



## 12. CNC Operator Manual

### General Overview:

Standing experience.

- CNC operator is a simulation where the users will be tasked with working on a large CNC vertical milling machine.
- They will need to interpret and read design drafts, and then program the functionality of the machine.
- The user will need to use a control pendant to program the machine to move around, turn on and off and perform several different cuts of a raw piece of metal.
- They will also need to work on various tools required to set up an operator CNC machine, like an air gun and vice.

### Macros / Shortcut keys:

T = turn teleportation on or off

**Wrist Watch:** The wrist watch is always on the user's left wrist. When a call is coming in for the user, the icon on the watch will be an orange vibrating phone (Image 1 below). They must place their right hand on top of the watch and a blue circular progress bar will fill up (Image 2 below). Once it is filled, the call will be answered and the watch icon will become a green chat bubble (Image 3 below). When the call is finished, the watch icon will become a yellow question mark (Image 4 below). When the yellow question mark is visible, the user can place their right hand on top of the watch and the narrator will repeat the last set of instructions.



Image 1



Image 2

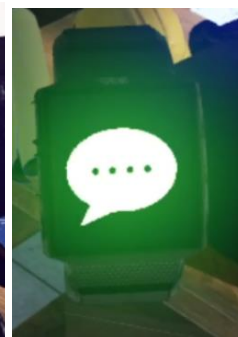


Image 3

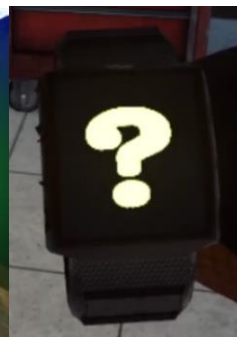


Image 4

**Facilitator Panel:** The facilitator panel is an options menu that allows a simulation facilitator to adjust gameplay and accessibility options while a user is inside the experience. To access the facilitator panel during the simulation, press the TAB key.



There are five core options from this menu:

**Hint Task:** When pressed, the in-game narrator will repeat their most recent instruction, which is helpful if the user misses something or is distracted while in the simulation.

**Print Screen:** This button will save a screenshot of the current view that the user sees.

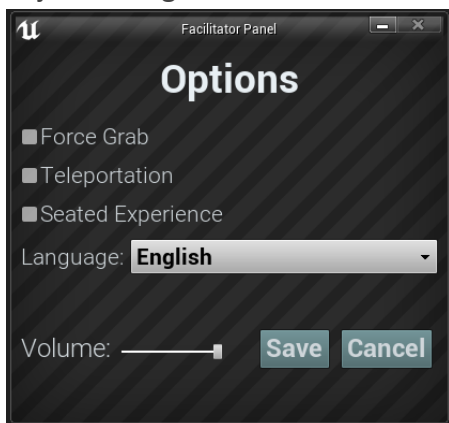
**Settings:** This will bring the facilitator into a separate menu screen where they have multiple options to change the experience. This is detailed below.

**Restart:** This will restart the simulation from the very beginning.

**Quit:** This will exit the experience.

**Greyed out buttons:** Finish Task & Restart Task - These functions are not currently working but will be implemented in the near future.

**Settings:** The gameplay settings have an additional set of toggles and sliders the facilitator can adjust during the simulation.



**Force Grab:** If someone is unable to reach something or is running the experience while seated, this option allows the user to grab objects without being directly next to them. The user can point their hands at objects that are far away and pulling the trigger will bring the object into their hand, grabbing it

**Teleportation:** This will turn on the granular teleportation around the game world. To use teleportation 1) hold down the center thumbpad button (Vive Pro) or push forward on the thumb joystick (Oculus Rift S) to create a blue teleportation arc 2) select a location to go by moving the controller until the blue circle at the end of the arc is in the desired location (A red line means that location is not valid or blocked) and 3) release the center thumbpad button (Vive and Vive Pro) or thumb joystick (Oculus Rift S) which will cause the screen will quickly fade to black and when it fades back in, the user will be in a new location.

**Seated Experience:** When turned on, this option will move the user's location in the game world to be higher up, so that if they are sitting down, their view will be similar to a standing position.

**Language:** This drop-down menu will allow the facilitator to change the language of the experience. When changing language, the simulation will need to restart.

**Volume:** This slider will adjust the master volume of the game. If the sliding bar is on the right side, the volume will be at 100% and on the left side, the volume will be set to 0%.

**Full written walkthrough:**

Quest	Task	Description
1	call	Answer your watch by holding your right hand above the watch icon on your left wrist
1	info1	Listen to introduction information from the narrator
1	page1	Pick up page 1 of the design drafts, the overview.
1	hangup1	Hang the page 1 onto the side rack
1	explain1	Listen to the narrator explain the first page.
1	open1	Open the CNC machine using the front doors. Make sure that the user opens the door all the way open, then the pallet will move forward for easier access.
1	info2	Listen to the narrator explain how to use the air gun.
1	pickup_airgun1	Grab the airgun from the right side of the CNC machine
1	press_airgun	Turn on the airgun by pressing the big button on the back of the air gun
1	clean1	Blast away the debris on the pallet by pointing the air gun at the debris and it should fall into the back garbage chute.
2	info3	Listen to information about the tool wheel and tools

2	find_drill	Grab the correct tool from the tool rack, this will be the tool labelled 2
2	insert_drill	Insert that tool into the tool wheel of the CNC machine, following the blue hologram as a guide.
2	complete_drills	Repeat the process until all three tools are in place. The second and third tools will be random each time the user run to the experience
2	close1	Close the doors of the CNC machine all the way shut
2	info4	Listen to information about the control pendant
2	tool_btn	Press the Tool button on the control pendant
2	tool_number	Press 2 on the control pendant
2	run1	Press the green Run button on the control pendant and watch as the tool wheel runs its test
2	outro	listen to some final notes about cleaning and testing
3	stock	Pick up and read page 2 of the design drafts, which will display the specific command they need to enter for the first cut
3	open2	Open the CNC machine using the front doors then place the stock onto the vice
3	handle	Grab the vise handle from the workbench.
3	clamp	Clamp the stock using the handle. First, place the vise handle on to the vice where indicated. Then rotate that handle to the right or clockwise to lock the stock on the vice.
3	remove	Remove the handle of the vise by pulling it away from the vice.
4	info5	Listen to the narrator explain the control pendant and the functionality and help with the first command
4	cmd1	Press the safe button
4	cmd2	Press the call button
4	cmd3part1	Press the X then 1 button
4	cmd3part2	Press Y then 9
4	cmd4	Turn on the tool by pressing the start button
4	cmd5	Turn on the coolant by pressing the coolant button
4	cmd6	Move the spindle down by pressing these dead then 9 button
4	cmd7	Press X 9 Y 9
4	cmd8	Press X 9 Y 1
4	cmd9	Press X 1 Y 1

4	cmd9B	Press X 1 Y 9
4	cmd10	Press Z 0 to move the spindle up
4	cmd11	Press Stop to turn off the spindle
4	cmd12	Press Coolant to turn off the coolant
4	close2	Close the CNC machine doors
4	run2	Run the program by pressing the green run button on the control pendant
4	clean2	Open the doors and clean the inside using the airgun
4	outro	Listen to the narrator explain some final notes about the first set of cuts.
5	info6	Program the second milling process, which will require the user to read and follow the third page of the design drafts.
5	run3	Close the doors and run the program by pressing the Green Run button
5	clean3	Open the doors and clean the inside using the airgun
6	page2	Grab the last page of the design drafts and see a very complex pattern
6	startProg	Have the player see the list of commands needed to make this complex pattern
6	tooAdv	Tell the player that it is too difficult for the player and that someone else will help
6	phone	Communicate to the programmer by using the walkie-talkie
6	convo	Listen to CNC programmer
6	flip	While waiting for the USB, release the stock using the vice handle and turn it upside down
6	usb	The USB will arrive on the workbench and user will need to plug it into the control pendant
6	run4	Run the new program and watch as it makes a series of very complex cuts.
6	clean3	Open the doors to the CNC machine and clean off the debris using the airgun
6	release	Release the stock using device handle
6	inspect	Pick up the stock and place onto the inspection station
6	outro	After scanning, listen to some final notes from the narrator about the career.

## Map

The user will work on a large CNC machine inside a machining facility. They will see other people working on different machines.



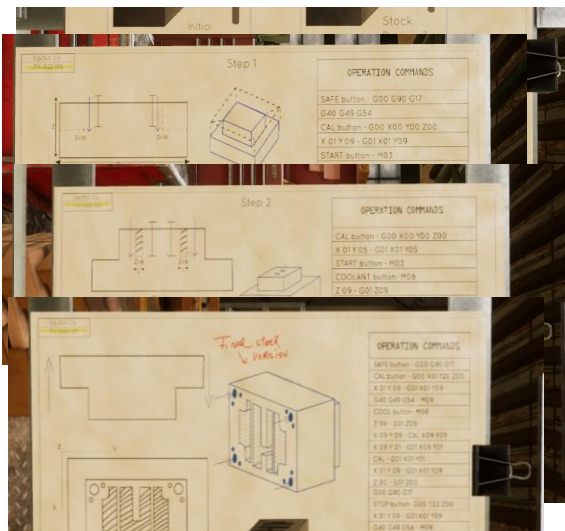
**Location 1 - CNC Workstation:** This is the only location that the user will experience Which is inside of a large machining facility. They will have access to several different tools at a workbench. They will also have access to a large vertical CNC milling machine, which they will need to use throughout the duration of the simulation.



## Key Objects

Note: Some objects will not be visible at the beginning of the tutorial and will only appear when they are required.

**Design Drafts:** The design drafts are hanging along the top of the workbench behind the user in the simulation. There are four different pages of design drafts, each containing different information. The first page of the design draft is an overview of the part that the user will be producing during the simulation. It shows a brief overview of all the different cuts they will need to make, as well as the types of drilling tools they will need to use for the job. The second page of the design draft displays the information and the code that the user will need to input to complete the first set of cuts. The third page of the design drafts displays the information and code that the user will need to input to complete the second set of cuts. The fourth and final page of the design drafts contains all the information the user will need for the final cut. This will seem very complicated and is used to demonstrate the fact that CNC operators do not always program everything that they run. For this section, the user will be inserting a pre-written code by the on-site programmer and not have to input these commands themselves.



**CNC machine:** The CNC machine is located in front of the user when they begin the experience. The user will be able to open the doors of the scene scene machine, to access the inside area. They will need to insert the stock into the CNC machine, placing it on to the vice located in the palate inside. They will need to use the Vise handle to lock the stock inside the CNC machine in place. They will need to clear off the debris from the pallet, with the air gun several times for the simulation. Inside the CNC machine, the user will also need to place the three different tools that they will use for their tasks. The user will also be able to see the spindle and the coolant spray that are hanging above the vice inside of the CNC machine.



**Control Pendant:** The control pendant is the large keyboard and screen that are attached to the right side of the CNC machine. This is where the user will be spending the majority of the simulation, as they will need to input multiple different commands.

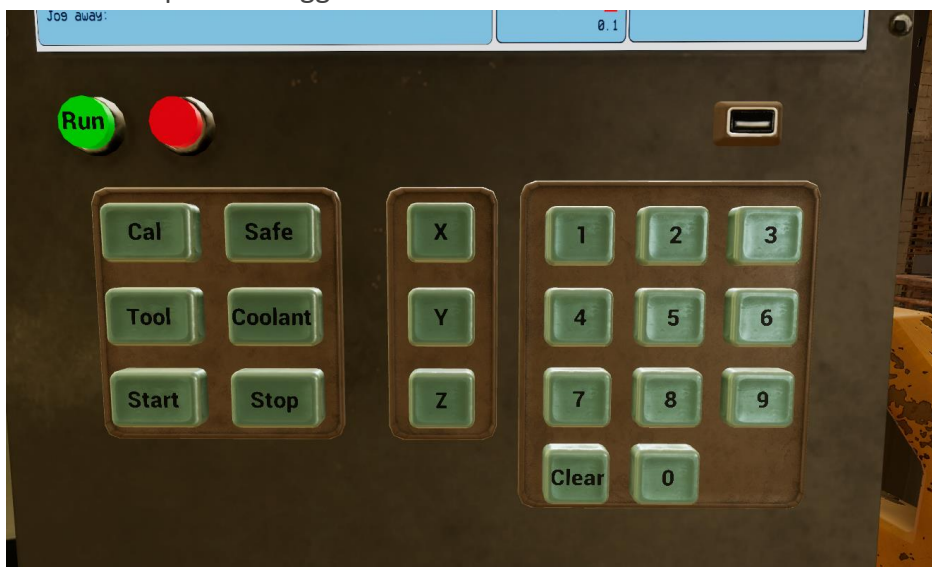




**Control Pendant Screen:** The screen above the keyboard displays which commands the user has input as they progress through the simulation, and will also update and show which command is being run in the CNC machine once the program has started to run its course. To show which line is being run, it will be highlighted in a black colour.



**Control Pendant Keyboard:** The keyboard underneath the screen has several different buttons that will do different things. Below is a list of all the different keys on the keyboard. During the initial stages of the tutorial, the different buttons that the user must press in order to program the CNC machine will be highlighted with a blue outline, to help the user get started. Once the user has pressed one of the buttons, it will no longer highlight when it is needed later on. When the hand gets near the keyboard, it will automatically start to point the index finger. The user needs to touch the keys they wish to use by tapping the key with the pointed finger, they will not need to pull the trigger on the VR controllers.



When the user inputs a command using the keyboard, the actual G&M code that a real CNC operator would use will be shown on the screen above. This was done to keep the programming section simple and to avoid having the user use a full keyboard with several dozens of keys, which would be very difficult to do in VR. There is also a USB slot on the bottom right of the control panel that the user will need to insert a USB key during the final stage of the simulation.

**RUN:** This green button will run the enter commands if the doors to the CNC machine have been shut.

**CAL:** Calibrate the CNC machine to zero.

**SAFE:** This button is the safe startup command, and is a safe Machining practice that should be run at the beginning of every program.

**START:** This will spin the currently selected tool , allowing it to cut into the stock.

**STOP:** This will stop the currently selected tool from spinning.

**TOOL:** This button will allow the user to select which tool will be used during the program, it is used in conjunction with a number, which will refer to the tool that will be used.

**COOLANT:** This button is a toggle for the coolant spray, turning it on or off. It is used to keep the drill bit and stock from getting too hot.

**X and Y:** These three buttons are used to choose the location of the pallet. They can be used with the keypad to the right to set a location, for example if the user wishes to move the pallet to the bottom right location, they could enter X 9, Y 9.

**Z:** This button is used to set the height of the drill bit. It is used in conjunction with a number on the keypad, and it will move the drill bit up or down depending on which number is used.

**Number pad:** the number pad on the right side of the keyboard is used for selecting which tool will be used, and also setting the location of the pallet using the X & Y button or the drill bits height using the dead button.

### Specific Commands:

Below are the specific commands that the user must input in the following order during the first and second cut of the simulation. Below will be the button that they will need to press on the left, and on the right will be the G&M code that the user will see on the monitor.

#### Specific Commands Part 1:

<b>BUTTON</b>	<b>- G/M code</b>
SAFE	- G00 G90 G17 G40 G49 G54
CAL	- G00 X00 Y00 Z00
X 1 Y 9	- G01 X01 Y09
START	- M03
COOLANT	- M08
Z 9	- G1 Z09
X 9 Y 9	- G01 X09 Y09
X 9 Y 1	- G01 X09 Y01
X 1 Y 1	- G01 X01 Y01
X 1 Y 9	- G01 X01 Y09
Z 0	- G01 Z00
STOP	- M05
COOLANT	- M09

#### Specific Commands Part 2:

<b>BUTTON</b>	<b>- G/M code</b>
CAL	- G00 X00 Y00 Z00
X 1 Y 5	- G01 X01 Y05
START	- M03
COOLANT	- M08
Z 9	- G01 Z09
Z 6	- G01 Z06
X 9 Y 5	- G01 X09 Y05
Z 9	- G01 Z09
Z 0	- G01 Z00
STOP	- M05
COOLANT	- M09

**USB Key:** The USB key will be sent to the user from the on side programmer during the final section of the simulation the user will need to pick up the USB key from the workbench and place it into the USB slot on the control pendant. Once it has been placed into the control pendant, a full list of the commands on the USB key will appear on the monitor above the keyboard.



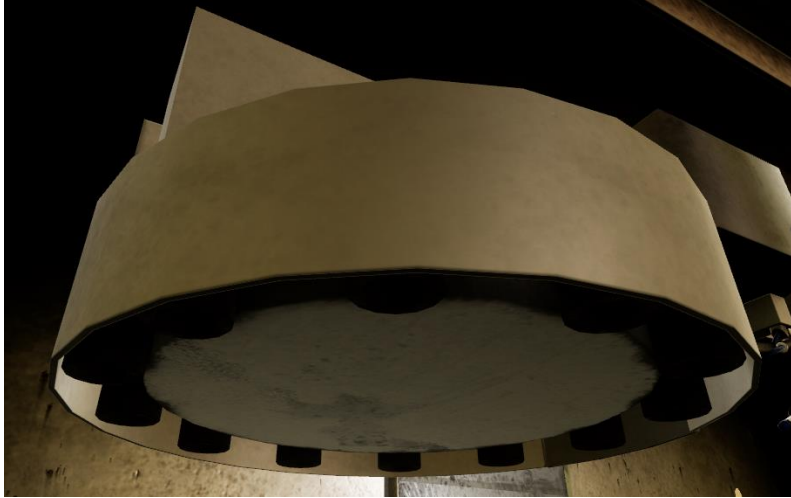
**Walkie-Talkie:** The walkie-talkie is located on the workbench. It is used to communicate with the on-site programmer and get a USB key with the final set of complex programming commands.



**Tool Rack:** The tool rack is located on the left side of The CNC machine. By default, there are six different tools that the user can select from the tool rack. These tools are labelled 1 through 6, and will be placed into the tool wheel of the CNC machine which is located inside of the machine on the top left.



**Tool Wheel:** The tool wheel is located on the inside and top left part of the CNC machine. There are three slots on the underside of the tool wheel that the user will need to insert tools. Once the tool has been placed into the tool wheel, it will snap into place. During the tutorial, there will be a hologram version of one of the tools to help show the user where it will need to go.



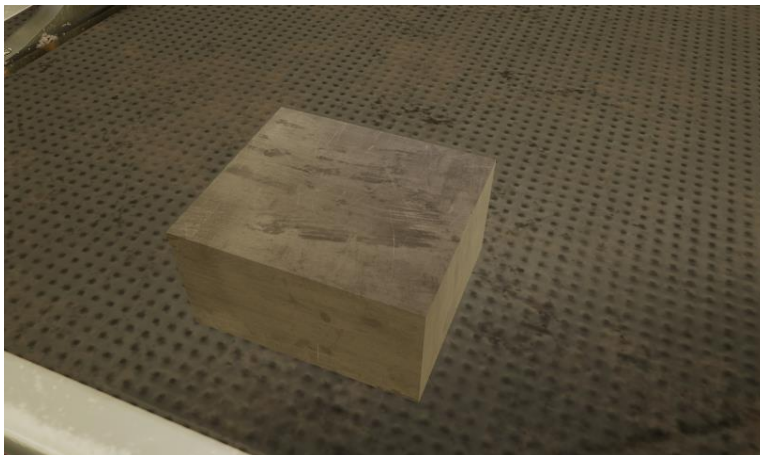
**Drilling Tools:** There are six different types of drilling tools that the user will need to select between for the simulation. They are all located on the tool rack. Each tool has a label on the middle section which displays a number between 1 and 6. The user will have to read over their design draft and check the first page to see which three tools they will need for the job.



**Airgun:** The airgun is located on the bottom right side of the CNC, just to the left of the control pendant. The airgun can be picked up by the user, and with their other hand tap the big red button on the back of the air gun to turn on the air spray. They can then point the air gun towards the debris that is located on the pallet inside the CNC machine, and blow the debris off into the garbage underneath. Once the user is finished with the airgun, they can put it back on the rack that is on the CNC machine.



**Stock:** The stock is the wrong metal that the user will be cutting into throughout the simulation. At the beginning of the simulation, it is located on the workbench behind the user. They can pick it up and place it into the face of the CNC machine, and then lock it while they're using this device handle. Once it is locked in place, the user will not be able to pick it up again until they grab the vise handle, put it back onto the vice and unlock it. The stock will be cut and shaped into a specific part using the different tools that the user will select at the beginning. At the end of the simulation, the user will need to remove the stock and place it on an inspection station to make sure that they had completed all of the cuts properly.



**Vice:** The vice is located inside the CNC machine on the pallet. The vice will hold the stock in place while it is being cut. To open the vice, the user will have to grab the vise handle from the workbench and place it onto the knob that is facing the user. They will then have to rotate the handle to be right if they wish to lock the vice and move it to the left if they wish to unlock the device. Once they have a locked or unlocked device, the user can grab the vise handle and pull it off removing it.



**Vise Handle:** The vise handle is located on the workbench. It is used to lock or unlock the vice. Once the vise handle has been placed on to the vice, rotating it to the right or clockwise will lock the vice and rotating it to the left or counterclockwise will unlock the vice. To remove the vise handle, grab it and pull it away from the vice and it will snap off.



**Inspection station:** The inspection station is located to the right of the workbench. the user can place the finished stock on to the inspection station and it will scan it to see if it was completed properly. If the user has followed the tutorial properly, the stock should have been completed properly and will flash green in the inspection station. If the stock was not cut properly or the user has tried to use the inspection station too early, it will flash red.



**Freeplay vs. Tutorial:**

In the tutorial, the narrator will guide the user through the multiple steps required to complete the piece. They will first be instructed on how to clean the machine of any debris. Then, they'll be told how to set up the CNC machine with the various tools required and get the stock into the correct place in the vise. Then, the user will be taught how to program the CNC machine to complete the various cuts. For the first set of cuts, The narrator will walk the user through each individual command that they will need to put into the machine. For the second set, they will have to figure out which commands will be the input based off of the design draft. For the third and final set of cuts, the user will need to insert a USB key from the on-site programmer which already has all of the commands written up. Once this is finished, the user will need to check their work in the inspection station.

In freeplay, the user will not have a narrator to guide them through the three different cuts they will need to complete. They will have to complete all three of these cuts on their own, only using the design draft to figure out what the correct commands are.