

VBX-160 Vise Table Configurations

The following document is intended to give guidance for VBX-160 installations with recommended table configurations (setup of 1, 2, or 3 MultiGrip vises) for Milling applications. The following sections are included:

- Background information Overview of system optimization and peripheral devices such as vise sensors, rotary couplers, etc.
- Robot reach Dimensions of VBX to CNC with links to guidance document
- Supported Table Configurations review of the vise setups for milling applications for optimized VBX-160 processing. CAD model examples are provided via link to DropBox folder.

Background Information

Robot Overhead

Robot overhead is the amount of time it takes the VBX-160 between CNC cycles. For example, the VBX-160 is most efficient with two-operation parts with two vises. In this configuration, the VBX-160 is always loading one vise while unloading the other vise.

A single or three operation part on a two vise system will have about 60-90 seconds of additional overhead because the completed part is located in the same vise as the new first operation will be placed into. This means that the robot removes the completed part and jaws from vise 1, rinses and dries the part, returns the part to the infeed, rinses and dries the jaws and return them to the jaw storage plate, then pick the first operation jaw from the jaw storage plate, pick a new blank and transfer the jaws and part into vise 1. A 3-operation part on a three vise system can be optimized and will not have the additional overhead.

Note: vise table configurations are designed to allow the robot to reach all vises with the table in one calibrated position, without moving the CNC table between pick/place operations from vise to vise. If it is not possible to reach all vises without moving the table an addition of 30 to 60 seconds of overhead will be required for the robot to move out of the CNC, close the CNC door, run a CNC program to move the table and then re-open the door.

Vise Sensors

The VBX-160 uses vise sensors to determine if the MultiGrip jaws and part have been loaded successfully. VBX-160 configured vise sensors detect vise fully open and vise fully closed while holding MultiGrip OD Clamping Jaws, thus determining proper jaw loading with the absence of a sensor signal. For 3-axis and 4-axis trunnion setups (see supported table configuration #4 on the following pages), the vises sensors are connected to MultiGrip Vises directly (threaded into the body of the vise, detecting a moving flag at fully open or fully closed). In 4th axis and 5th axis configurations, sensors mounted directly to the vise is not recommended due cable wrapping. For these rotary or 5-axis installations we



recommend part load verification via CNC spindle probe. If a spindle probe is not available, some 4th and 5th axis setups allow for the addition of a sensor bracket attached to either the CNC table or the 4th axis trunnion, thereby avoiding rotation and cable wrap problems. The sensors then detect features on a "sensor flag" bolted to the bottom of one MultiGrip Vise Intermediate Jaw. *<u>Note</u>: 4th axis trunnion setups allow for vise sensors directly attached to the vises.

Vise Placement on CNC Tables

Recommended vise layouts detailed in this document should be followed to avoid reach issues and limitations in part size. Vises should be mounted as far forward as possible on the CNC table to minimize robot reach. 4 and 5-axis equipment added to CNC's should be placed as far forward on the CNC table as possible.

Vise subplates

The typical 3-axis vise subplate accommodates the most common CNC table designs with hole patterns matching spacings of 63mm, 80mm, 100mm and 125mm. 5.75" Riser-subplates are also useful for dual 5-axis/3-axis tables and 4-axis configurations to raise either vises or rotaries as needed. 4 and 5-axis subplates include porting for plumbing air lines to vises thru the body of the 4th or 5th axis. Each subplate has material machining allowance (0.010") for setup parallelism.



Table Load Positions

Each CNC Type is different, but there is historical information and rules of thumb for the commanded location of the CNC table when robot part exchanging occurs.

Rules of Thumb:

- Position of table in X-direction:
 - Position the table such that the vises are, as much as possible, centered about the door frame or centered about the base of the robot. If the table position is near the end of the X-travel, leave ~1-inch of travel available for any adjustments or recalibration that might be required in the future
- Position of table in Y-direction:
 - Position the table as far forward as possible, with 1-inch of travel available for any adjustments or recalibration that might be required in the future
- Limit the number of table load positions:
 - As much as possible, calibrate the system such that only one table load position is required
 - If more than one table load position is required, due to robot reach, position of vises on the table, or 4th or 5th axis position changes during pick and place, the robot will exit the CNC, door will close then the table will shift, causing added cycle time.

Historical information:

- UMC-500/UMC-750 with 2 vises position the 5th axis at 20-degrees. Refer to the image below in the VMC with 5-axis section, and provided SolidWorks models
- Data from existing customers with similar or equivalent table configurations can be accessed for reference



Rotary Couplers for 4-axis and 5-axis CNCs

The VBX-160 uses vises that are pneumatically actuated. The air lines must be routed to the vise in a way that does not interfere with the movement of the 4-axis or 5-axis table movement. This is typically done through the center of the rotary axis opposite where the vise is mounted. Many vendors of table mounted 4-axis and 5-axis rotaries have options for a rotary coupler. Most of these rotary couplers will work with the VBX-160 standard vise subplate. Haas is a notable exception, as of this writing, Haas does not offer rotary couplers for any of its table mounted rotaries or UMC line of 5-axis machines.

VBX-160 accessories include rotary couplers for the following Haas rotaries:

- HRT-160
- HRT-210
- TR160
- TR160-2
- UMC-750

*<u>Note 1</u>: It is the discretion of the manufacturer of these rotary systems to make changes to their rotary geometries, thereby making previously designed rotary couplers obsolete. Prior to implementation, check for proper fit and function.

*<u>Note 2</u>: OEM Rotary Couplers have been used in VBX-160 applications for NIKKEN, KOMA and DMG-MORI rotary systems

As an alternative to rotary couplers, if the customer's CNC and CAM can support limiting the rotation of the rotary axis to less than 720 degrees, the flexibility of the pneumatic air lines can handle the rotation without adding a rotary coupler. This configuration will require the rotary axis to have a through hole.



Robot Reach - VBX-160 - Dimensional relationship to CNC

Installations of VBX-160's require consideration for robot reach



installing a VBX-160, consideration for robot reach is important. While the robot reach is ~900mm and the center of the MultiGrip Jaws are ~155mm from the center of the wrist, a number of things need to be taken into consideration, including:

- Height of the vises relative to the height of the robot base
- Available X. Y positioning of the CNC table
- Space for VersaDoor (2.75 to 3.00 inches)

The image above shows a VBX-160 with a Haas UMC-500, including a VersaDoor.

- Dimension "A" = 14.2-inches (364mm) * front of VBX to center of robot base
- Dimension "B" varies per CNC, with available Y travel and the position of the vises on the table. For example, UMC-750 table center is 24-inches (609mm) from the front of the CNC



Supported CNC Table Configurations

The following pages include detailed information for these supported CNC table configurations:

- 1. VMC with Single 3-axis vise
- 2. VMC with Two 3-axis vises
- 3. VMC with Two 3-axis vises and a 4th axis rotary mounted vise
- 4. VMC with 4th axis trunnion table
- 5. VMC with a Single Platter 5-axis Rotary
- 6. VMC with a Dual Platter 5-axis Rotary
- 7. 5-axis VMC with One or Two Vises
- 8. VMC with 5-axis and 3-axis Vise

*<u>Note 1</u>: Refer to 3D models of configuration examples listed here: <u>https://www.dropbox.com/sh/ohsm7lngz5q52bn/AACRNcAvI1lp3V7kR6X0cLwKa?dl=0</u>

*<u>Note 2</u>: Check for manufacturing updates, changes to hole patterns, sheet metal, as the provided 3D models may be out of date to future applications



1.0 - VMC with Single 3-axis vise



This table arrangement is limited to single operation parts. Two operation processing requires the part to be completed as two separate jobs: first operation job and then a second operation job. The operator must flip over the parts between the job. If clocking (rotation about the Z axis of the part) is required between the first operation and second operation, the clocking must be achieved by the X and Y datums of the infeed part locators.



2.0 - VMC with Two 3-axis vises





This is the most common CNC table arrangement. It is widely used for 3-axis and one, two or three operation parts. The vises are mounted to the CNC table via a 3-axis subplate that accommodates t-slot spacings of 63mm, 80mm, 100mm and 125mm. A new blank is placed in one vise and a completed part removed from the other vise each time the CNC door opens. The above image shows the recommended vise spacing of 9.75".. This spacing is not required but can aid in consistent setup from system to system.

SolidWorks model available in the link above - Same SolidWorks model available as VMC with Single 3axis vise, with configurations for 1 and 2 vise setup



3.0 - VMC with Two 3-axis vises and a 4th axis rotary mounted vise



This is a flexible table arrangement that allows for one, two or three operation parts between any of the 3 vises on the table. Both 2 and 3 operation parts can be configured to run in an efficient manner. A key component of this setup is the addition of a riser mount for the 4th axis. Depending on space constraints on the table, the 4th axis may need to be mounted on a riser to clear the 3-axis MultiGrip vises. The image above shows an example of an HRT160 with a 4.0-inch riser and 2x 3-axis MultiGrip 160 vises.

SolidWorks model example available via the link above



4.0 - VMC with 4th axis trunnion table

One or two vises can be mounted on a trunnion table driven by a 4th axis rotary. The two vise configuration results in robot overhead that is the same as a two 3-axis vise configuration. Vise sensors in this configuration can be directly connected to the vises, same as a 3-axis setup, with cables and air lines routed directly to the vises. Previous implementations of 4-axis trunnion table configurations include Haas HRT-160 and HRT-210, with vise mount components purchased from Martin Trunnion, specifying the mount of a vise subplate. **The following models are available in the link above:**

- HRT-160 Vises are spaced 9.0-inches and centered on trunnion plate
- HRT-210 Vises are spaced 9.0-inches and centered on trunnion plate





5.0 - VMC with a Single Platter 5-axis Rotary



This table arrangement is limited to single operation parts. Two operation processing requires the part to be completed as two separate jobs: first operation job and then a second operation job. The operator must flip over the parts between the job. If clocking (rotation about the Z axis of the part) is required between the first operation and second operation, the clocking must be achieved by the X and Y datums of the infeed part locators.

The image above shows the Haas TR160 single platter 5-axis.





6.0 - VMC with a Dual Platter 5-axis Rotary

This table configuration has the same robot overhead and operation process capabilities as the two vise 3-axis configuration but with the added capability of 5-axis machining. Image above shows the Haas TR160-2 dual platter 5-axis.



7.0 - 5-axis VMC with One or Two Vises



A 5-axis CNC with a single vise configuration is limited to machining parts with one operation. The single vise can be mounted on the center of the table assuming the robot has sufficient reach to the vise and clear table equipment (like front trunnion axis on UMC systems).

The two vise configuration, shown above, typically mounts both vises off-center of the table, with one vise mounted on a 5.75" riser for a UMC-750 and a 3.5" riser for a UMC-500. The risen vise becomes the primary 5th axis vise. The unrisen vise has some tool access limitations and is typically used to dovetail the part in a pre-operation or to complete the backside of the part. The two vise configuration can run one, two or three operation parts with the same robot overhead limitations of any two vise system.





The image above shows a UMC setup without a rotary coupler by connecting lines to bulkhead fittings at the bottom of the rotary and flexible coiled tubing inside the rotary to a fitting assembly at the table.



8.0 - VMC with 5-axis and 3-axis Vise





A single vise configuration on a table mounted 5-axis will provide single operation job processing and will require probing or a two port rotary coupler for the vise. There are OEM and 3rd party rotary couplers available for NIKKEN and KOMA 5-axis rotaries.

Adding a second vise mounted in a 3-axis configuration increases flexibility and allows for one, two or three operation processing with the same processing overhead as a two 3-axis vise configuration. This setup will require a vise riser for the 3-axis vise to provide clearance for the CNC's Z axis. A riser for a tool probe may also be required.