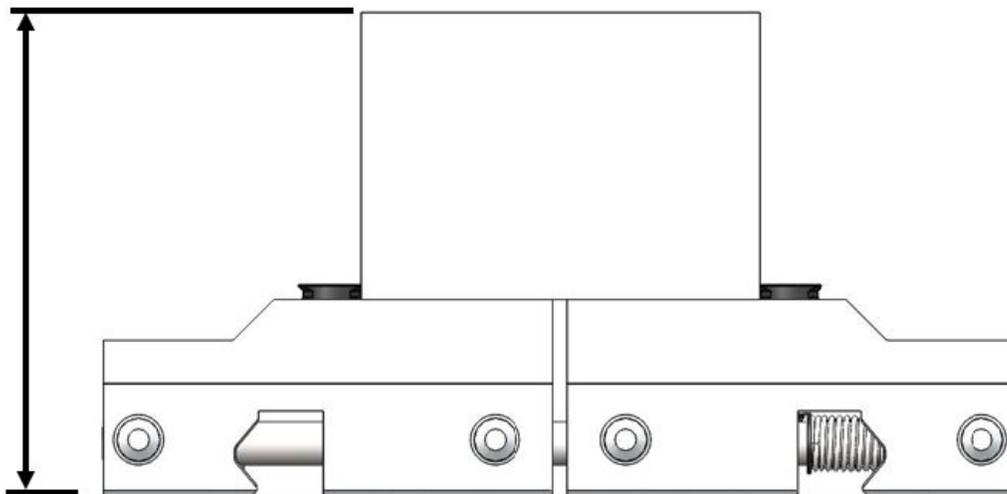


FIGURE 3. INFEEED HEIGHT IS FIRST OPERATION JAW + RAW MATERIAL + SHELF LOCATOR THICKNESS

7. What is the Outfeed Height? Outfeed height consists of **Last Operation Jaws + Finished Part + Shelf Locator thickness.**

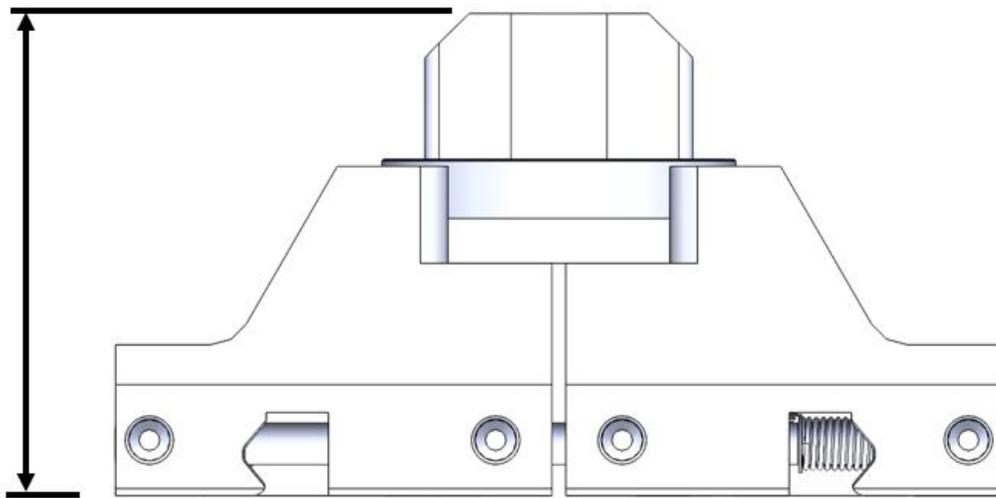


FIGURE 4. OUTFEED HEIGHT
LAST OPERATION JAWS + FINISHED PART + SHELF LOCATOR THICKNESS

8. Does the part require an index or settle against a Y-datum before machining, for any operation?
- If yes, there are options either available in the Part Definitions options or in the G-Code commands with a Y-Push tool. See Note below.
9. Does the part require seating against the Z-datum before machining, for any operation?
- If yes, there are options either available in the Part Definitions options or in the G-Code commands with a Z-Push tool.

Note: G-Code Vise Control - A VBXC software option to open and close vises or control vise pressure with G-Code during a CNC Program. This feature may not be available for all CNC types.

10. Are MultiGrip™ Jaws the workholding used during machining or are they used to pick and drop off the part into other workholding (e.g., collet chuck)?
- a. Jaw Load = Part plus MultiGrip™ Jaws into MultiGrip™ Vise workholding.
 - b. Part Load = Part only into workholding (including MultiGrip™ Jaws, 3 jaw chuck, collet chuck, etc.).
11. If there are more than 1 operation, what is the Op-to-Op transfer height(s)?
- Current Operation Jaws + Partially Complete Part + Next Operation Jaws

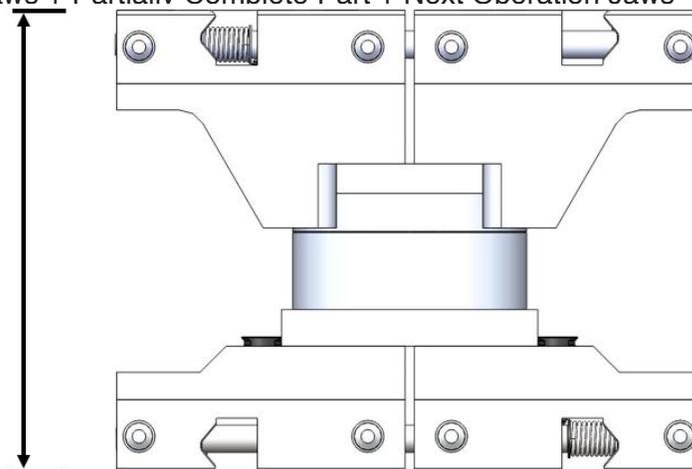


FIGURE 5. OP-TO-OP TRANSFER HEIGHT
CURRENT OPERATION JAWS + PARTIALLY COMPLETE PART + NEXT OPERATION JAWS

12. When using the VBXC it is necessary to break-up the CNC program into individual programs. Has the CNC program been broken up into individual programs?
 - a. Op1 Program
 - b. Op2 Program
 - c. Op3 Program... etc.
 - d. Table and Vise Wash Program(s)
 - e. Table Load Program(s)
13. Are all programs ending with M99, rather than M30?
 - M99 will communicate to the VBX-160 to start next program or operation in sequence.

Adding Jaws and Part information

1. When introducing a new part, first add the required MultiGrip™ Jaws used for processing.
 - a. Click on the icon to add Jaws.
 - b. Input a number corresponding to labeling or engraving on jaws.
 - c. Input a description for operator reference.
 - d. Select either OD Jaws or ID Jaws.

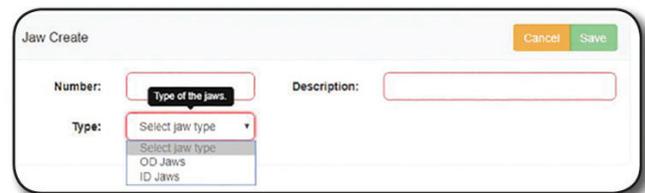


FIGURE 6. CREATE JAWS DIALOG BOX

Examples of Jaw Definition Naming Structures

- Identifier should match engraving or labeling on MultiGrip™ Jaws.
 - Description should be useful in identifying the MultiGrip™ Jaws for their application.
2. Once MultiGrip™ Jaws are defined, add Part Definition.
 - a. Click on the icon + to add a Part Definition.
 - b. Input information in the following sections:
 - i. General
 - ii. Infeed
 - iii. Outfeed
 - iv. Cleaning Options
 - v. Fumble Check Options
 - vi. CNC Operation Information

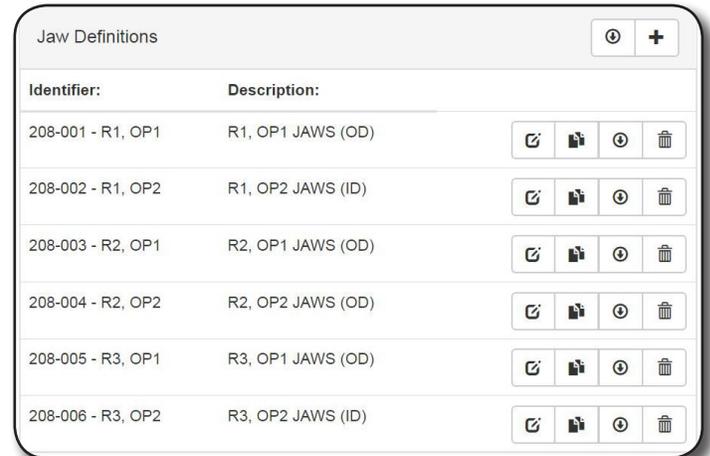


FIGURE 7. JAW DEFINITIONS

Examples for Part Definitions Naming Structure

- Identifier should match documentation of paperwork for the part.
- Description should be useful in identifying the part.

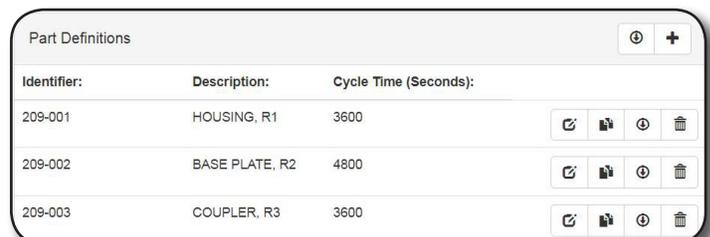


FIGURE 8. PART DEFINITIONS

Part Definition - General Section

This section includes a part identifier number, part description, and information to prepare the system for starting a new part.

- Number** - This is the part number or identifier for the part, which will be displayed on the Operation screen during production.
- Description** - A brief name or description to expand on the identifier or part number.
- Pre-Job Program** - Runs a set-up or pre-milling programming. If not needed or required, leave blank.
- Cycle Time** - A time value for reference only, as an estimated cycle time of the complete processing of the part.
- Skip Pre-wash** - Optional check box to eliminate the washing step of the CNC with the default wash program, prior to starting this part.

FIGURE 9. GENERAL DIALOG BOX

Part Definition - Infeed Section

This section includes a part identifier number, part description, and information to prepare the system for starting a new part.

- Material** - For communication purposes to Operators, input a description of the material used.
- Height** - First operation Jaw + Raw Material + Shelf Locator thickness *Reference Figure 3 & Table 3 for Standard and High Entry values. The Height value entered here needs to be less than the entry height selected.
- Slot Type** - Select from pull-down menu the shelf pick template or locator that will be used with part.
- Jaws** - Select from pull-down menu the jaws used to pick the raw material from the shelf. The pull-down menu will include the jaws added in the “Jaw Definitions” sections.
- High Entry** - Optional check box for selecting the jaw entry height for picking. Reference Table 3. Select High Entry if the Infeed height is greater than the Standard Entry Height.
- Overhang** - Optional check box for selecting if the parts will hang over the edge of the shelf. For example, on a standard shelf locator template, parts larger than 6-inch diameter will overhang. If The “Overhang” is selected and “High Entry” is selected, the VBXC will only allow operators to load every-other-shelf, as the robot gripper would collide with parts during picking. When machining rectangular parts, it is common practice to offset parts longer than 6-inches in the “Y” direction, to avoid overhang, then settle or push the part into position via a robot settle or CNC function (Y-Push tool).

FIGURE 10. INFEEED DIALOG BOX

SHELVES PER RACK	STANDARD ENTRY HEIGHT	MAX ENTRY HEIGHT
4	10.8"	12.3"
5	7.6"	9.1"
6	5.7"	7.2"
7	4.4"	5.9"
8	3.5"	5.0"
9	2.8"	4.3"

TABLE 3. VBXC-160 SHELF CONFIGURATION

Part Definition - Outfeed Section

This section includes a part identifier number, part description, and information to prepare the system for finishing a new part

1. **Slot Type** - Select the location the finished part will be placed from pull-down menu. By default, parts will be placed back in the slot from which they were original picked, the “Infeed Slot”.

FIGURE 11. OUTFEED DIALOG BOX

An alternative to placing back in the Infeed Slot is “Bin Drop”, which is a custom drop location, defined on a per part basis, e.g., dropping off parts into the VBX-160 Rinse and Air bucket.

2. **Height** - Last Operation Jaw + Finished Part + Shelf Locator thickness refer to Figure 4 on page 6 and Table 3 on page 8, for Standard and High Entry values. The Height value entered here needs to be less than the Entry Height selected in the Infeed section.
3. **Clap Cycles** - Enter a value only if required. This function is used to drop parts that may stick to the MultiGrip™ Jaws during handling, due to surface tension or some other mechanism. Clap Cycles will open and close the VBX-160 Gripper the number of cycles entered at a “Clap Rate.” It is common to start with a Clap Cycle value of 5 and fine tune the process.
4. **Clap Rate** - If a value greater than 0 is entered into “Clap Cycles” a dialog box will appear for “Clap Rate”. The value entered here is the number of times per second (Hz) the VBX-160 Gripper will open and close. It is common to accompany a Clap Cycle of 5 with a Clap Rate of 15, then fine tune your process.

Part Definition - Cleaning Section

This section includes two types of cleaning options: Rinse and Air inside the VBX-160 enclosure and dumping coolant inside the CNC.

1. **Rinse and Air Feature** - Select from the pull-down menu preferred cleaning options:

FIGURE 12. CLEANING DIALOG BOX

- a. **None** - No Rinse or Air will occur during processing of the part.
- b. **Rinse** - Only the Rinse option for washing the part and jaws
- c. **Air** - Only the Air Knife will be used for cleaning the part and jaws.
- d. **Rinse then Air** - The VBX-160 will first Rinse the parts and jaws with water or water and coolant mixture, then clean and dry the parts and jaws with the Air Knife.

Note: Both Rinse and Air will have options for robot speed through the operation. It is recommended to start with a conservative speed, then refine or fine tune the process with increased speed if the part or process allows.

2. **Coolant Dump** - Check box is selected by default. If checked the robot will rotate right and left, after picking up jaws in the CNC, to drip coolant inside the CNC that may collect on the part or jaws. This is a useful operation to minimize debris and coolant from exiting the CNC. If the check box is unselected, the VBXC will skip the coolant dump step.

Part Definition - Fumble Checking Section

This section includes a check box for detection of mis-picks when picking MultiGrip™ Jaws or when picking parts with MultiGrip™ Jaws.

The VBX-160 Gripper is equipped with sensors to detect:

- The absence of MultiGrip™ Jaws in the VBX-160 Gripper, “Jaw Fumble.”
- Fully Open MultiGrip™ Jaws, “ID Clamping Part Fumble.”
- Fully Closed OD MultiGrip™ Jaws (empty), “OD Clamping Part Fumble.”

1. When the check box is enabled, the VBX will detect “Fumbles” if:

- a. The robot fails to pick jaws from inside the VBX enclosure or jaws inside the CNC. This is detected if the pull stud retract sensor is triggered, indicating the absence of MultiGrip™ Jaws in the VBX Gripper.



FIGURE 13. FUMBLE CHECKING

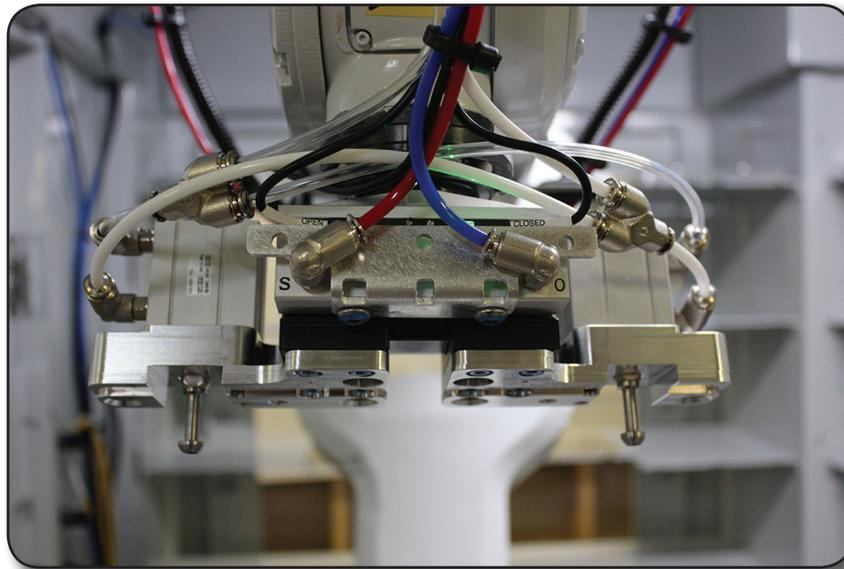


FIGURE 14. GRIPPER CYLINDER

- b. The robot fails to pick a part from the shelf or during part and operation transfer in the CNC if the closed sensor is triggered when picking OD clamped parts or if the open sensor is triggered when picking ID clamped parts.

c. Fumble causing the VBX-160 to stop operation:

- i. If a fumble occurs when picking from the shelf, by default, the robot will continue to the next slot or part pick until there are 3 consecutive fumbles. Upon the 3rd consecutive fumble, the robot will halt operation. This value is configurable in the advanced configuration section of the “Support” screen.
- ii. If a fumble occurs picking jaws or picking parts in the CNC, the VBX-160 will stop operation, and enter “Recovery” on the Operator screen.

2. If the check box is not selected the robot will not stop in the event of a fumble.

Note: Refer to the “How to Install or Adjust Gripper Sensors” document for more information about Gripper sensors. Document # D10020, located on our website versabuilt.com.

Part Definition - CNC Operation 1

This section includes options for loading parts only or loading parts with MultiGrip™ jaws, process information for loading and unloading vises, chucks and fixtures, starting CNC programs, and process control options for each CNC operation.

The CNC Operation section is composed of 4 parts:

1. Load
2. Pressure
3. Milling
4. Unload

Load

Jaws Load

1. The robot will use MultiGrip™ Jaws to pick parts from the shelf, then load the part and jaws into a MultiGrip™ vise or chuck.
2. **Item** - Select jaws, if loading MultiGrip™ Jaws and part into MultiGrip™ vises
3. **Vise** - Select vise 1, 2 or 3 from the pull-down menu.
4. **Table Program** - During installation of the VBXC, each vise is calibrated to the robot with a CNC program to position the CNC table, vise or chuck into a position for loading and unloading. It is possible to have multiple “Table Programs” but the robot will have a “pre-programmed” or “calibrated” position where it will move to 1 of 3 vise positions. Select a table program that matches the vise selected. Typically, a CNC table program will match with a vise number.



FIGURE 15. LOAD JAWS DIALOG BOX

Example: One program can be used is for loading and unloading vises 1 and 2, and a separate program can be used for loading and unloading vise 3.

5. **Robot Settle** - This check box opens and closes the VBX-160 gripper, while holding MultiGrip™ Jaws and the Infeed material, before entering the CNC. This feature is used to allow the part or material to gravity settle into position in the MultiGrip™ Jaws. If the application requires the part to settle in the Y direction on the MultiGrip™ Jaws, an option for entering an angle is available. See the Figures 16 and 17 for orientation of rotation based on value entered. Angle values for Y settling may require fine tuning or experimentation for reaching a stable, repeatable process. If using an angle for Y-settling with gravity, include a Y-datum feature on the MultiGrip™ Jaws.
6. **Vise Settle** - This check box opens and closes the MultiGrip™ Vise, while holding MultiGrip™ Jaws and the Infeed Material, after placing in the CNC. This feature is used to allow the part or material to gravity settle into the MultiGrip™ Jaws. When configuring the vises, you can choose either to use the default table load position for the Vise Settle or enter a custom location. The alternate Vise Settling table load position is typically used in applications with a 5-axis set-up, where a Y-settle is implemented and the 5-axis tilts the vise, then opens and closes for settling.

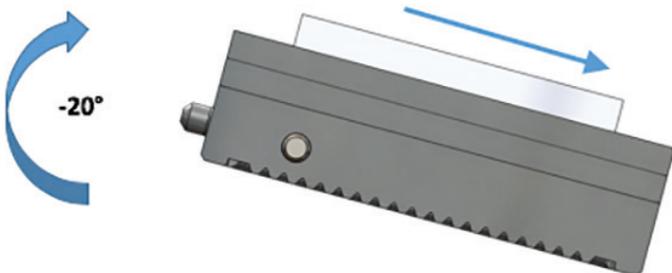


FIGURE 16. GRIPPER SETTLE = -20°, RELATIVE TO FLAT VISE

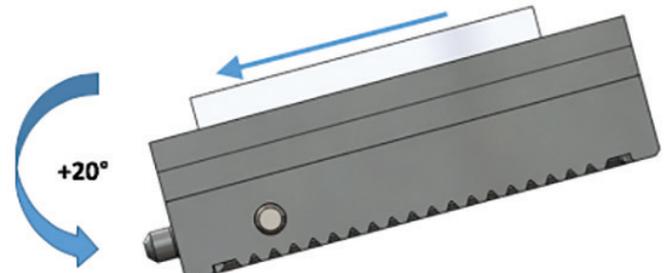


FIGURE 17. GRIPPER SETTLE = +20°, RELATIVE TO FLAT VISE

Part Load

1. The robot will use MultiGrip™ Jaws to pick parts from the shelf, then load the part (only) into workholding in the CNC.
2. **Item** - Select part
3. **Vise** - Select vise 1, 2 or 3 from the pull-down menu.
4. **Table Program** - During installation of the VBXC, each vise is calibrated to the robot with a CNC program to position the CNC table, vise or chuck into a position for loading and unloading. It is possible to have multiple “Table Programs” but the robot will have a “pre-programmed” or “calibrated” position where it will move to 1 of 3 vise positions. Select a table program that matches the vise selected. Typically, a CNC table program will match with a vise number.

Example: One program can be used is for loading and unloading vises 1 and 2, and a separate program can be used for loading and unloading vise 3.

5. **Height** - Enter place height = First Operation Jaw + Raw Material + offset from calibrated Z0 value to Z surface of workholding.

Pressure

Vise air pressure can be regulated by the VBX-160 system. It is necessary to check the Set, Min and Max vise pressure for each operation. The VBX-160 will stop operation before the CNC will run, if the pressure does not fall between the Min and Max values. For process control and variations in air pressure, it is recommended to start with Min and Max values ± 10 psi of Set pressure.

Note: If the system includes a VBX booster, the air pressure to the vises will be 2x the pressure value in the part configuration, as the air is regulated before the booster, and the display pressure on the VBXC screen will be equal to the value set in the Part Definition, but $\frac{1}{2}$ the actual pressure at the vises.

Milling

1. **Program** - Enter the CNC program number to run CNC Operation #1.

Note: The program should end with M99 to alert the VBXC to restart robot interaction with the part.

2. **Alert Time** - Enter a value representative of the time for the CNC Operation. This value does not need to be accurate, just greater than 0.
3. **Wash Program** - If the check box is selected, the CNC will run the default CNC table wash program. For example, for typical Haas machines the default wash program is #81004 to clean the entire table and all vises. If the check box is not selected, an alternate wash program can be entered. Alternate wash programs are typically used in-between CNC operations to clean only the next vise to be used.

Unload Parts

1. **Part Unload** - The robot will use MultiGrip™ Jaws to pick parts from the current operation CNC workholding, then be ready to either place the part back on the shelf or place the part in the next operation vise or workholding.
 - a. **Item** - Select Part from the pull-down menu.
 - b. **Jaws** - Select the MultiGrip™ Jaws, that will be used to unload the part from the first operation workholding, from the pull-down menu .

Note: This can be from a MultiGrip™ vise workholding, a chuck or other workholding.

FIGURE 18. LOAD DIALOG BOX

FIGURE 19. PRESSURE DIALOG BOX

FIGURE 20. MILLING DIALOG BOX

FIGURE 21. UNLOAD PART DIALOG BOX

- c. **Table Program** - During installation of the VBXC, each vise is calibrated to the robot with a CNC program to position the CNC table, vise or chuck into a position for loading and unloading. It is possible to have multiple “Table Programs” but the robot will have a “pre-programmed” or “calibrated” position where it will move to 1 of 3 vise positions. Select a table program that matches the vise selected. Typically, a CNC table program will match with a vise number.

Example: One program can be used is for loading and unloading vises 1 and 2, and a separate program can be used for loading and unloading vise 3.

- d. **Height** - Enter pick height = Unload Jaw + Part Height + offset from calibrated Z0 value to Z surface of workholding.

Note: If the first operation part is held by MultiGrip™ Jaws in MultiGrip™ Vises, the Height = Unload Jaw + Part Height + Op1 Jaw Height (as shown in Figure X)

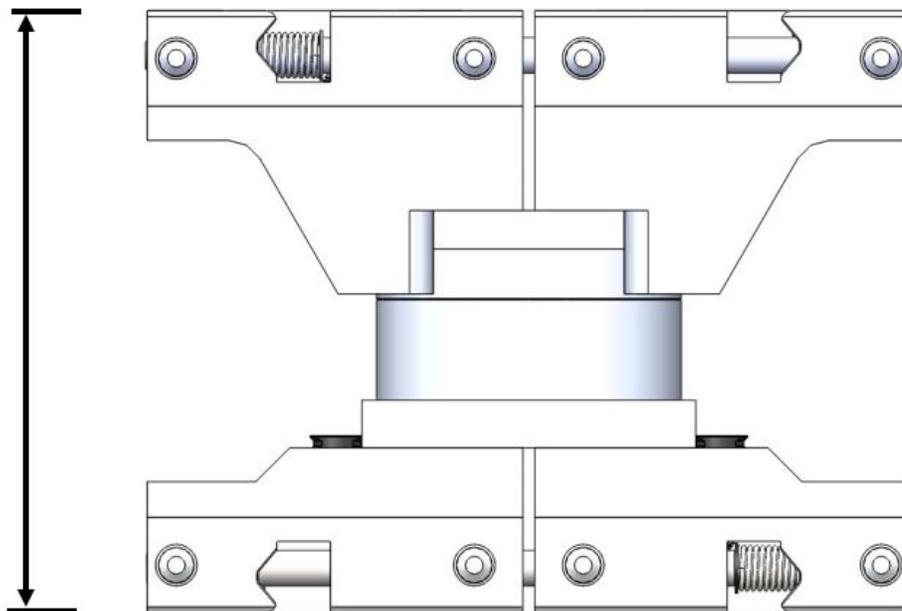


FIGURE 22. PICK HEIGHT = UNLOAD JAW + PART HEIGHT + OP1 JAW HEIGHT

Unload Jaws

1. **Jaws Unload** - The robot will unload the jaws and the part from the MultiGrip™ Vise, in preparation to either place the finished part back on the shelf (or to the Outfeed location), or place the part and/or jaws in the next operation workholding.

- a. **Item** - Select from pull-down menu, “Jaws.”

- b. **Table Program** - During installation of the VBXC, each vise is calibrated to the robot with a CNC program to position the CNC table, vise or chuck into a position for loading and unloading. It is possible to have multiple “Table Programs” but the robot will have a “pre-programmed” or “calibrated” position where it will move to 1 of 3 vise positions. Select a table program that matches the vise selected. Typically, a CNC table program will match with a vise number.



FIGURE 23. JAWS UNLOAD DIALOG BOX

Example One program can be used is for loading and unloading vises 1 and 2, and a separate program can be used for loading and unloading vise 3.

Adding Additional CNC Operations:

Click on + icon above the previous CNC Operation. Next Operation has the same options as the previous Operation.

Removing CNC Operations

Click on  icon above CNC operation to remove.

CNC Process Control

Beyond the options in VBXC Part Configuration, VersaBuilt Robotics has software options, if available for your CNC machine, to allow G-Code in the CNC to communicate with the VBXC system and control the function of the MultiGrip™ Vises, dynamically, within a CNC program. This functionality is called “G-Code Vise Control”, allowing G-Code commands to:

- Open and Close Vises with G-Code during a CNC Program
- Regulate the Vise pressure with G-Code during a CNC Program

There are a number of applications where this can be useful:

1. Dynamically adjust vise pressure during a machining program, if needed.

Example: A part with large material removal may require high pressure at the start of the program, but lower pressure toward the end of the program to prevent part deformation.

2. Y-Push

- a. If it is not possible to locate the Y-Datum of the part with the robot part pick, robot settle or vise settle in the MultiGrip™ Jaws. There is an option is to use a Y-Push tool, shown in Figure 26, or a custom tool to push the part.
- b. It is common to use a Y-Push tool with parts longer than 5 to 6-inches, an example is shown in Figure 24. The example shows a 11.5-inch long part, where the raw material is picked from the shelf with a Y-Offset, then is pushed into place in the vise with a Y-Push tool.
- c. To push the part, the CNC will change tools to a Y-Push tool, position the tool on one side of the part, then using G-Code Vise Control, open the vise, move the vise relative to the spindle in the Y-direction to push the part, then close the vise. It is recommend in some situations to push from both sides to get the most accurate Y-datum location.

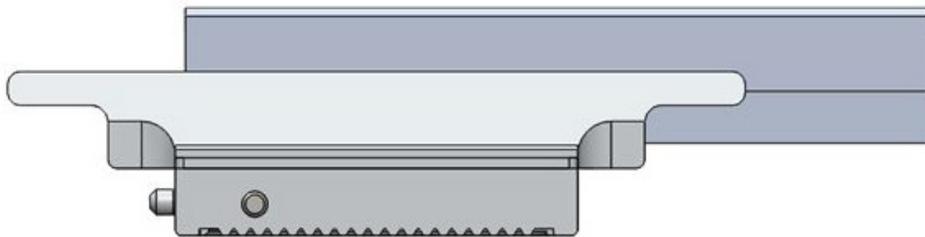


FIGURE 24. 11.5-INCH LONG PART WITH Y-OFFSET



FIGURE 25. 11.5-INCH LONG PART PUSHED INTO PLACE USING Y PUSH TOOL

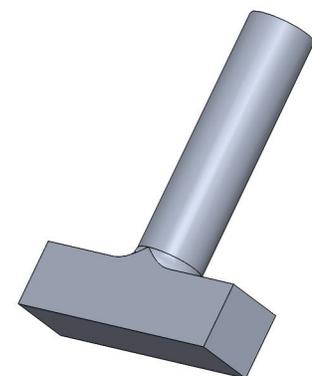


FIGURE 26. Y PUSH TOOL

3. Z-Push

- a. If it is not possible to effectively seat or settle the part with the robot part pick, robot settle or vise settle in the MultiGrip™ Jaws, an option is to use a Z-Push tool shown in Figure 27, or a custom tool to push the part.
- b. Z-Push becomes necessary with parts that have flatness, parallel call-outs, deform during machining from stress relief or require force (similar to using a mallet when manually tended) to fully seat the parts in the jaws.
- c. To push the part, the CNC will change tools to a Z-Push tool, position the tool above the part, then using G-Code Vise Control, lower the vise pressure to 10 psi \pm 10 psi, then move the spindle down to push the part, 1 or more times across the part. Once the push process is complete, the CNC program can increase the vise pressure back to the proper milling pressure.

Note: Please confirm with VersaBuilt Robotics that G-Code Vise Control is available for your CNC system.

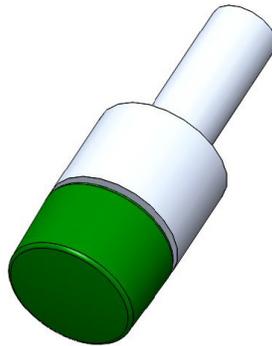


FIGURE 27. Z-PUSH TOOL

Glossary of Terms

Clap - An option in the VBXC Part Configuration to rapidly open/close the VBX-160 Gripper when placing parts back on the shelf. Option is useful for parts that may stick to the MultiGrip™ Jaws due to mechanical interference, surface tension or other.

Coolant Dump - VBXC Part Configuration option to rotate the robot left and right after picking parts or MultiGrip™ Jaws from CNC workholding to minimize coolant, chips or debris from exiting the CNC.

Default Wash Program - The generic CNC program used to clean vises or MultiGrip™ Jaws in the CNC with coolant or air. This program is used by all programs, unless “Skip Pre-Wash” is selected in VBXC Part Configuration and other wash programs are called in each configured CNC Operation.

Example: Haas CNC machines come with a default wash program #81004.

Fumble - VBXC logic when either the VBX-160 Gripper Sensors or the Vise Sensors detect the absence of a part or MultiGrip™ Jaws when they are expected to be held by either the robot or the vises.

Fumble Detection - The state of the sensors for the VBX-160 Gripper or the MultiGrip™ Vises. Fumble Detection can be enabled or disabled for the VBX-160 Gripper for each VBXC Part Configuration. Fumble Detection for vises is a global setting for the system and is not configurable from part-to-part.

Fumble, Jaw - A mispick, either picking jaws from the VBX-160 shelves or picking jaws from MultiGrip™ Vises.

Fumble, Part - A mispick, either from the shelf or when picking a part from workholding.

G-Code Vise Control - A VBXC software option to open and close vises or control vise pressure with G-Code during a CNC Program.

Note: This feature may not be available for all CNC machines.

High Entry - In the Part Configuration, an optional check box for selecting the jaw entry height for picking. Refer to Table 3 on page 6. Select High Entry if the Infeed Height is greater than the Standard Entry Height.

Note: If “High Entry” and “Overhang” are both selected, the VBXC will automatically limit the placement of parts to every-other-shelf to prevent collisions with parts on the shelf above.

Load and Unload, Jaws - The process of loading or unloading MultiGrip™ Jaws into MultiGrip™ Vises

Load and Unload, Part - The process of loading or unloading parts into workholding with MultiGrip™ Jaws, i.e., using MultiGrip™ Jaws as a Gripper to move parts only, not as the workholding.

Overhang - In the Part Configuration, an optional check box for selecting if the parts will hang over the edge of the shelf. If The “Overhang” is selected and “High Entry” is selected, the VBXC will only allow operators to load every-other-shelf, as the robot gripper would collide with parts above during picking. For rectangular parts, it is common practice to offset parts longer than 6-inches in the “Y” direction, to avoid overhang, then settle or push the part into position via a robot settle or CNC Vise Control function (Y-Push tool).

Example: On a standard shelf locator template, parts larger than 6-inch diameter will overhang.

Pre-Job Program - For a Part Configuration, this option allows users to run a set-up or pre-milling programming, before the robot loads raw material. If not needed or required, leave blank.

Rinse and Air (Wash Bucket) - Part and Jaw cleaning station inside the VBX-160 enclosure.

Robot Settle - Option in VBXC Part Configuration to open and close the MultiGrip™ Jaws in the VBX-160 Gripper, allowing the part to drop or “settle” against a Y and/or Z datum, after picked from shelf and before placing into a CNC workholding. With standard OD MultiGrip™ Jaws, the nominal gap between jaws opens from 0.125-inches to 0.52-inches.

Settle - Open and Close of MultiGrip™ Vise, VBX-160 controlled workholding or MultiGrip™ Jaws in the VBX-160 Gripper, allowing the part to drop or “settle” against a Y and/or Z datum.

Settle, Vise - Option in VBXC Part Configuration to open and close a vise after the part has been placed into MultiGrip™ Vises with MultiGrip™ Jaws (or placed into another workholding) to drop or “settle” against a Y and/or Z datum. With standard OD MultiGrip™ Jaws, the nominal gap between jaws opens from 0.125-inches to 0.56-inches.

Settle, Y - The drop of a part in MultiGrip™ Jaws in the VBX-160 Gripper, with an angle to allow gravity to shift the part in the Y-direction, in the MultiGrip™ Jaws, to a hard stop in the MultiGrip™ Jaws, locating the part against a Y-datum.

Table Program - CNC Program to position the table, vise, chucks, spindles or any CNC axis, into a position for robot loading or unloading. During installation of the VBXC, each vise is calibrated to the robot with a CNC program to position the CNC table, vise or chuck into a position for loading and unloading. It is possible to have multiple “Table Programs” but the robot will have a “pre-programmed” or “calibrated” position where it will move to 1 of 3 vise positions. Select a table program that matches the vise selected. Typically, a CNC table program will match with a vise number.

Example: One program can be used is for loading and unloading vises 1 and 2, and a separate program can be used for loading and unloading vise 3.

VBX-160 Booster - Optional equipment to accompany VBX Systems to double the pressure supplied from the VBX-160 to MultiGrip™ Vises.

Note: The VBX-160 Booster doubles the air pressure after the regulator, therefore if you want 200 psi at the vises, select 100 psi in the VBXC Part Configuration.

VBX-160 Gripper - Gripper assembly attached to robot arm to exchange MultiGrip™ Soft Jaws .

Wash Program(s) - A CNC program used to clean vises or MultiGrip™ Jaws in the CNC with water, water and coolant, coolant or air. Wash programs are called by the VBX-160 system when defined as a step in the VBXC Part Configuration.

Y-Push - The process of moving or pushing a part held by MultiGrip™ Jaws or other workholding in the CNC, using G-Code Vise Control to open and close the MultiGrip™ Vise or other workholding, then move or push the part with a CNC tool to a datum position.

Example of a typical process in a 3-axis CNC setup with OD clamping:

1. Part and MultiGrip™ Jaws placed in MultiGrip™ Vise.
2. CNC Milling Program starts, with G-Code commands, Y-Push Tool is the active tool the in CNC spindle.
3. CNC table moves to programmed position for Y-Push.
4. Spindle lowers to place Y-push tool on one side of the part.
5. G-Code Vise control commands the MultiGrip™ Vise to open.
6. Table moves in the Y-direction to touch the Y-Push tool and move the part into position.
7. G-Code Vise control commands the MultiGrip™ Vise to close.
8. CNC table moves away from spindle.
9. Spindle moves up and out of the way, ready for tool change and milling to start.

Note: Depending on the application, it is possible to vary this process for Y-Push on both sides of the part or to lower the pressure of the vise, rather than opening the vise.

Z-Push - The process of pushing a part held by MultiGrip™ Jaws or other workholding in the CNC, using G-Code Vise Control to lower the supplied air or hydraulic pressure to the MultiGrip™ Vise or other workholding, then move or push the part with a CNC tool to a datum position. This process is analogous to manual operation with a mallet.

Example of a typical process in a 3-axis CNC setup with OD clamping:

1. Part and MultiGrip™ Jaws placed in MultiGrip™ Vise.
2. CNC Milling Program starts, with G-Code commands, Z-Push Tool is the active tool the in CNC spindle.
3. CNC table moves to programmed position for Z-Push.
4. Spindle lowers above the part.
5. G-Code Vise control commands the MultiGrip™ Vise lower the pressure to 10±10 psi.
6. Spindle moves to push the part into position.
7. After the push is complete, G-Code Vise control commands the MultiGrip™ Vise to return to milling pressure.
8. Spindle moves up and out of the way, ready for tool change and start milling.

Example VBX-160 Subroutines for Haas CNC Machines

Prior to installation of the VBX-160, VersaBuilt Robotics will provide the following CNC files:

- 81004 – Default Vise and Table Wash Program, cleaning the vises
- 81016 – Vise Table Load Position (routine called by the VBX to position the table for vise load and unload)
- 81017 – Vise Table Load Position (alternate 1)
- 81018 – Vise Table Load Position (alternate 2)

Files for Communicating with the VBX-160

- 9000 – Dispatcher for VBX communication subroutine
- 9001 – Op Result for VBX communication subroutine
- 9002 – Vise Open and Close command subroutine
- 9003 – Vise Pressure control subroutine
- 9004 – VBX routine for the VBX Dispatcher
- 9005 – VBX routine for the VBX Dispatcher
- 9006 – VBX routine for the VBX Dispatcher
- 9007 – Vise test routine to check G-Code Vise control, shows G-Code for vise open and close
- 9008 – Mailbox subroutine
- 9009 – Test routine to check G-Code Vise control, G-Code for vise pressure control and open and close

Part Indexing and Settling for V1 Systems

Subroutines are available to communicate between the CNC and VBX-160 to:

1. Open and close the vise
2. Adjust vise pressure
3. Refer to VBXC Configuration & Process Control Manual for instructions on setting up these CNC programs
4. Vise Subroutine examples, Haas CNC Machines

Note: Look ahead can be enabled on the CNC, but only looking ahead 1 line at a time G-Code Vise Control

Example G-Code Vise Control Commands for Haas CNC Machines

The following subroutines or lines of code can be inserted into milling programs for pushing the part (y-datum), seating the part (z-settle), or adjusting the pressure during the machining process

1. G-Code Vise Control Set Vise Pressure to 40 ±10 psi
2. G65 P9003 S40. H50. U30. (Vise Pressure 40)
3. Set Vise Pressure to 100 ±5 psi
4. G65 P9003 S100. H105. U95. (Vise Pressure 100)

Closing Vises

- G65 P9002 D1. C0. (Vise 1 Close)
- G65 P9002 D2. C0. (Vise 2 Close)
- G65 P9002 D3. C0. (Vise 3 Close)

Opening Vises

- G65 P9002 D1. C1. (Vise 1 Open)
- G65 P9002 D2. C1. (Vise 2 Open)
- G65 P9002 D3. C1. (Vise 1 Close)