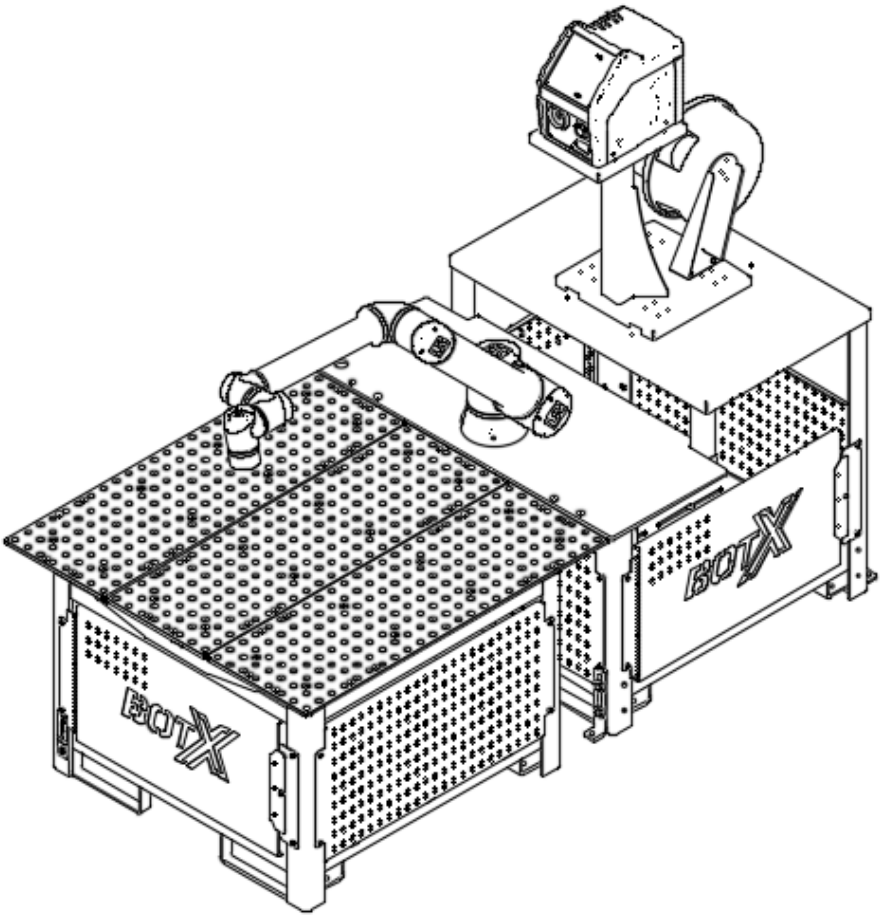
Operations and Owner's Manual

BotX™ XSR Robot Welding System



Forward

Thank you for renting, leasing, or purchasing the BotX XSR, a collaborative arc welding system. This system and its components were designed for safe usage in a production environment alongside people with the proper personal protective equipment as expressed in the safety section of this manual. It includes meeting current industrial standards of ANSI/RIA 15.06-2012 (ISO10218-2) specifications, employing force sensors that trigger an immediate stop of motion and arc.

The system includes a Universal Robots UR10e or UR20 robot and controller, OTC Welbee P400L II or P500L II and CM-743-U wire feeder including a welding torch, which are all housed in the Docking Station. The Docking Station can be used by itself or could include several welding tables that can be mechanically connected via the adapter plate to support multiple table manufacturers' designs.

Intended Use of this Equipment

The system's sole use is Gas Metal Arc Welding (GMAW) of steel, stainless steel and aluminum in a flat or horizontal position. It is also intended to be used in an indoor environment. It is equipped with levelers and anti-tip brackets that must be properly adjusted and deployed.

System users and/or owners need to take measures to safeguard people who work with the system, including those that might be in the general area. Red-D-Arc's risk assessment which can be found at the end of this manual outlines assumed hazards of operation, however it is the end user's responsibility to take all appropriate safety measures. Items that should be considered are tooling, fixtures, or other equipment that might be added after installation.

Rental and Lease customers are not allowed to move, change, or alter the system in any way, doing so could result in additional unforeseen safety hazards and equipment damage resulting in additional fees, including legal action as required.

Sale customers should not move, change, or alter the system in any way, doing so could result in additional unforeseen safety hazards and equipment damage resulting in loss of warranty.

Service or Support

Only qualified individuals should perform maintenance or service on the system. Red-D-Arc has a team of trained personnel located throughout Canada and the United States that can be contacted via the RDA APP or using the information below:

Botx-service@airgas.com
1-866-620-7737
www.botx-welder.com

Red-D-Arc

BOTX

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Section 1: Safety Information - READ BEFORE USING

Prior to using your BotX System it is important to keep your safety in mind. We have outlined where hazards can exist and what steps you can take to ensure a safe operating environment.

1.1 Symbol Usage

Danger! - Indicates a hazardous situation which if not avoided, will result in death or serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Electrical Shock - Indicates a hazardous situation which if not avoided, will result in death or serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Pinch Point - Indicates a hazardous situation which if not avoided, will result in a serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Arc Welding Hazards - Indicates a hazardous situation which if not avoided, will result in a serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Fire Hazard - Indicates a hazardous situation which if not avoided, will result in death or serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Cylinder Damage - Indicates a hazardous situation which if not avoided, will result in death or serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Noise - Indicates a hazardous situation which if not avoided, will result in a serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Welding Wire - Indicates a hazardous situation which if not avoided, will result in a serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Electrical and Magnetic Fields - Indicates a hazardous situation which if not avoided, will result in death or serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Hot Parts - Indicates a hazardous situation which if not avoided, will result in serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Buildup of Gases - Indicates a hazardous situation which if not avoided, will result in death or serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Fumes and Gases - Indicates a hazardous situation which if not avoided, will result in death or serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Lifting - Indicates a hazardous situation which if not avoided, will result in a serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

Slips, Trips and Falls - Indicates a hazardous situation which if not avoided, will result in a serious injury. The possible hazards are shown with further explanation and instruction to avoid the hazard.

1.2 Personal Protection Equipment

The use of personal protective equipment such as safety glasses, hearing protection, welding helmet, welding gloves, aprons, boots, jackets, leggings and shoe protectors and/or appropriate flame-retardant clothing are essential to your safety while using the welding systems. These PPE items will protect your eyes and body from arc flash, burns, noise and welding spatter.

Safety Glasses - Always wear them to avoid any eye injuries.

Welding Helmet - Always use when welding and follow the ANSI Z49.1 recommendations.

Work Boots - Always use when welding or operating the system, follow your company policy and choose the proper type and style.

Work Gloves - Always use and select the proper work glove to match the task being performed.

Hearing Protection - Always use hearing protection and comply with your company's policy regarding both the type and style.

Fire Extinguisher - Always keep one nearby and ready for use and know how to use it, follow your company's policy.

1.3 Arc Welding Hazards

Additional protection from the Welding Arc using a welding helmet properly fitted with the appropriate filter plate and/or electronic selection based on the ANSI Z49.1.

1.4 Hazards and Precautionary Measures

Electrical Shock - Avoid disassembly, modifications or maintenance of powered devices including Robot, Robot Control, Weld Power Source and Feeder.

Pinch Point - Avoid robot and wire feeder travel areas during operation.

Arc Welding Hazards - Avoid arc welding hazards by using a weld helmet with proper Lense selection.

Fire Hazard - Avoid having flammables within 33 feet of the welding arc, so that sparks and spatter do not ignite.

Cylinder Damage - Avoid excessive heat, mechanical shock and arcing on a cylinder. Cylinders should also not be used to hang items on or directly mounted without insulation from the welding area.

Noise - Avoid operating equipment without proper ear protection.

Welding Wire - Avoid handling of weld wire without proper PPE, be cautious when working with or in operations as cuts and punctures can happen.

Electrical and Magnetic Fields - Those people with a pacemaker should avoid being close to the weld equipment during operation, the equipment will generate a magnetic field affecting pacemaker operation.

Hot Parts - Avoid handling the robot, welding nozzle, tip, wire or processed parts that might be hot.

Buildup of Gases - Avoid welding in confined spaces or in poorly ventilated areas, add ventilation or use respiratory equipment.

Fumes and Gases - Avoid placing your head in the fumes and gases, add ventilation or respiratory equipment.

Lifting - Avoid lifting heavy objects and awkward positions while lifting and moving.

1.5 Principal Safety Standards

The following standards were used to develop this manual to ensure safe use of the equipment. It is recommended to review them to develop a robust safety plan in accordance with them.

Agency	Standard	Description
American National Standards	ANSI Z49.1:2005	Safety in welding & cutting
American National Standards	ANSI RIA R15-06-2012	Robot & Systems safety requirements
American National Standards	RIA TR R15.606-2016	Collaborative robot & system safety requirements
American National Standards	RIA TR R15.806-2018	Testing for power & force limited collaborative robots
American National Standards	B11.0-2023	Safety of Machinery
American Weld Society	AWS D16.3M/D16.3:2017	Risk Assessment Guide for Robotic Welding
American Weld Society	AWS F1.1M:2018	Methods for sampling Fume for welding & cutting
International Standard	ISO 10218-1	Safety requirements for industrial robots
International Standard	ISO 10218-2	Safety requirements for robots and integration
International Standard	ISO TS/15066	Collaborative robots
National Fire Protection	NFPA 70E	Standard for electrical safety in workplace
National Fire Protection	79-18A	Electrical standard for industrial machinery
OSHA	OSHA Tech. Manual	Industrial Robot Systems and Industrial Robot System Safety
OSHA	3071	Job Hazard Analysis
Robotic Industries Assoc.	TR R15.306-2016	Task Based Risk Assessment Methodology

Note: The codes and regulations listed may be improved or eliminated, always refer to the updated codes and regulations.

1.6 California Proposition 65 Warnings

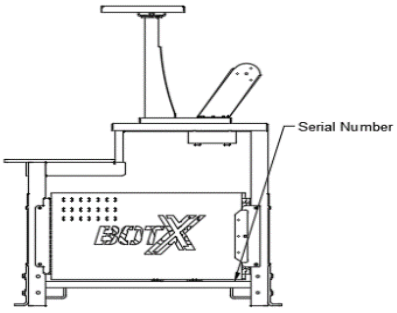
At the time this manual was created there were no listed warnings in regard to proposition 65 from any of the manufacturers of the equipment provided.

Section 2: Product Specification and Configuration

2.1. Equipment Identification

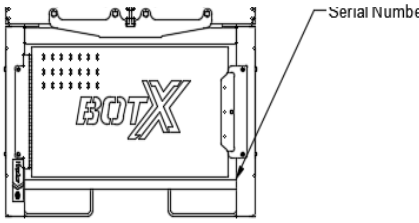
Docking Station

Serial Number is located at the bottom right corner of the docking station when facing the power source control panel.



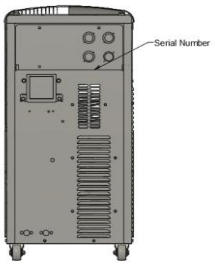
BotX Table(s)

Serial Number is located at the bottom right corner of the docking station when facing the power source control panel.



OTC Power Source

Serial Number is located on the rear of the power source.



OTC Wire Feeder

Serial Number is located on the rear of the Wire Feeder.

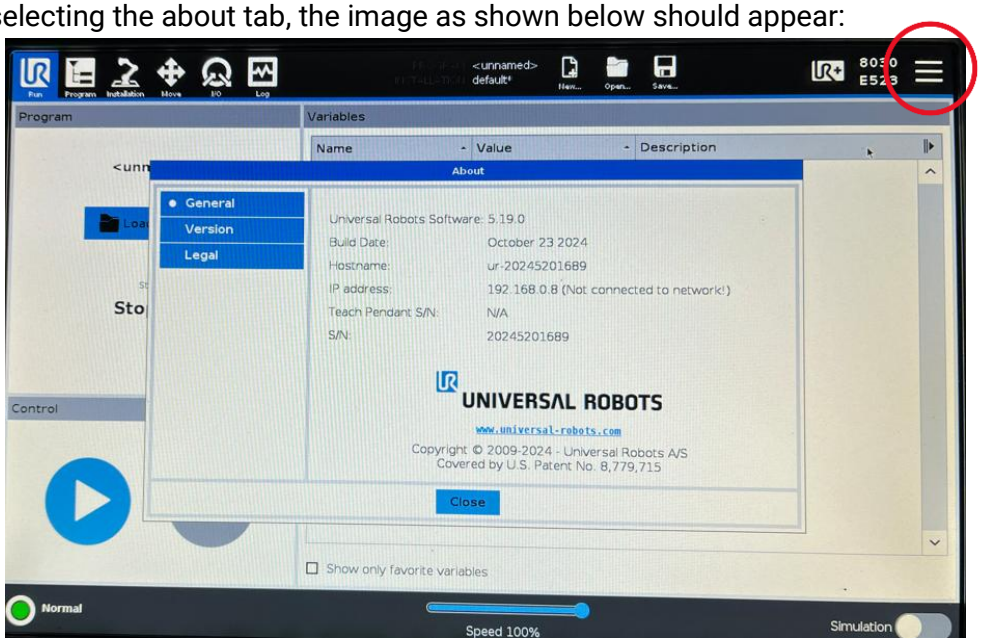
Universal Robot

Serial Number is located on the lower portion of the first arm.

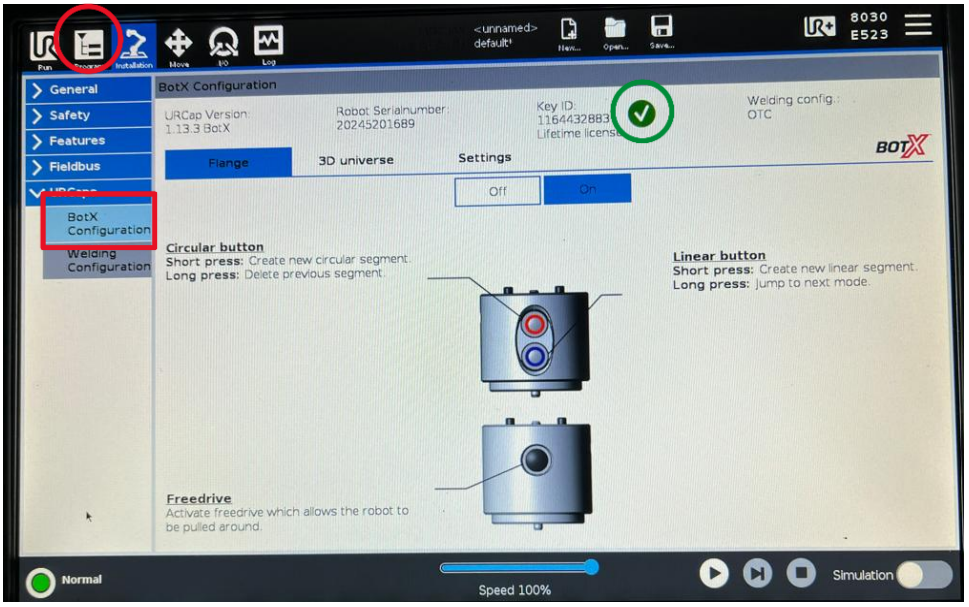
2.2 Licensing Information

There are two forms of software included with your system, the base software (Polyscope) and the added UR Cap (BotX) that controls the welding features.

Polyscope information can be found by clicking the Hamburger menu top right corner and selecting the about tab, the image as shown below should appear:



The UR Cap (BotX) can be found by clicking on the Installation tab in the top left side of the menu. Then select the UR Caps as shown below:



There is other useful information shown on this tab, including robot serial numbers, Key ID and welding configuration.

Indicates a successful installation of the BotX UR Cap via a dongle key.

2.3. Equipment Specifications

OTC Feeder

Model		CM-743-U
Applicable wire size	inch	(.030"), .035", .040", .045", (.052"), (1/16")
	mm	(0.8), 0.9, 1.0, 1.2, (1.4), (1.6)
Wire feeding rate		Max. 866.4 ipm [22m/min]
Applicable wire reel	Shaft diameter	1.97"Ø [50mmØ]
	External diameter	Max. 11.8"Ø [300mmØ]
	Wide	4.05" [103mm]
Mass of applicable wire		Max. 55.1 lbs [25kg]
Temperature range		14 ~ 104 ° F (-10 ~ 40 °C)
Moisture range		20% ~ 80% (no condensation)
Storage temperature range		14 ~ 140 ° F (-10 ~ 60 °C)
External dimensions (WxDxH)		10.00" x 24.06" x 15.47" (254mm x 611mm x 393mm)
Storage moisture range		20 ~ 80% (no condensation)
Mass		33.3 lbs [15 kg]

OTC Power Source

Specification/ Model/Welding method	Welbee P400L II								Welbee P500L II			
	DC	DC PULSE	DC TIG	DC STICK	DC	DC PULSE	DC TIG	DC STICK	DC	DC PULSE	DC TIG	DC STICK
Model	WB-P402L								WB-P502L			
Number of phase	Three phase				Single phase				Three phase			
Rated frequency	50/60 Hz											
Rated input voltage	208/230 V 460 V				208/230 V				460 V			
Input voltage range	208/230 V ± 10 % 460 V ± 10 %				208/230 V ± 10 %				460 V ± 10 %			
Rated input	20.1kVA, 18.6 kW (*1) 21.0kVA, 19.2 kW (*2)				13.4 kVA, 10.1 kW				25.4 kVA, 23.1 kW			
Rated input current	56.2/50.4 A (*1) 26.3 A (*2)				56.3/50.1 A				31.7 A			
Rated output current	400 A			300 A	250 A	200 A	250 A		500 A	400 A		
Rated load voltage	34 V		26 V	32 V	26.5 V	24 V	20 V	30 V	39 V	34 V	26 V	36 V
Maximum no-load voltage (*3)	73/79 V (*1) 70 V (*2)				73/79 V				92 V			
Rated duty cycle	60%	50%	60 %	80 %	60%	40%	60 %		60 %	80 %	100 %	
Number of welding condition	100											
Temperature rise	+320 °F (+160 ℃)											
Operating temperature range	+14 to +104 °F (-10 to 40 ℃)											
Operating humidity range	up to 50% at 104°F (40 ℃), up to 90% at 68°F (20 ℃)											
Storage temperature range	-4 to 131 °F (-20 to 55 ℃)											
Storage humidity range	up to 50% at 104°F (40 ℃), up to 90% at 68°F (20 ℃)											
External dimensions (W×D×H)	15.6" × 28.0" × 31.9" (395 mm × 710 mm × 810 mm) (w/o eyebolt)											
Mass	178.5 lbs (81 kg)								178.6 lbs (81 kg)			
Static characteristic	Constant voltage characteristic		Constant current characteristic		Constant voltage characteristic		Constant current characteristic		Constant voltage characteristic		Constant current characteristic	
IP Rating	IP23											

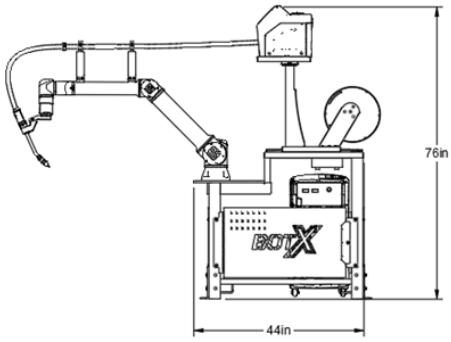
*1: Rated input voltage is 208/230 V.

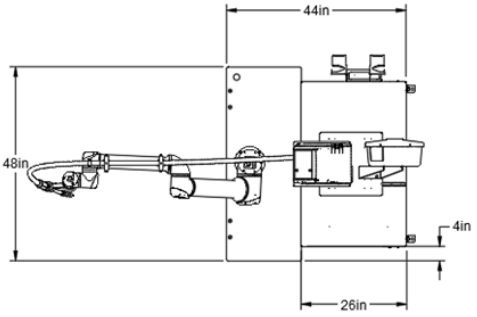
*2: Rated input voltage is 460 V.

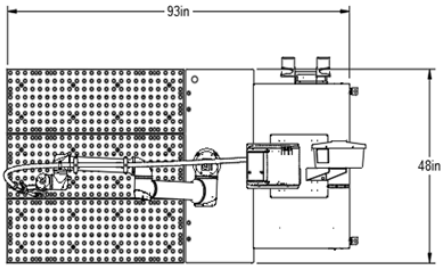
Universal Robot

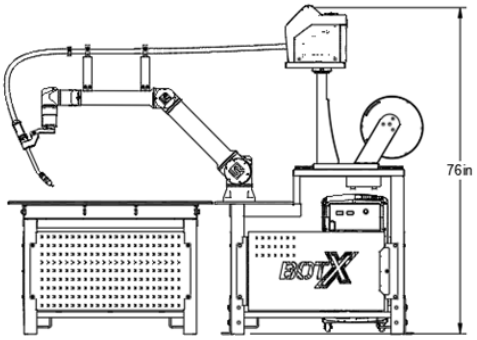
Robot type	UR10e
Robot weight	33.3 kg / 73.5 lb
Maximum payload	10 kg / 22 lb or 12.5 kg / 27.5 lb (3 Mechanical Interface on page 38)
Reach	1300 mm / 51.2 in
Joint ranges	± 360 ° for all joints
Speed	Base and Shoulder joints: Max 120 °/s. All other joints: Max 180 °/s . Tool: Approx. 1 m/s / Approx. 39.4 in/s.
System update frequency	500 Hz
Force Torque sensor accuracy	5.5 N
Pose repeatability	± 0.05 mm / ± 0.0019 in (1.9 mils)per ISO 9283
Footprint	Ø190 mm / 7.5 in
Degrees of freedom	6 rotating joints
Control Box size (W × H × D)	460 mm × 449 mm × 254 mm / 18.2 in × 17.6 in × 10 in
Control Box I/O ports	16 digital in, 16 digital out, 2 analog in, 2 analog out
Tool I/O ports	2 digital in, 2 digital out, 2 analog in
Tool Communication	RS
Tool I/O power supply & voltage	12 V/24 V 2 A (Dual pin) 1 A (Single pin)
Control Box I/O power supply	24 V 2 A in Control Box
Communication	TCP/IP 1000 Mbit: IEEE 802.3ab, 1000BASE-T Ethernet socket, MODBUS TCP & EtherNet/IP Adapter, Profinet
Programming	PolyScope graphical user interface on 12" touchscreen
Noise	Robot Arm: Less than 65dB(A) Control Box: Less than 50dB (A)
IP classification	IP54
Cleanroom classification (overall for model)	Robot Arm: ISO Class 6, Control Box: ISO Class 6
Power consumption (average)	615 W
Power consumption	Approx. 350 W using a typical program
Short-Circuit Current Rating (SCCR)	200A
Collaboration operation	17 advanced safety functions. In compliance with: EN ISO 13849-1, PLd, Cat.3 and EN ISO 10218-1
Materials	Aluminium, PC/ASA plastic
Ambient temperature range	The robot can work in an ambient temperature range of 0-50 °C
Control Box power source	100-240 VAC, 47-440 Hz
TP cable: Teach Pendant to Control Box	4.5 m / 177 in
Robot Cable: Robot Arm to Control Box (options)	Standard (PVC) 6 m/236 in x 13.4 mm Standard (PVC) 12 m/472.4 in x 13.4 mm HiFlex (PUR) 6 m/236 in x 12.1 mm HiFlex (PUR) 12 m/472.4 in x 12.1 mm

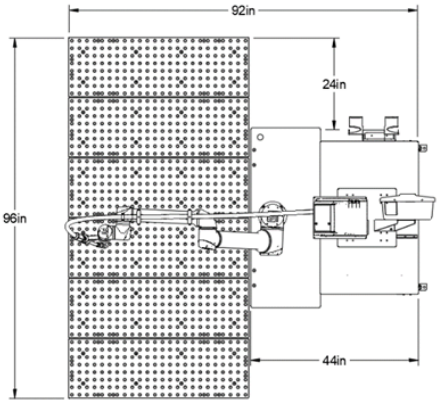
2.4 Equipment Layouts and Dimensions

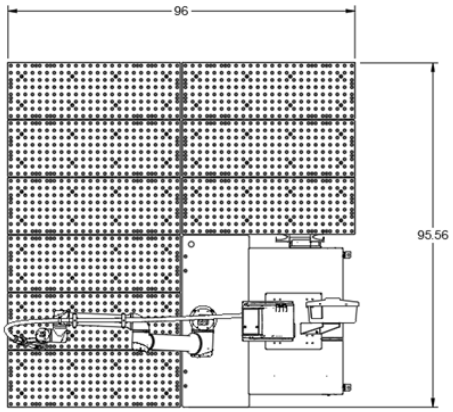












Section 3: Installation

3.1 Transportation of System

The Docking Station and Weld Table/s were designed to move by either forklift or pallet jack. Carefully lift and place the Docking Station or Table the location of your choice using the information found below.

3.2 Installation Environment

Careful consideration should be used prior to final placement of the system, understanding it has some specific operational needs. The system should be placed inside away from debris, extreme temperatures and wet areas. Leaving 36” all around for both operational and maintenance purposes. The operating temperature range should be between 32 - 122 degrees Fahrenheit. Understanding its main purpose is welding, keeping the area clear and free of combustibles is the best practice. All the equipment is electrical and keeping it away from damp or wet areas to ensure both operational and users’ safety.

3.3 System Inspection

Once the system and equipment arrive it is best just to inspect the packaging to see if any damage was done during freight. If damage is noticed, please contact your local contact and let them know. Do not attempt to unpackage the system or equipment, the installation team is responsible for unpacking, set-up and training. They are equipped with the proper tools and training to ensure a smooth and safe transition into operations.

NOTE: Robot mounting requires a torque specification and can be damaged if over torqued during the assembly process. Even if the system shipped with robot on, we still check to ensure it is in the specified torque range.

3.4 System Leveling

The Docking Station and Weld Tables come with adjustable floor levelers and for floor or rail mounting additional brackets are used for anti-tip or anchoring purposes.

3.5 Electrical Service Guide

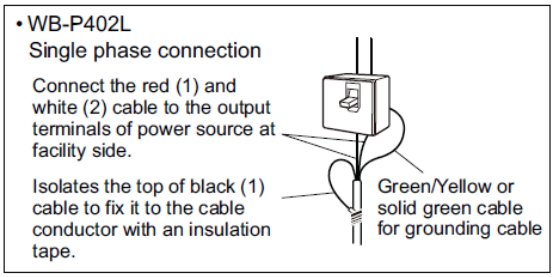
The onsite installer will ensure that all other connections are made correctly and according to specification.

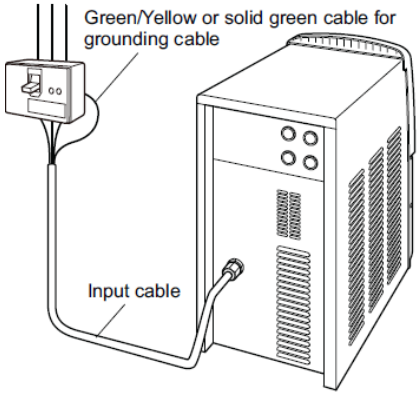
NOTE: The end user is responsible for connecting the equipment to their electrical system. Since we are unaware of incoming power or type of conductor used, we do not provide a plug on the pigtail of the welding power source.

Connecting 1- Phase or 3-Phase Input Power

The image below shows the proper method for connection. Best to use a **voltage tester** prior to touching any equipment. The welder cover will become hot, and it is a good indication that it is wired incorrectly.

NOTE: Please ensure incoming power has been turned off at the disconnect.



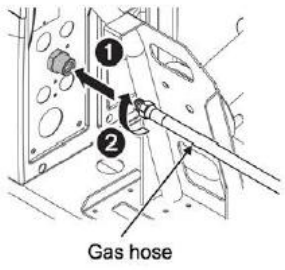


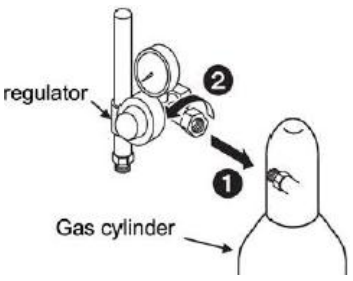
Connecting 120VAC Input Power

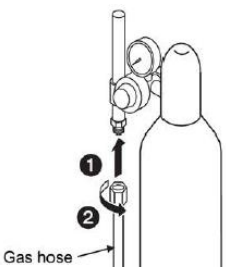
Simply plug in the robot controller to a standard 120 VAC outlet.

3.6 Connecting Weld Shielding Gases

1. Connect the supplied gas hose to the backside of the feeder.
2. Connect the supplied gas regulator to the cylinder, if not equipped with a built-in regulator.
3. Connect the gas hose to the regulator.





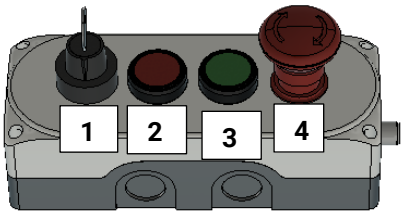


Section 4: Controls and Safety Devices

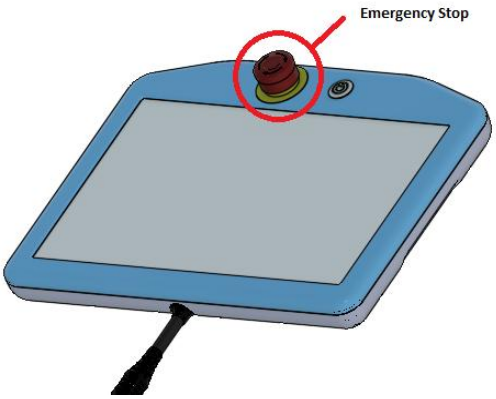
4.1 Operations Box with Emergency Stop

All BotX systems are equipped with an operations button box. This Operations button box should always be within reach of the operator allowing for the safe enabling/disabling of the BotX system quickly if needed.

1. Key Switch to enable/ disable the arc: allowing for simulation without welding.
2. Stop button: used to stop the program in all non-emergency situations.
3. Start button: used as a safe redundant start command.
4. Emergency Stop button: **This should be used in emergency situations only.**



4.2 Robot Teach Pendant with Emergency Stop



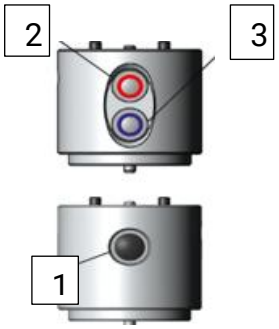
NOTE: Universal Robots that are shipped with a BotX system are packaged with a Universal Robots Teach Pendant. At the top of the Teach Pendant is another Emergency Stop Switch. **This should only be used in emergency situations.** Just like the E-stop on the operations button box: When this button is depressed it causes a stop condition. This is a controlled stop that involves quickly bringing the robot to a stop followed by the removal of power.

4.3 Stack Light with Horn

Mounted on the left side of the docking station is a 4-segment stack light with an audible horn. This stack light will indicate 3 different states of the machine by color:

1. **Red:** Indicates that there is a fault.
2. **Yellow and Red flashing:** Indicates that the robot is in motion.
3. **Blue Flashing:** Indicates that it is in a "Ready" state, however it is not actively playing a program and there is no error or warning active.
4. **Horn:** Is an audible feature used to indicate that the robot is about to start welding.
   "The horn activates twice before initiating the arc "

4.4 Torch Mounted - BotX Tool



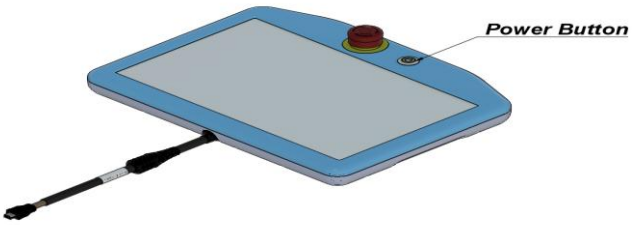
The BotX Tool attaches the end of the UR arm, mounted between the arm and the torch adapter. The tool has three buttons to be used by the operator to simplify teaching of the program.

1. **Black Button:** This is the free drive button: when pressed it allows the operator to manually manipulate the arm to the desired position. It is worth noting that as the robot approaches its limits (joint or special) the arm begins to stiffen/ create a repelling force.
2. **Red Button:** a short press of the red button is used to teach circular way points (see Section 6-3) as well as to teach tack points (see section 6-4). It can also be used to delete previous points as well: a long press of the red button will delete the last node.
3. **Blue Button:** Apart from teaching tack welds, the blue button will record a linear move (see section 6-2), while teaching tack welds the blue button will create an air move to avoid obstacles as described in section 6-4.

Section 5: System Operation Precheck

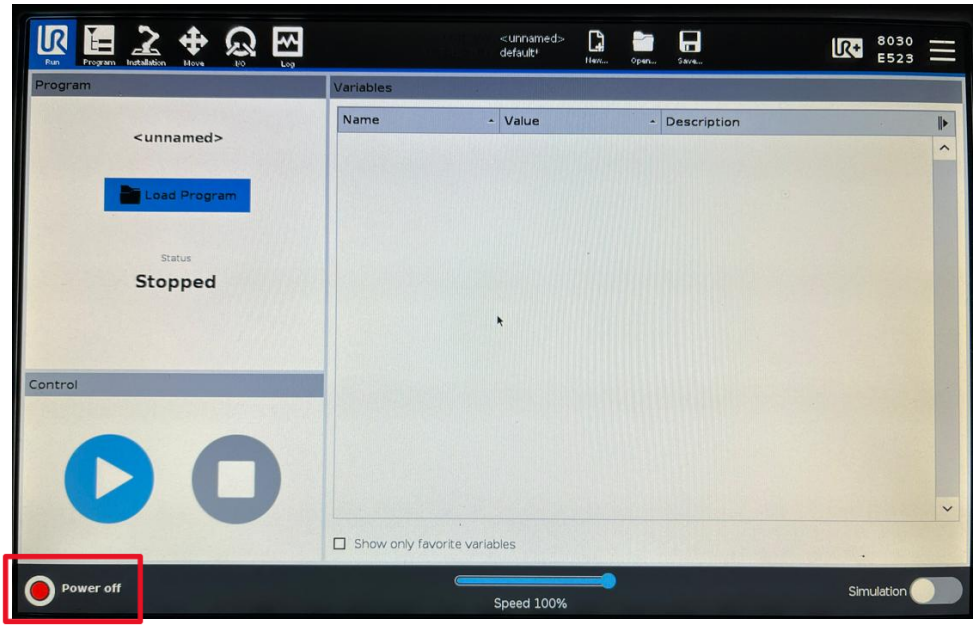
5.1 System Powering Up

1. On your Teach Pendant, press the **power button** to turn on the control box.

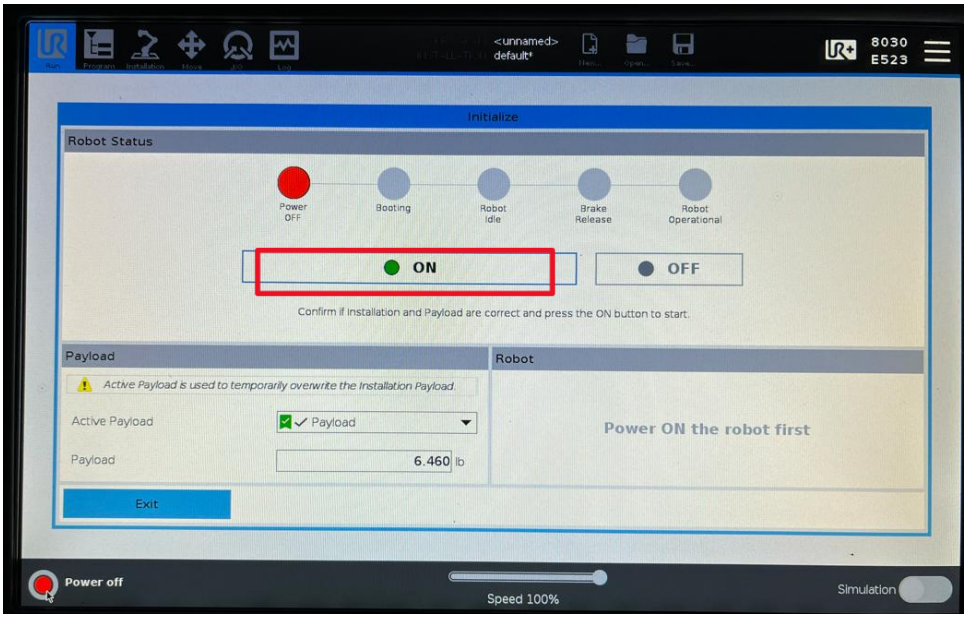


NOTE: It may take a few minutes to load up the Polyscope software.

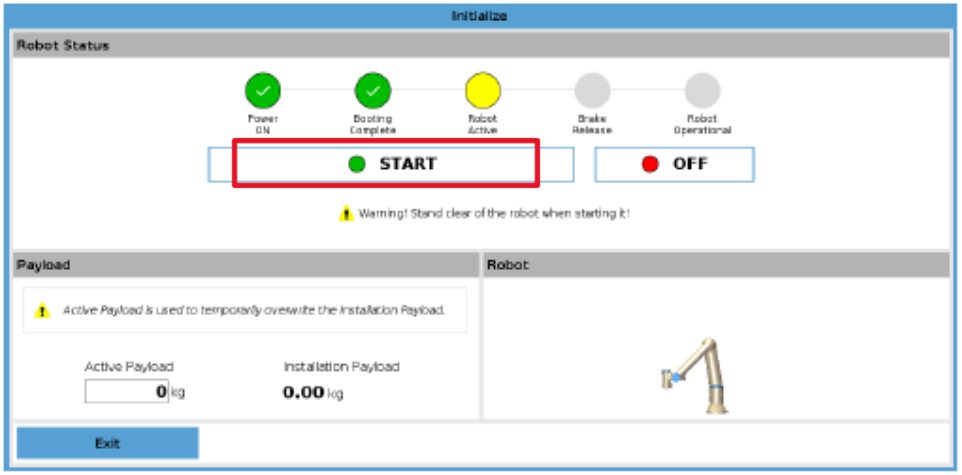
2. Select or press the **Power-Off button** to power on robot as shown in the image below:



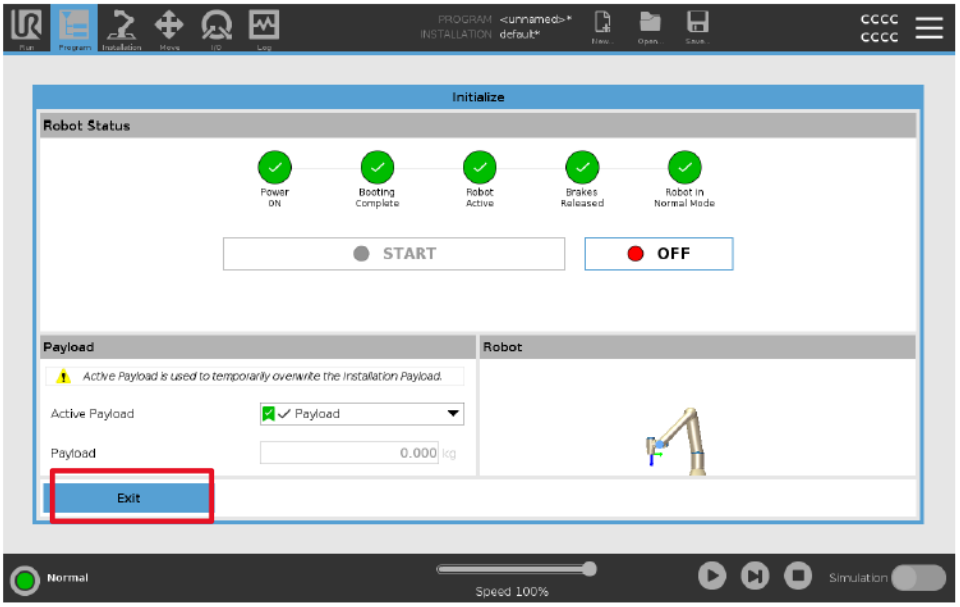
3. Select or press the **ON** tab on the screen as shown below:



4. Once the robot is activated as shown below, you will need to press the **START** tab.
NOTE: Stand clear of the robot



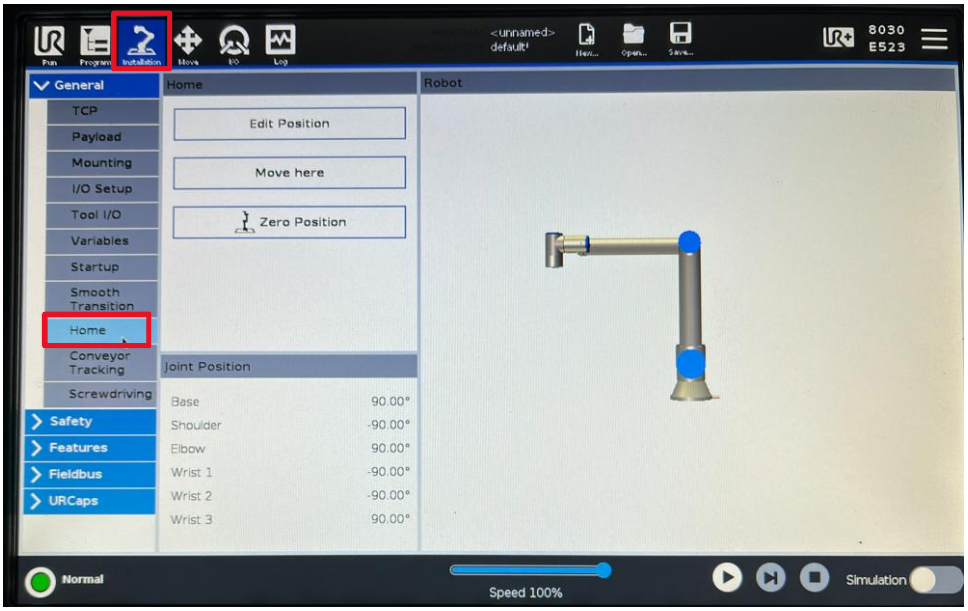
5. Once the unit is fully powered you can select the **EXIT** tab on the lower left corner of the pendant as shown below:



6. Turning on the **Weld Equipment** by moving the switch in an upwards motion at the location shown below:

5.2 Home Position Review

1. On the title bar, click on the **INSTALLATION** tab and select general, then select **HOME**.



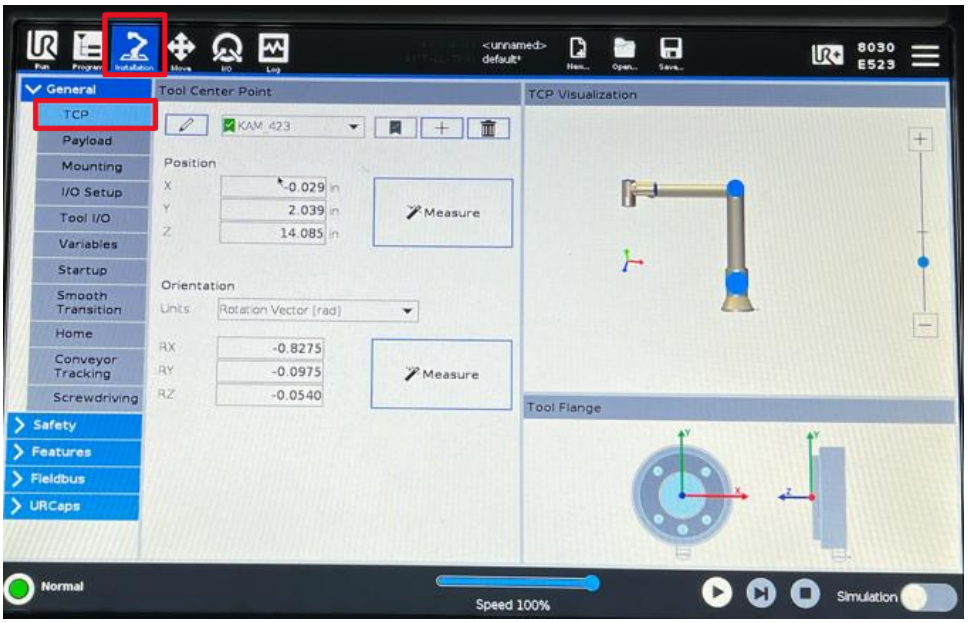
NOTE: This item is preset during integration, it is good to check and record those numbers.

Base:	90.00
Shoulder:	-90.00
Elbow:	90.00
Wrist 1:	-90.00
Wrist 2:	-90.00
Wrist 3:	90.00

NOTE: You can use the Home Position to define a Safe Home Position. These are pre-set during the integration process as shown above, however if needed the user may change these settings as needed. If changed it is good to record those numbers for future reference.

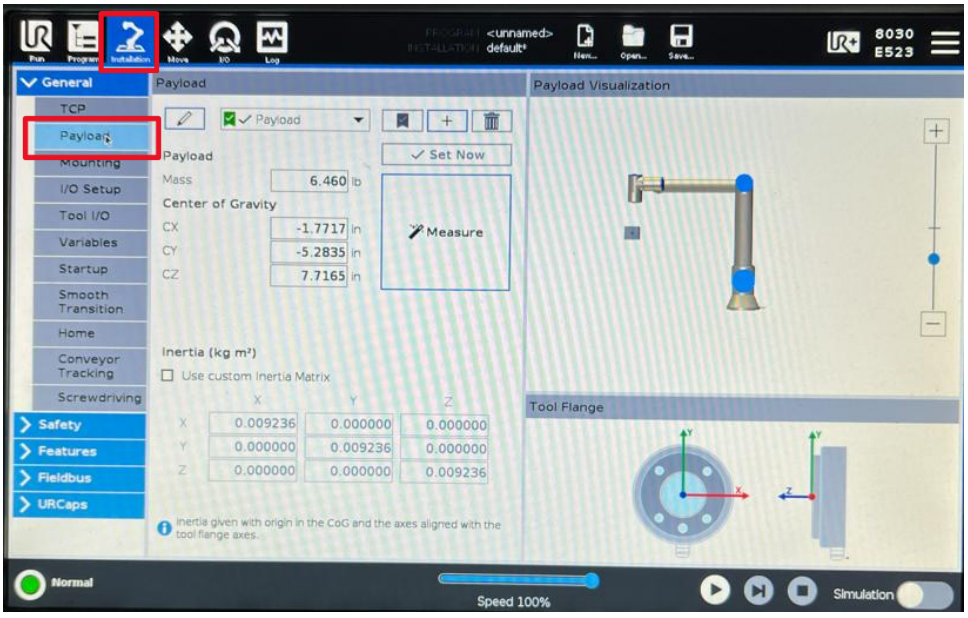
5.3 Check Tool Center Point

NOTE: This item is preset during integration, it is good to check and record those numbers.



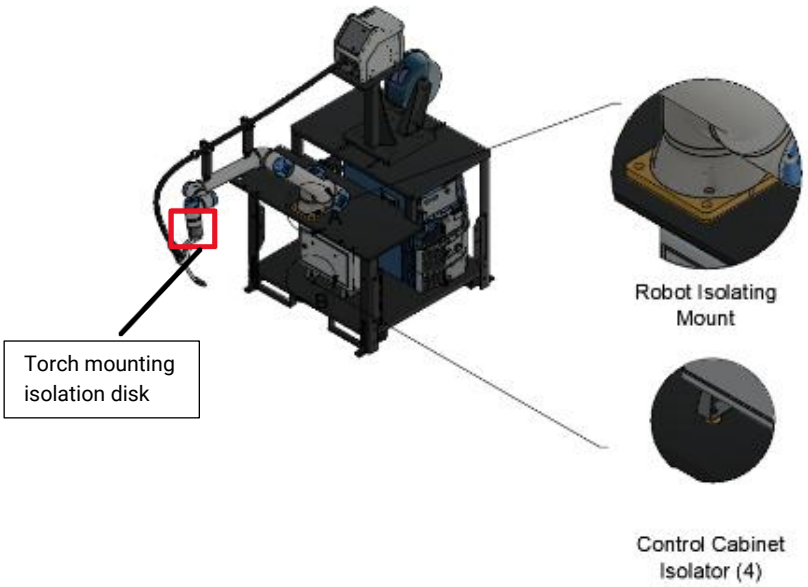
5.4 Payload

NOTE: This item is preset during integration, it is good to check and record those numbers.



5.5 Equipment Isolation points

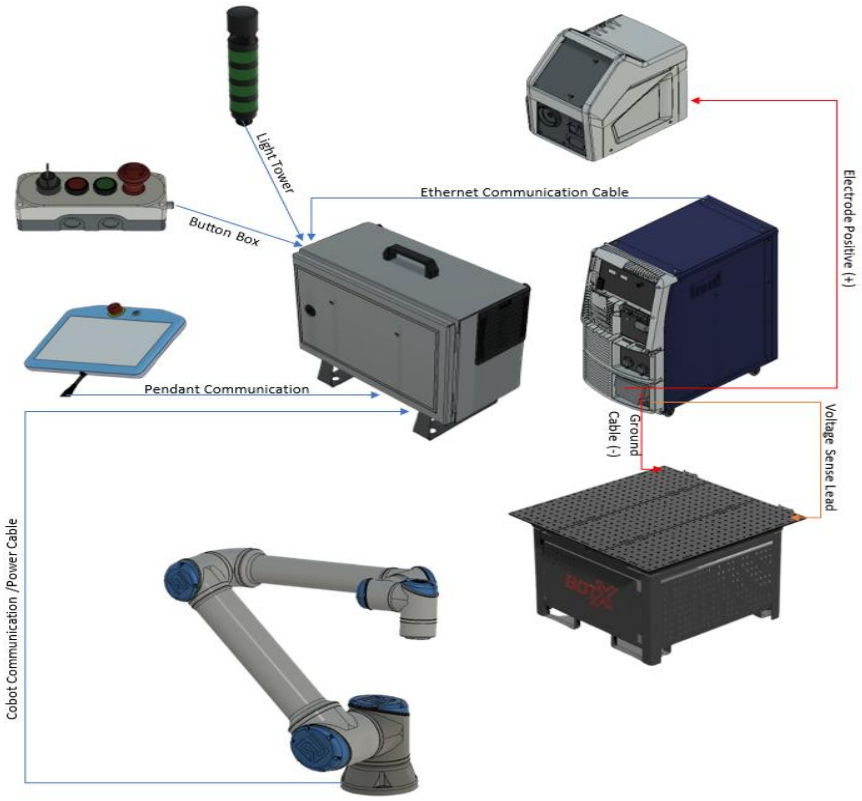
The robot, controller and torch all have added isolation devices added to ensure those items are isolated from the electrical magnetic fields. These are important as without them it could result in system failure.



5.6 Welding Gas Cylinder Mounting

Correct mounting of welding gas cylinders is important as these cylinders contain extremely high pressures. Using the mounting plate isolates them from the welding current and/or a chance to arc or damage that may lead to an explosion.

5.7 Equipment Connections Overview



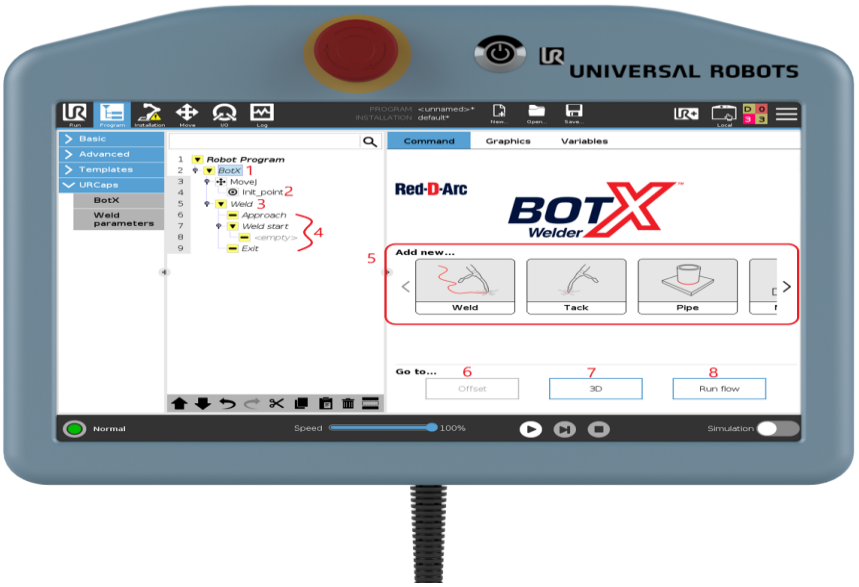
Section 6: Programming

6.1 BotX URCap Software Overview

This section is to provide an overview of the BotX URCap software used to program your fabricated assemblies.

The BotX URCap uses the following structure:

1. BotX node: which is the **Home Page** for programming robotic arm motion and weld segment types.
2. Init_point: which is the **start** for the program.
3. One or more **weld segments**.
4. Child nodes for the waypoints of the weld segment
5. Weld segments: are used to teach the system how to approach, how to travel through, and how to leave a weld. Weld segments have different names such as weld, pipe, tack, and multi-pass. Programming each of these weld segments is explained further in this section.



a. **Weld:** General purpose welding program template. Usually used for single-pass welding consisting of one or more sequential linear/circular welding segments.
b. **Tack:** Creates a new tack node which can be used to tack points on the workpiece. See section 6-8 for more details.
c. **Pipe:** Creates a template for a full-circle pipe weld but can also be modified to any weld item that contains a pipe. See section 6-7.
d. **Multipass:** Creates a Multipass template. See section 6-10.
e. **Touch Sense "Bump":** Creates a new touch node to automatically correct the welds that follows. See section 6-11 for more details.

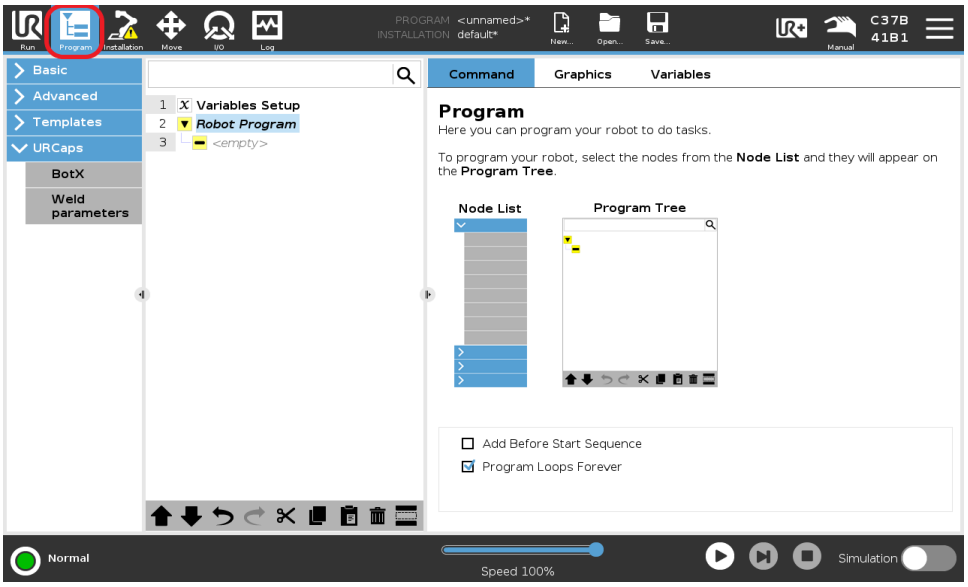
6. **Offset:** Offers moving/rotating and/or copying existing weld(s). Please note that this feature is only active when all points in all welds are set.

7. **3D:** Opens the 3D viewer universe of BotX Tool, where all active welds are visualized in 3D. It is also possible to make small adjustments directly from the 3D universe. See section 6.19.

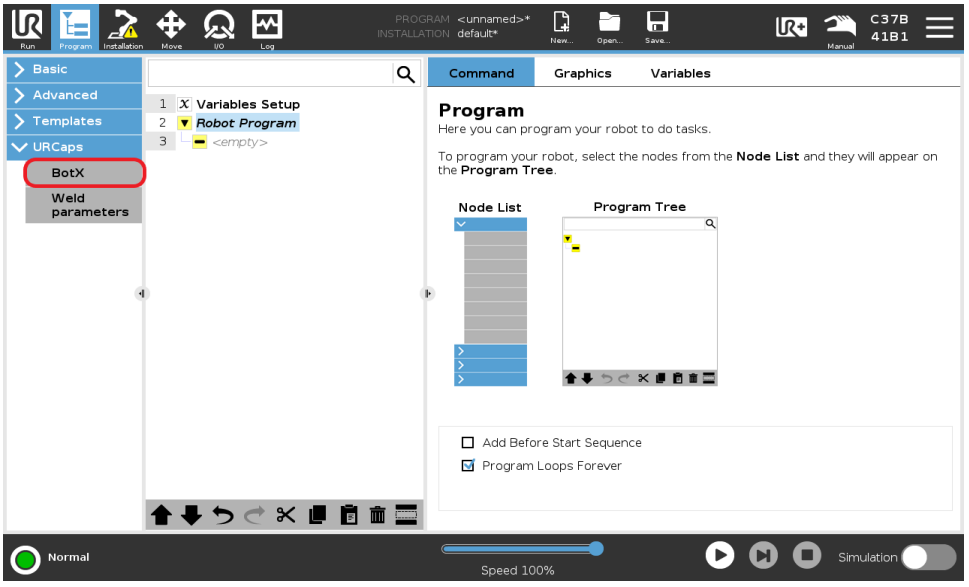
8. **Run flow:** Control the program execution flow, see more below in section 6.22.

6.2 Creating a New Program

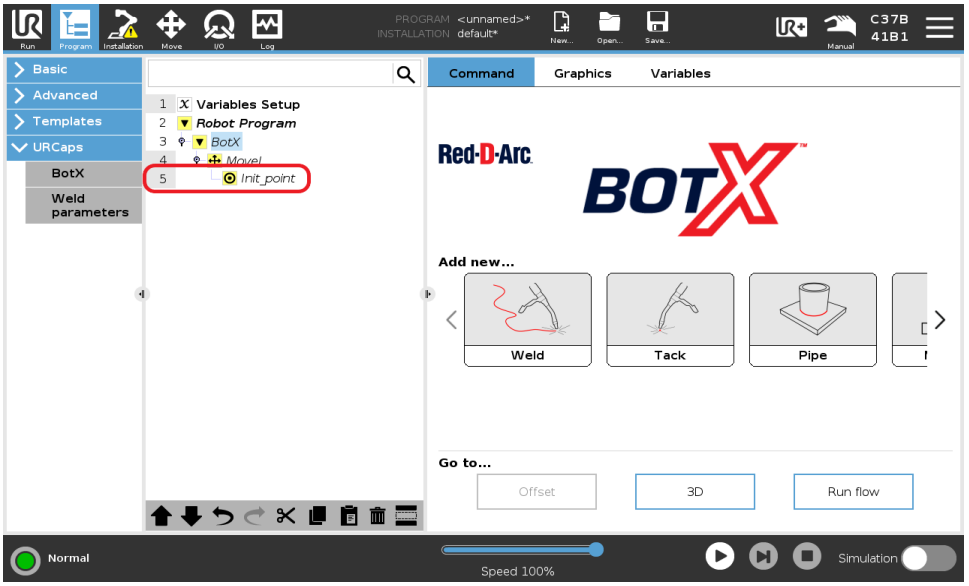
1. Select the **Program** tab.



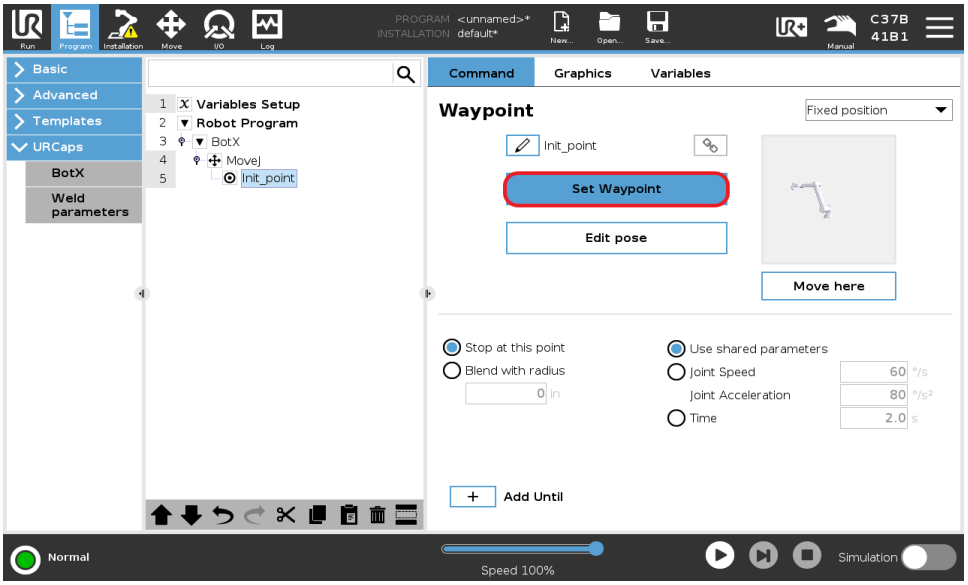
2. Select **URCaps > BotX.**

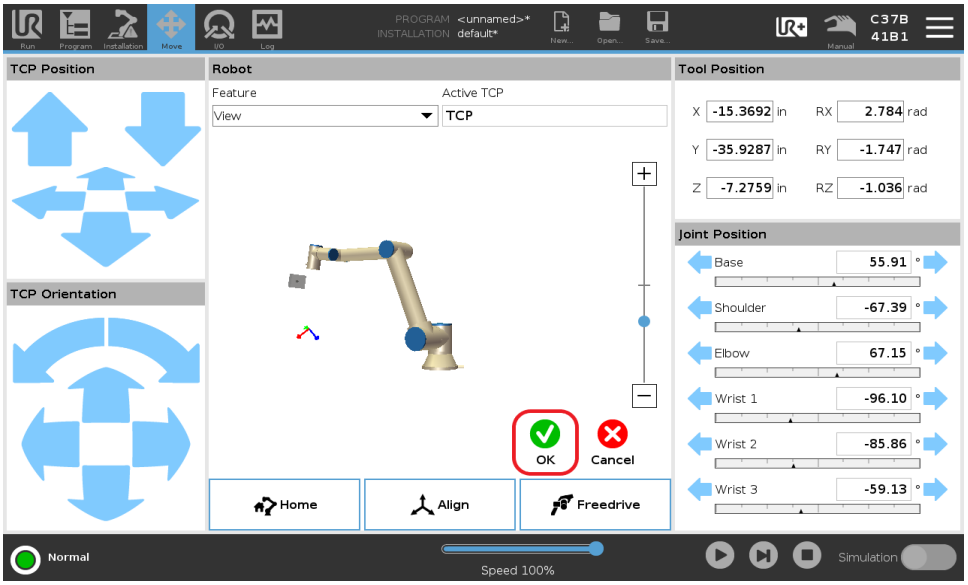


3. Select the yellow **Init_point** node.



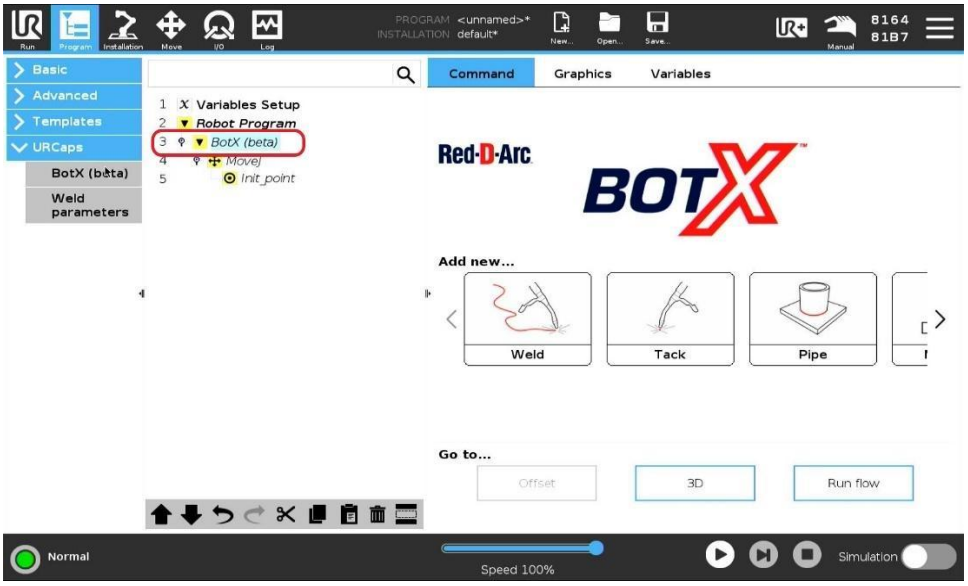
4. Move the arm to the desired **Init_point** location. This point will act as the starting location for the program. **Set** the point by selecting **Set Waypoint** on the UR pendant > **OK.**



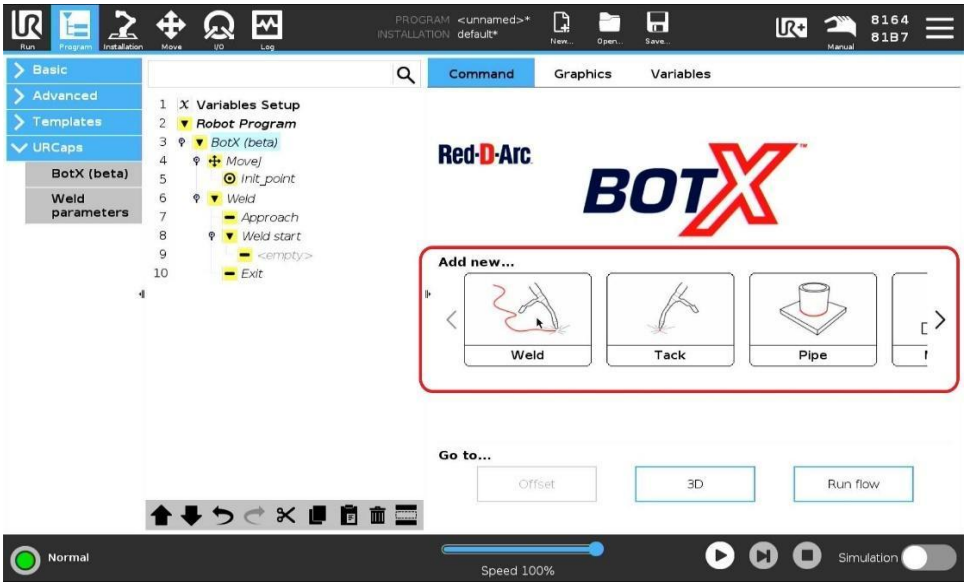


6.3 Add New Weld Sequence

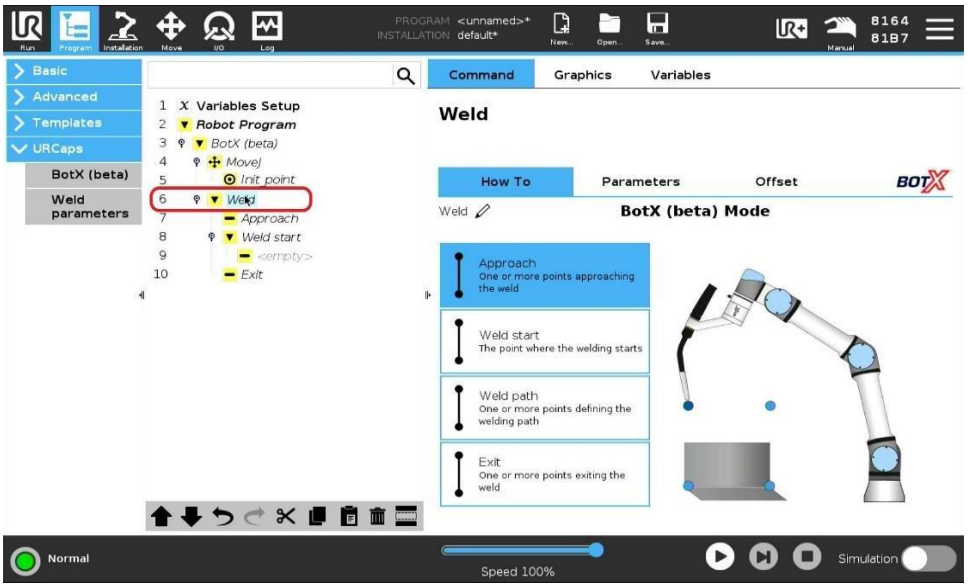
1. Select the **BotX Node** in the program tree.



2. Select **Weld** and a new weld segment will appear at the bottom of the program tree.



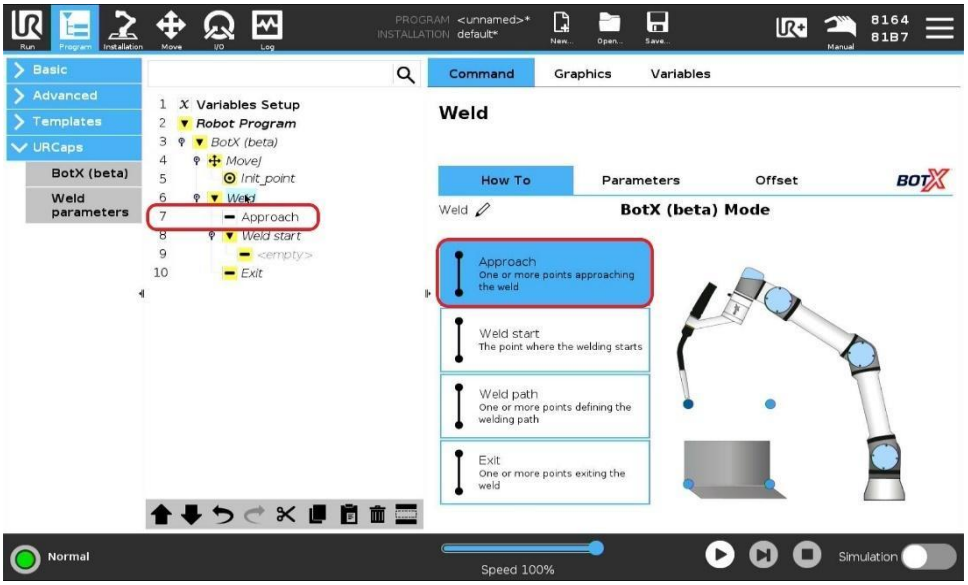
3. Select the **yellow Node** in the segment allowing the weld page to open in the right-side menu.



4. Select the **Approach** box on the right-hand side menu.

Physically move the arm to the location of the approach point desired.

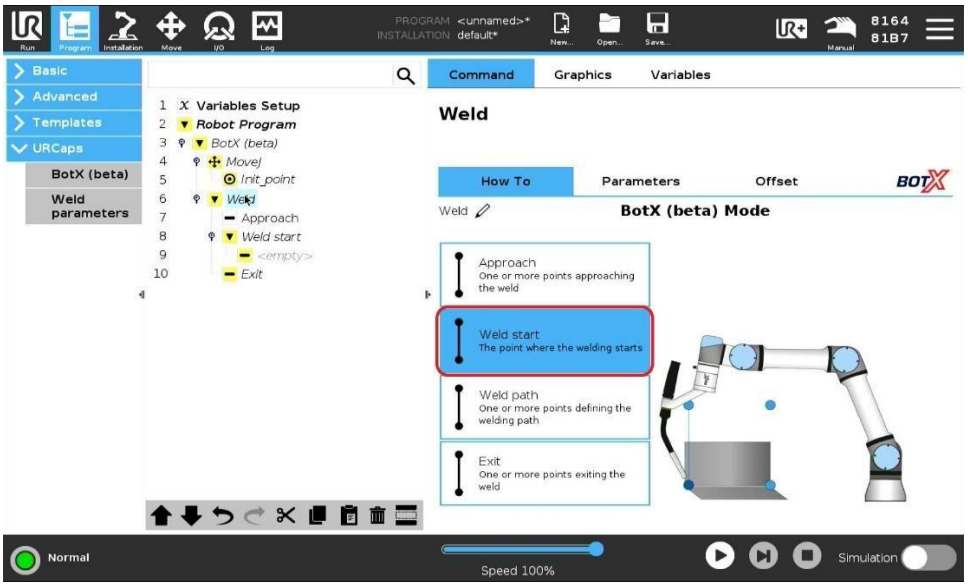
Press the quick flashing **Blue Button** to capture the waypoint location. The yellow Approach node in the program tree will be **White** when saved.



5. Select the **Weld Start** box on the right-side menu.

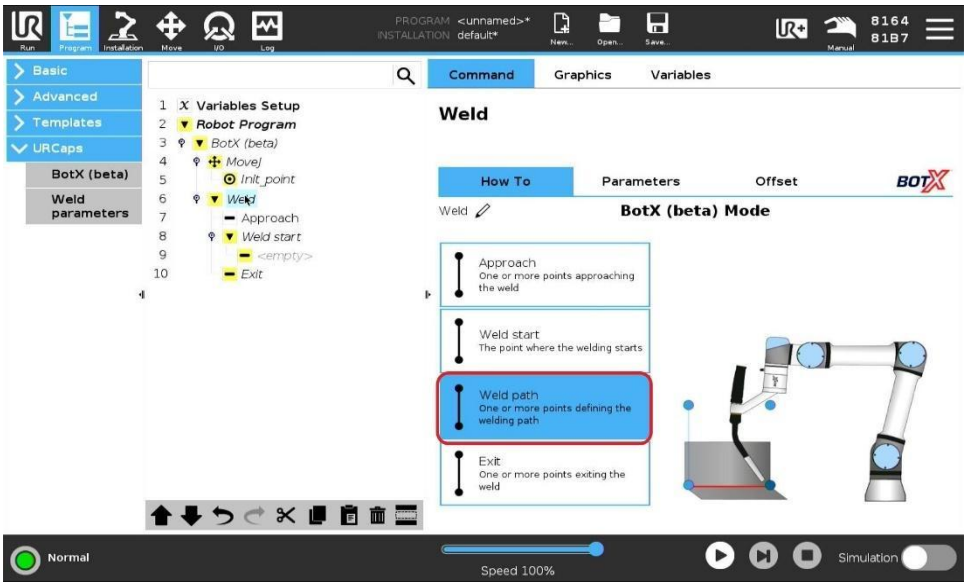
   Physically move the arm to the desired weld start position.

   Press the quick flashing **Blue Button** to capture the waypoint location.
   Note: The Weld Node will remain Yellow when saved.

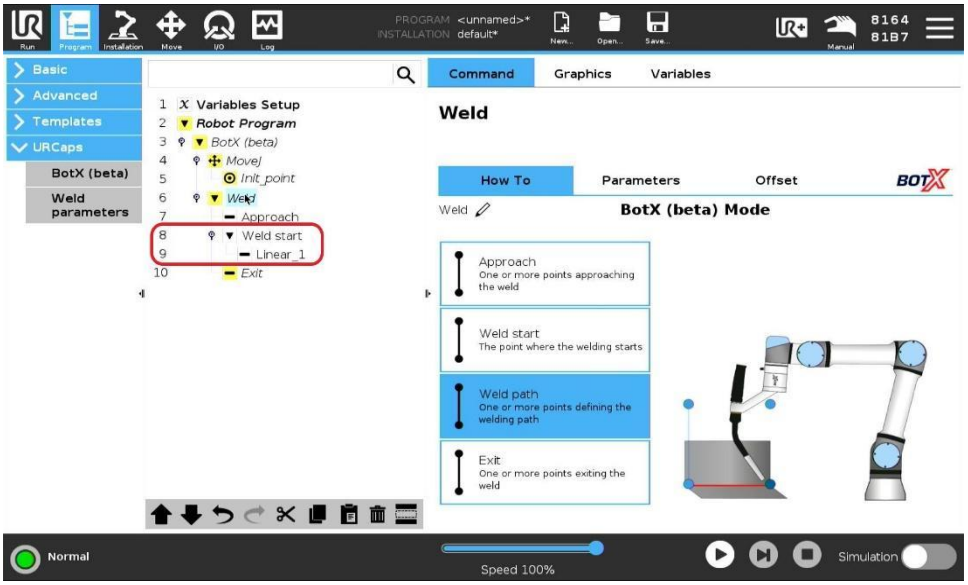


6. Select the **Weld Path** box from the right-side menu as shown below:

Physically move the arm to the location of the desired location.

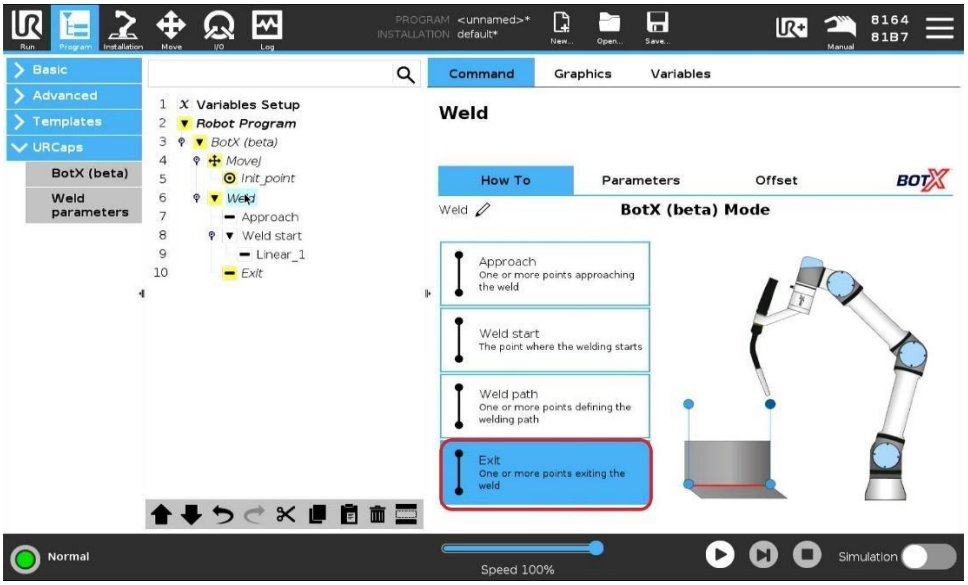


In the Weld Path you can place as many points as desired or necessary; by pressing the **Blue Button** these points will be saved and appear on the program tree as nodes under the Weld Start. The last position will be where the arc termination or weld ends.

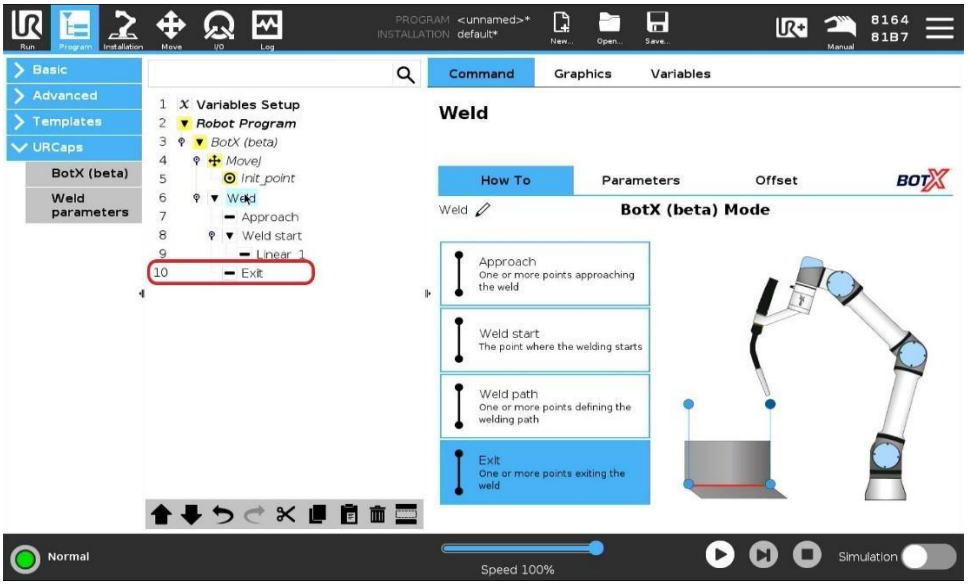


7. Select **Exit** on the right-side menu.

Physically move the arm to the location of the desired exit.



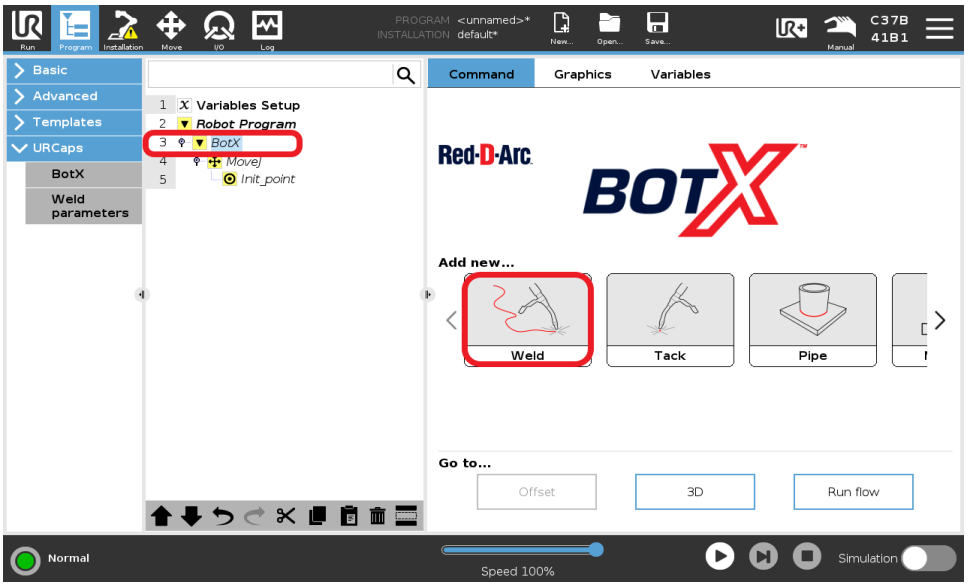
8. Press the quick flashing **Blue Button** to capture the exit point, the **Yellow** exit node will turn **White** when saved.



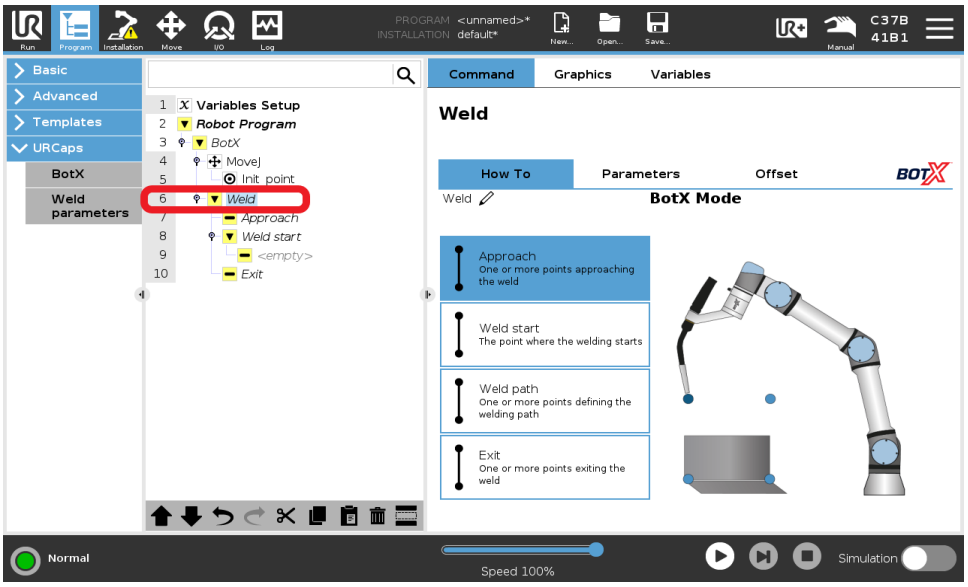
6.4 Programming a Linear Weld

1. Select the **BotX** node in the program tree.

   Weld can be used for both linear and complex geometries.

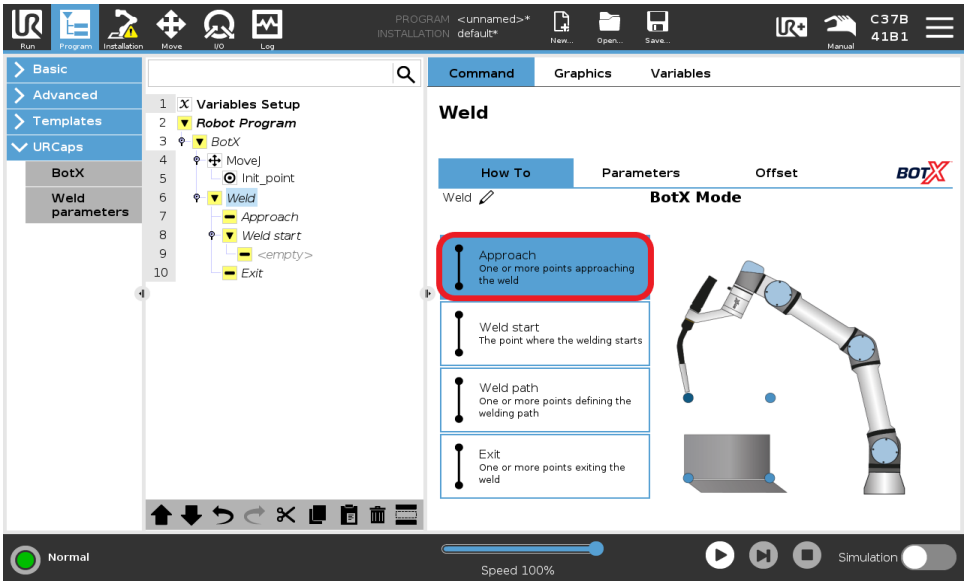


2. Select the yellow **Weld Node**



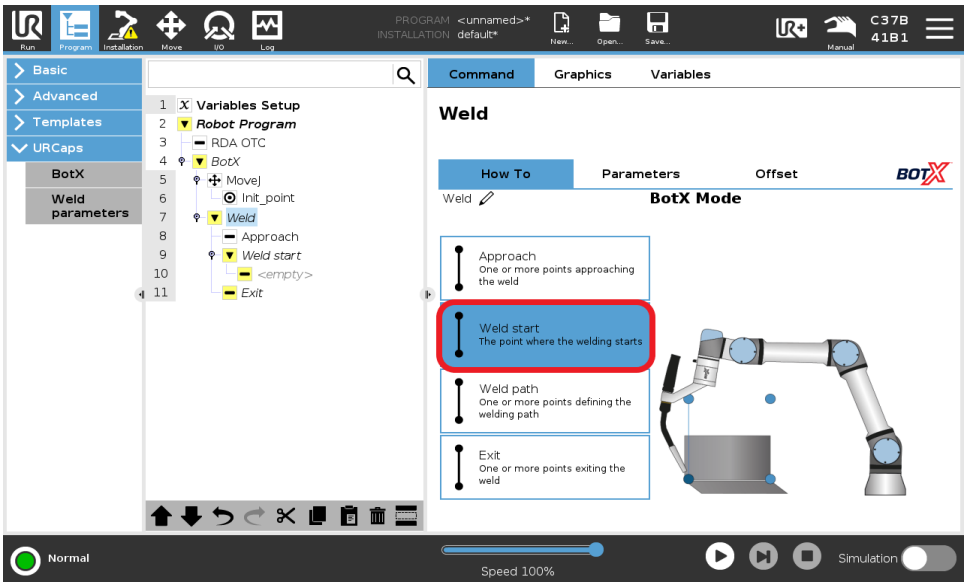
3. Select the **Approach** box on the right-hand side menu. Physically move the arm to the desired location.

4. Press the quick flashing **Blue Button** to capture the waypoint location. The **Approach** node will turn **White** in the program tree when saved.



5. Toggle to the **Weld Start** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select the **Weld Start** box on the right-side menu. Physically move the arm to the weld start desired position.

6. Press the quick flashing **Blue Button** to capture the waypoint location. The **Weld Start node** will remain yellow when the weld path point is saved.



7. Toggle to the **Weld Path** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select the **Weld Path** box in the right-side menu. Physically move the arm to the location of the desired point.

8. Saved the desired **Weld Path** location(s) by using the **Blue Button**.

In the Weld Path as many points as desired or necessary can be saved. These l locations will show on the program tree as new nodes under Weld Start.

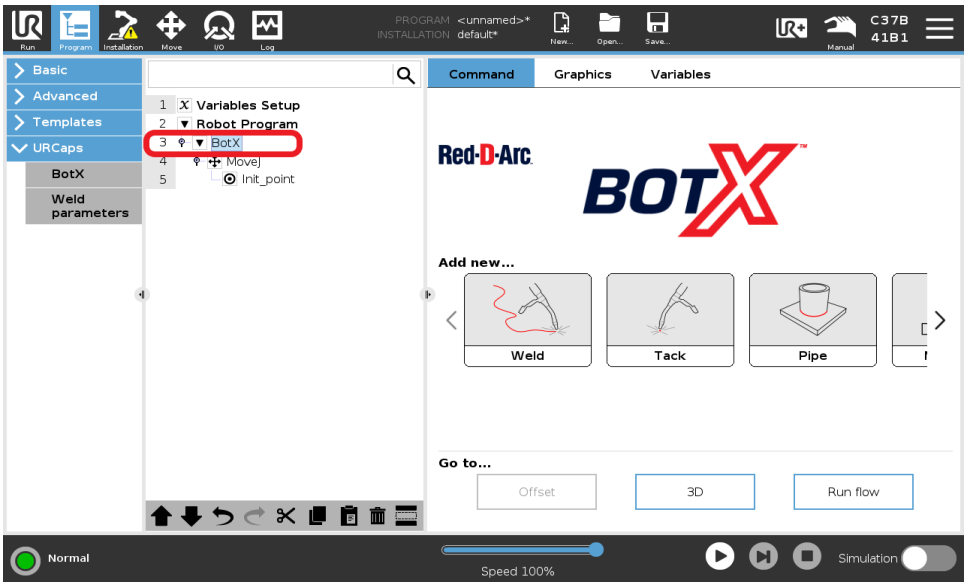
9. Toggle to the **Exit** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select **Exit** on the right-side menu. Physically move the arm to the location of the desired exit.

Press the quick flashing **Blue Button** to capture the waypoint location. The yellow **Exit Node** will turn white when saved.

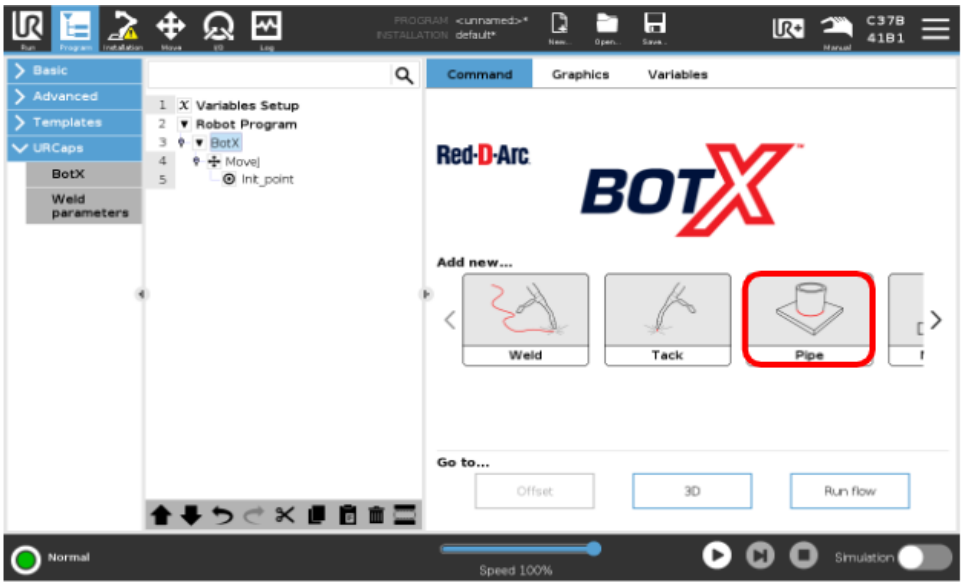
6.5 Programming a Circle

This function is used when many of the welds are circular and nearly perfectly round.

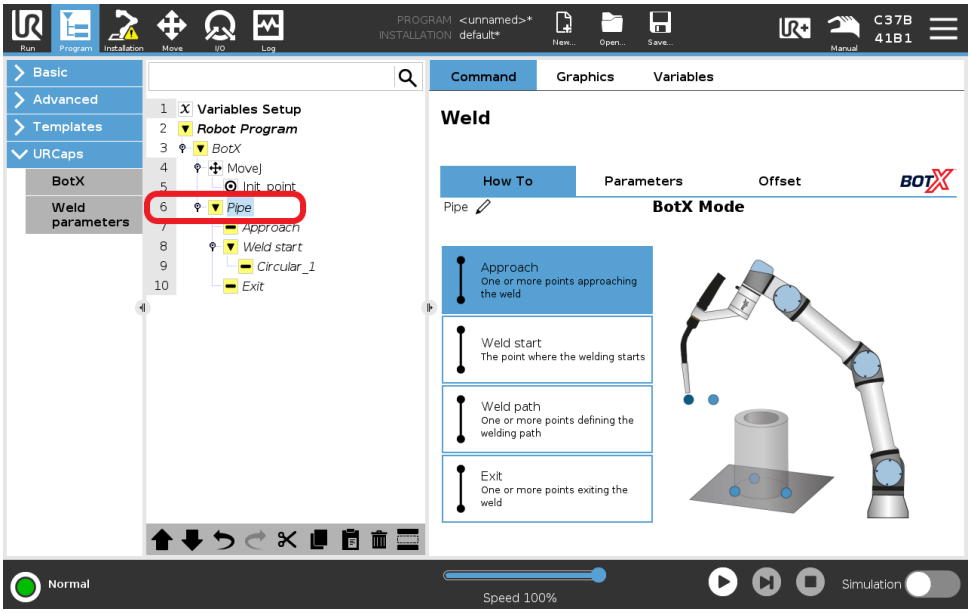
1. Select the **BotX** node in the program tree.



2. Select **Pipe** from the right-side menu.



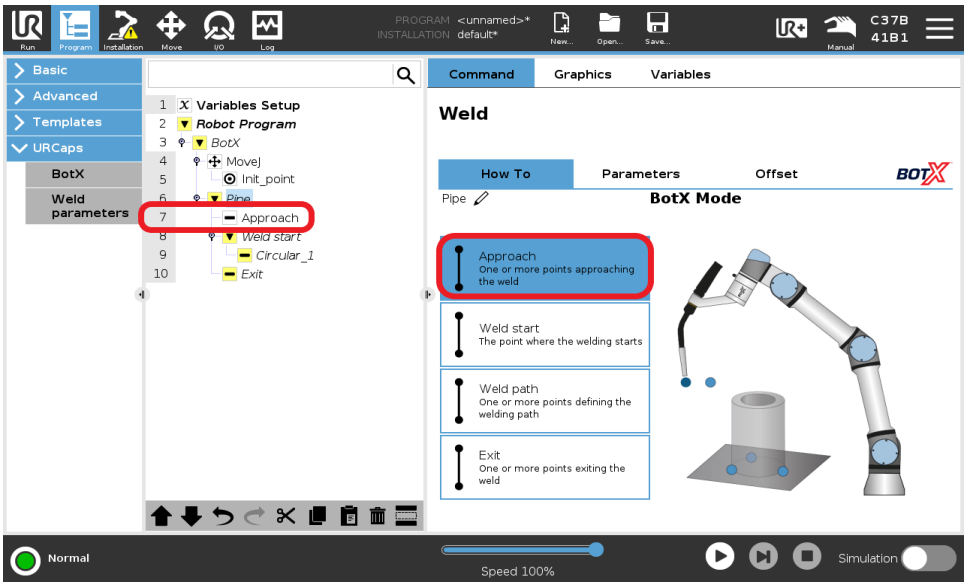
3. Select the yellow **Pipe Node**



4. Select the **Approach** box on the right-hand side menu.

Physically move the arm to the location of the approach point desired.

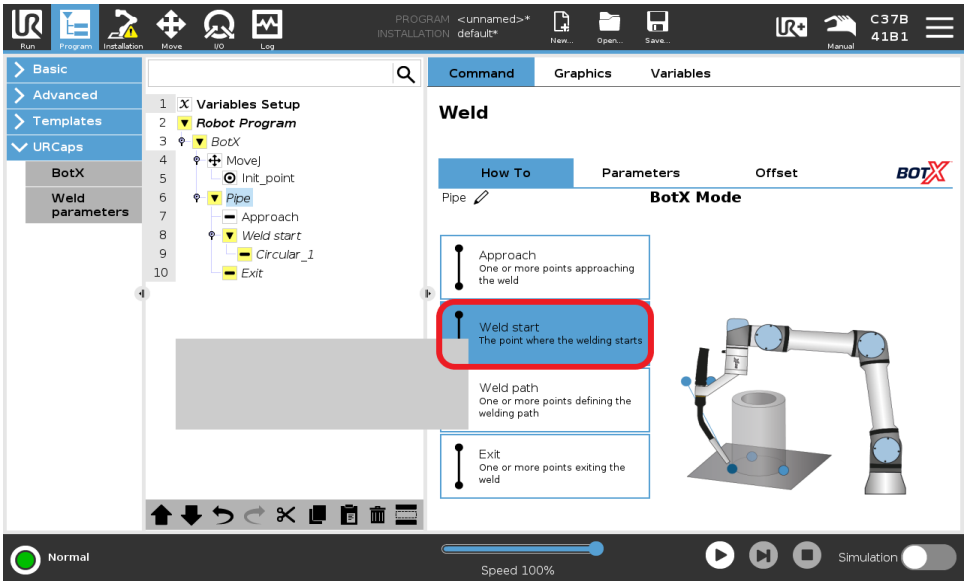
Press the quick flashing **Blue Button** to capture the waypoint location. The yellow Approach node in the program tree will be **white when saved.**



5. Toggle to the **Weld Start** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select the **Weld Start** box on the right-side menu.

Physically move the arm to the desired weld start position.

Press the quick flashing **Blue Button** to capture the waypoint location. The **Weld Start node** will remain yellow when the point is saved.



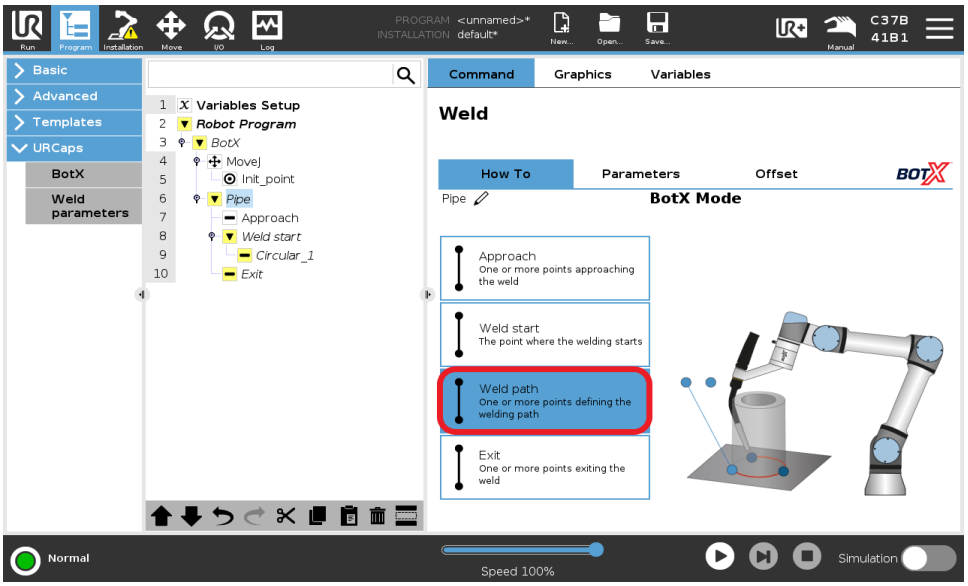
6. Toggle to the **Weld Path** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select the **Weld Path** box in the right-side menu.

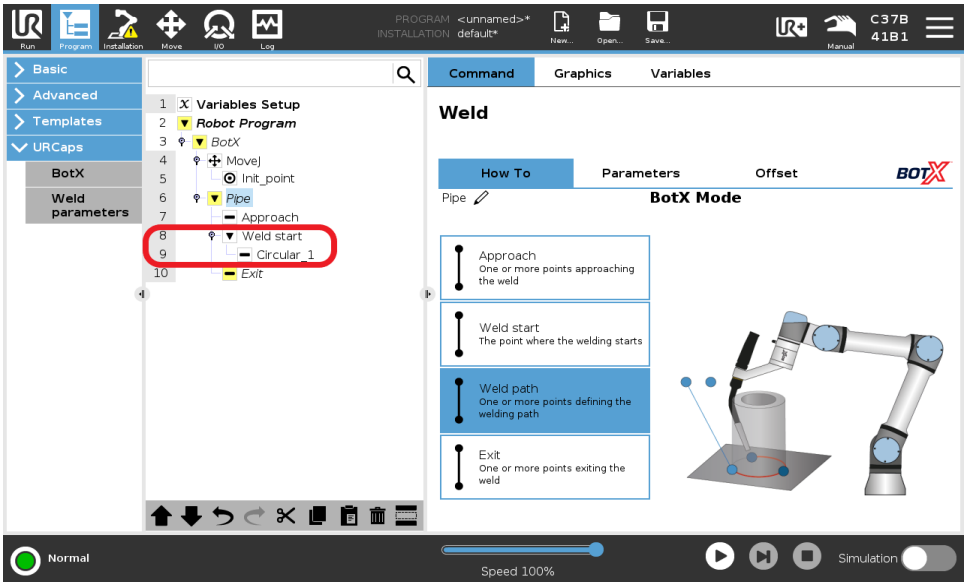
Physically move the arm to the location of the desired point. Approximately 120 degrees from the start of the waypoint. **Save waypoint** location by pressing the **Red Button**

Move the arm to the next location approximately 120 degrees from the previous point. **Save waypoint** location by pressing the **Red Button.**

These locations will show on the program tree as a new node called Circular_X under **Weld Start**.

When the 3 points are saved the **Weld Start and Circular_X Node** will be white.

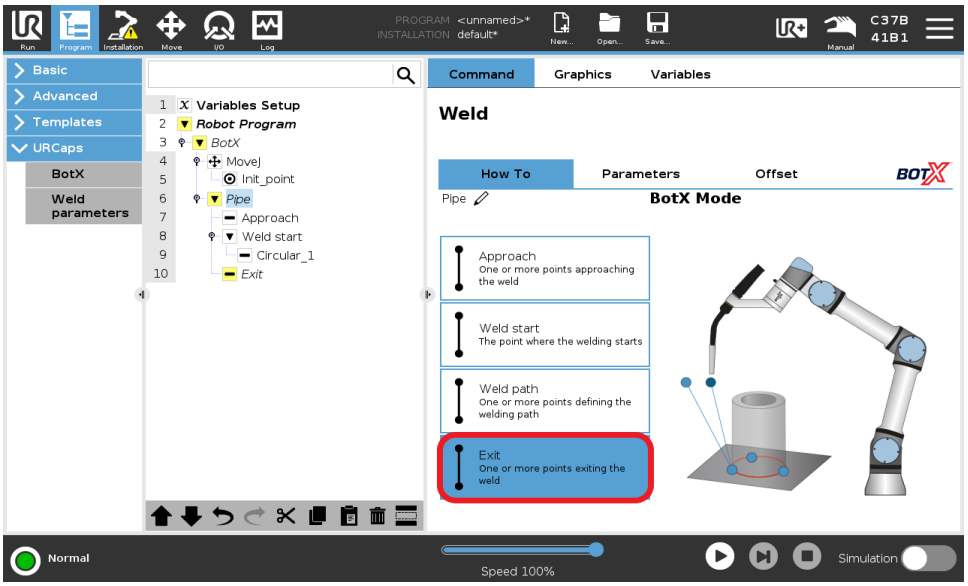


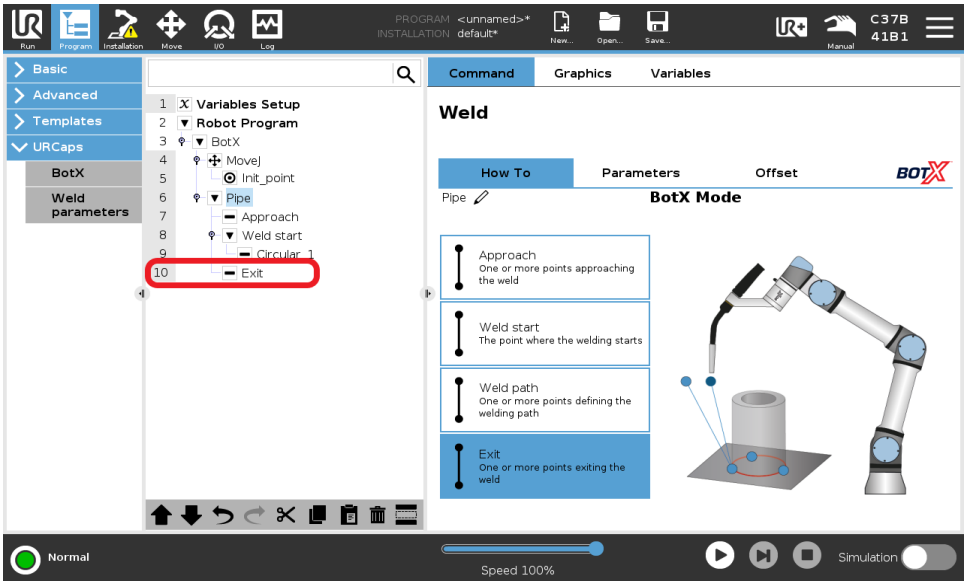


7. Toggle to the **Exit** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select **Exit** on the right-side menu.

Physically move the arm to the location of the desired exit.

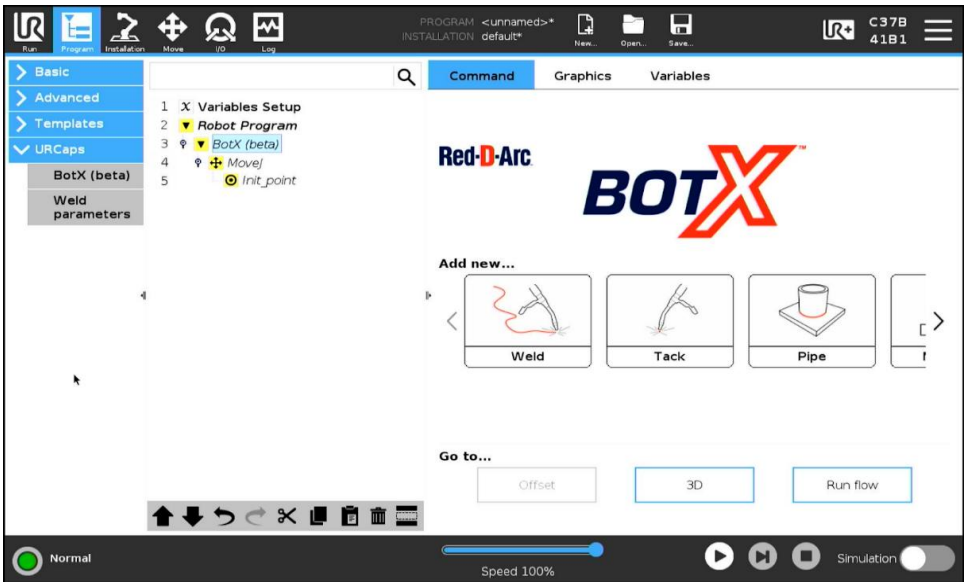
Press the quick flashing **Blue Button** to capture the waypoint location. The yellow **Exit Node** will turn white when saved.



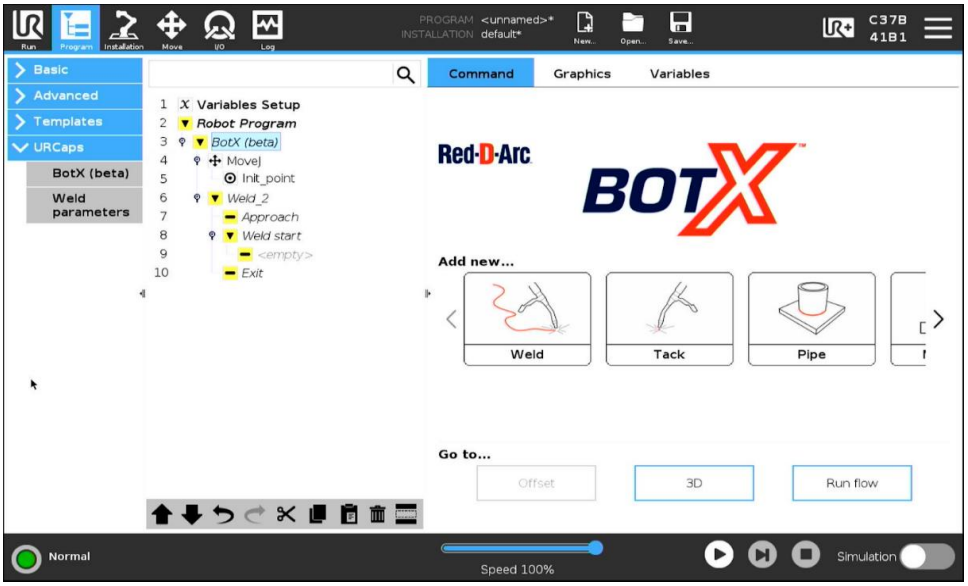


6.6 Ellipse

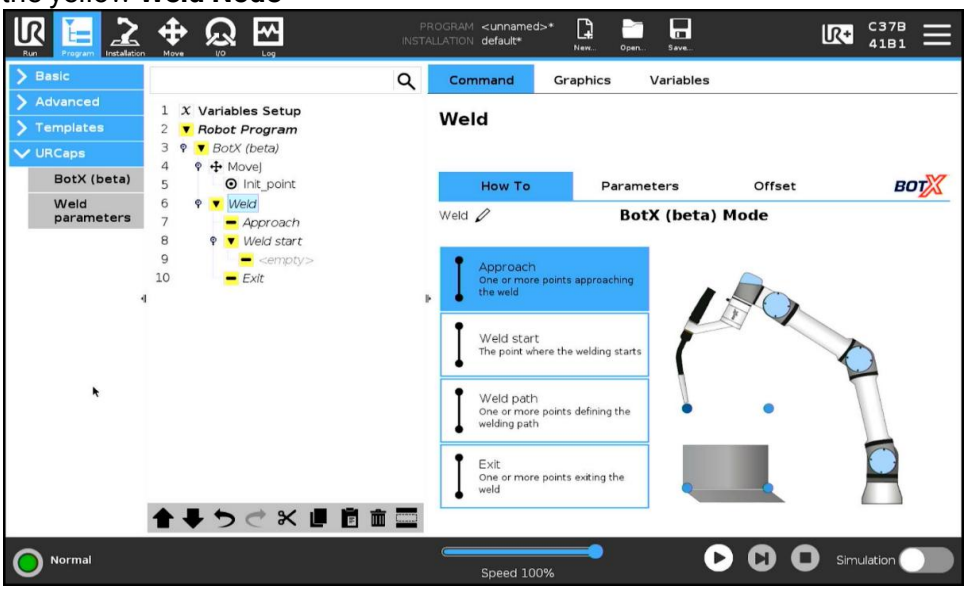
1. Select the **BotX** node in the program tree.



2. Select **Weld** from the right-side menu.



3. Select the yellow **Weld Node**



4. Select the **Approach** box on the right-hand side menu. Physically move the arm to the location of the approach point desired.

Press the quick flashing **Blue Button** to capture the waypoint location. The yellow Approach node in the program tree will be **white when saved.**

5. Toggle to the **Weld Start** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select the **Weld Start** box on the right-side menu.

Physically move the arm to the desired position of the weld start.

Press the quick flashing **Blue Button** to capture the waypoint location. The **Weld Start node** will remain yellow when the point is saved.

6. Toggle to the **Weld Path** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select the **Weld Path** box in the right-side menu.

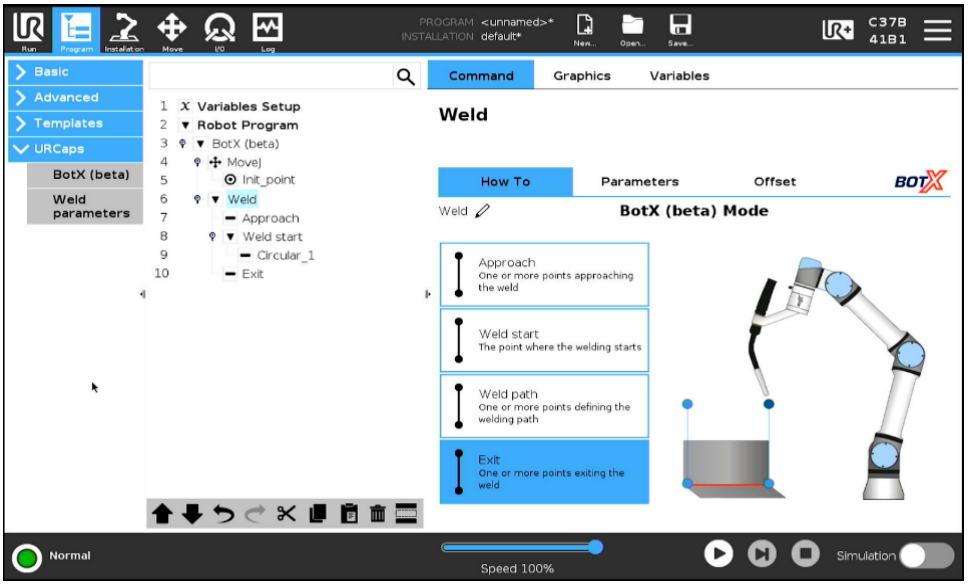
Physically move the arm to the location of the desired point. Approximately 90 degrees from the weld start waypoint.
Save waypoint location by pressing the **Red Button**

Once you press the **Red Button**, the **Blue Button** will go off and that is the only way you will know that way point was saved. There will be no change to the pendant.

Each circle requires 2 circular points saved by pushing the **Red Button.**

7. Move the arm to the next location approximately 90 degrees from the previous point. **Save waypoint** location by pressing the **Red Button**

These locations will show on the program tree as a new node called Circular_X under **Weld Start**. This saves the first half of the radius of the full circle.



8. Move the arm to the next location approximately 90 degrees from the previous point. **Save waypoint** location by pressing the **Red Button.**

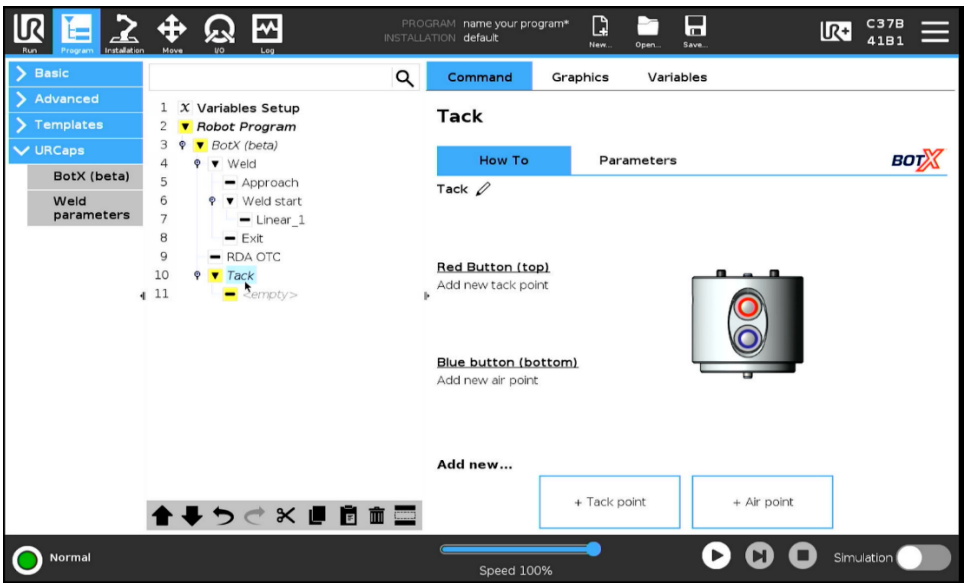
9. Move the arm to the final location of the circle to tie in the end of the weld to the weld start. **Save waypoint** location by pressing the **Red Button.**

These locations will show on the program tree as a new node called Circular_X under **Weld Start**. This saves the second half of the radius of the full circle.

10. Toggle to the **Exit** by pressing and holding the lower (normally) **Blue Button** on the tool **OR** select **Exit** on the right-side menu. Physically move the arm to the location of the desired exit. **Press** the quick flashing **Blue Button** to capture the waypoint location. The yellow **Exit Node** will turn white when saved.

6.7 Programming a Tack Weld

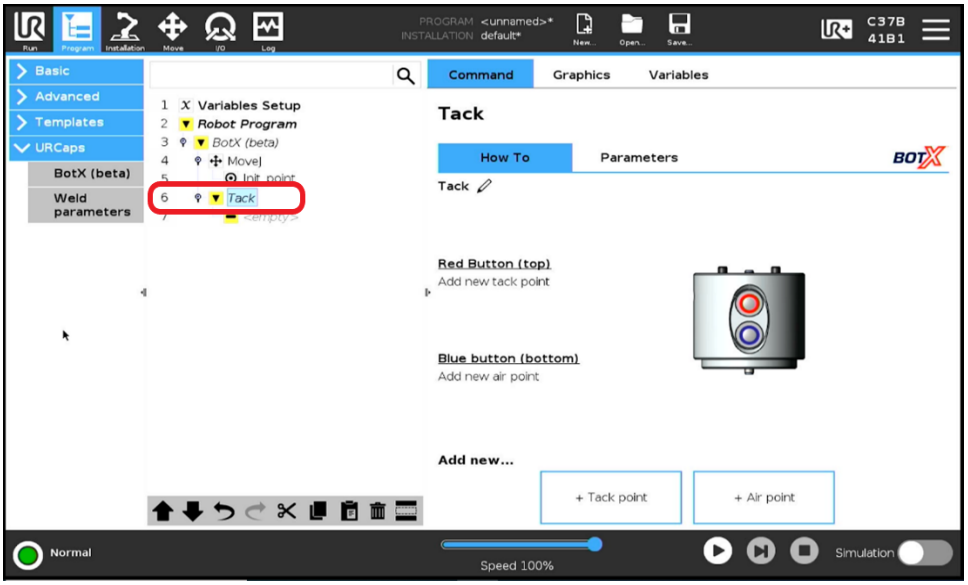
1. Select the **BotX Node** in the program tree.



2. Select the **Tack.**

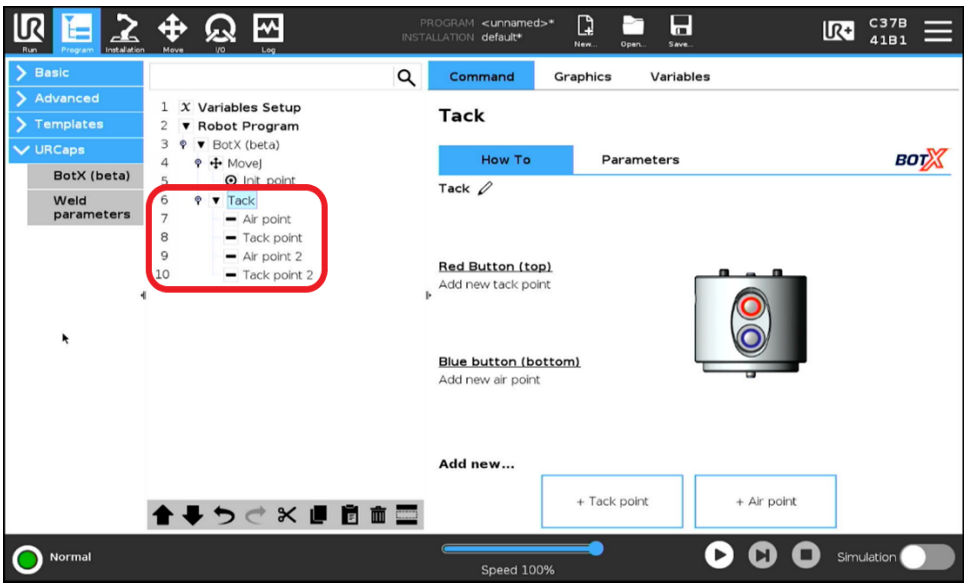
A new weld segment will appear in the program tree.

3. Move the arm to the desired location of an **Air Point** and capture the location using the **Blue Button.**

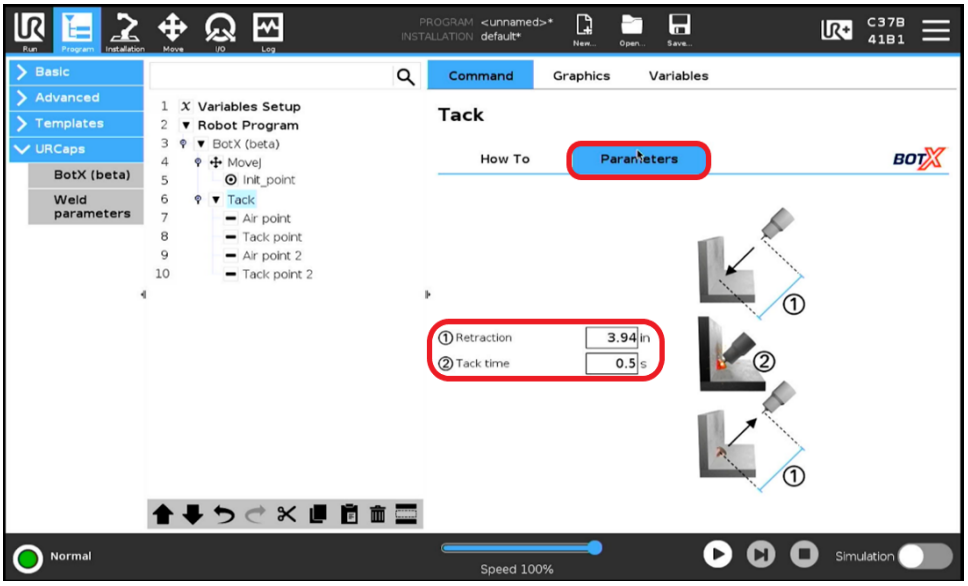


4. Move the arm to the desired location of a **Tack Weld** and capture the location using the **Red Button.**

Repeat steps 3 & 4 as necessary.

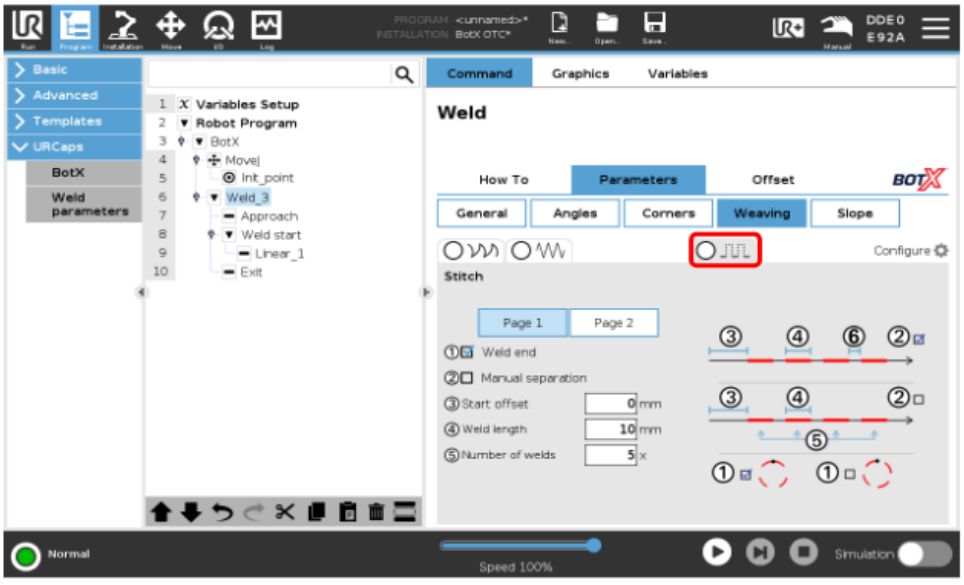


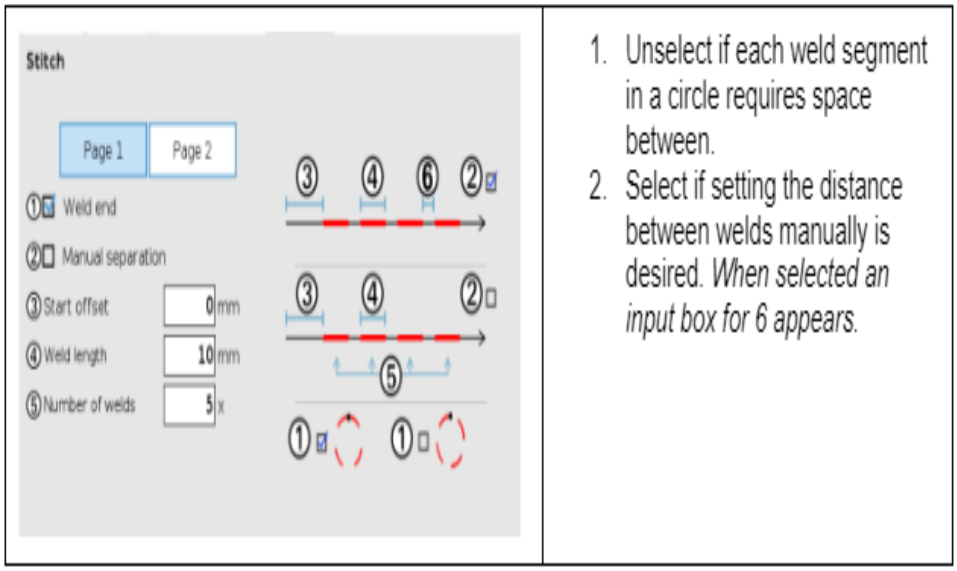
Once you have created your tack points, under parameters you can change the tack time and the distance the torch retracts.

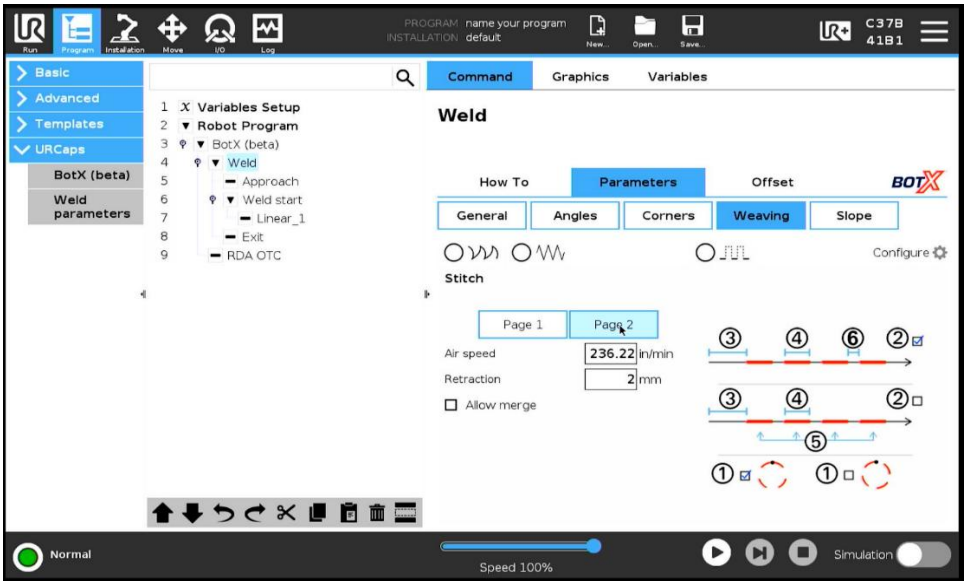


6.8 Programming Stitch Welds

1. Select the **Weld**
2. Select **Parameters** > **Weaving.**
3. Select the stitch tab.

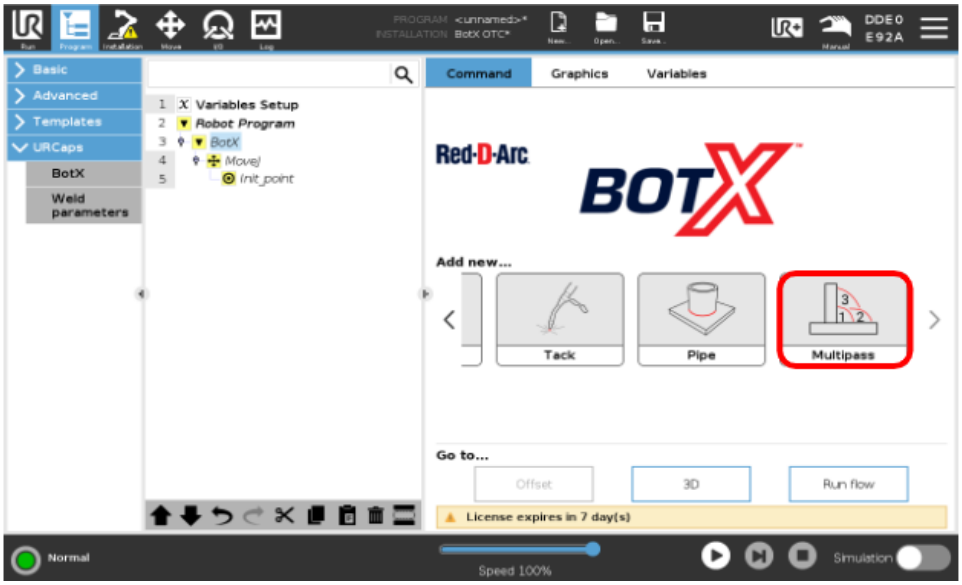



Stitch
Page 1
Page 2
1 Weld end
2 Manual separation
3 Start offset 0 mm
4 Weld length 10 mm
5 Number of welds 5 x
1. Unselect if each weld segment in a circle requires space between.
2. Select if setting the distance between welds manually is desired. When selected an input box for 6 appears.

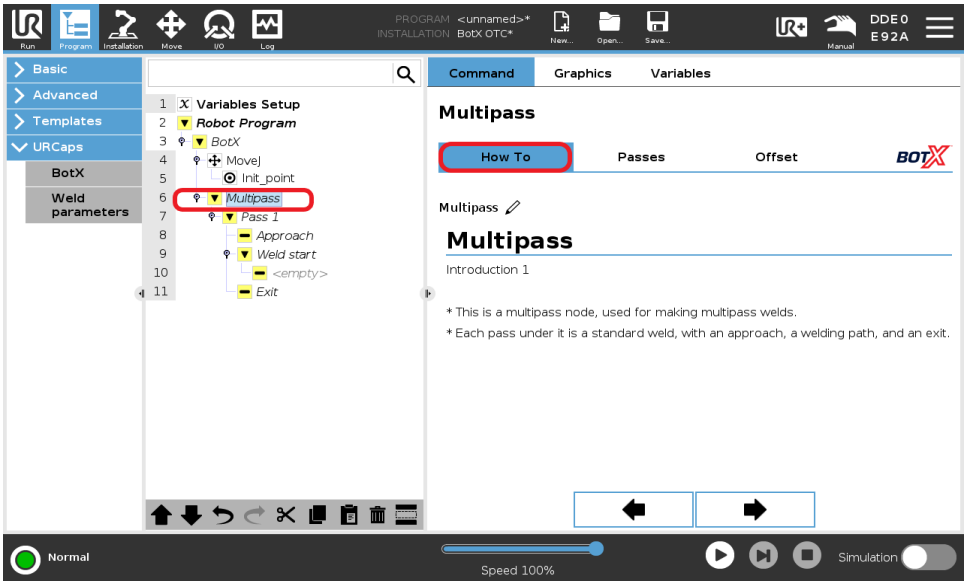

Basic
Advanced
Templates
URCaps
BotX (beta)
Weld parameters
Command
Graphics
Variables
Weld
How To
Parameters
Offset
General
Angles
Corners
Weaving
Slope
Configure
Stitch
Page 1
Page 2
Air speed 236.22 in/min
Retraction 2 mm
Allow merge
Normal
Speed 100%
Simulation

6.9 Programming Multi-pass Welds

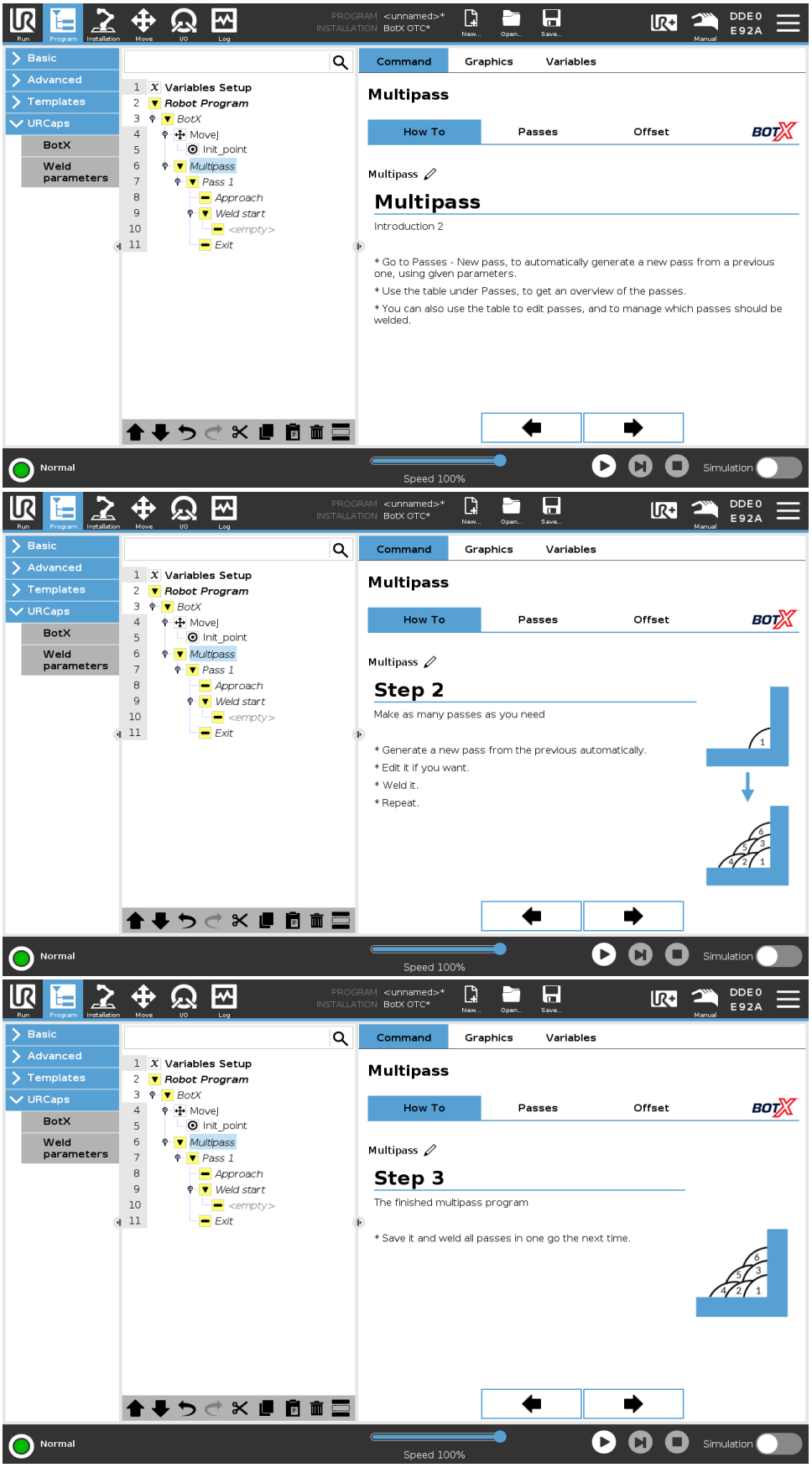
1. Select the **BotX Node** in the program tree.



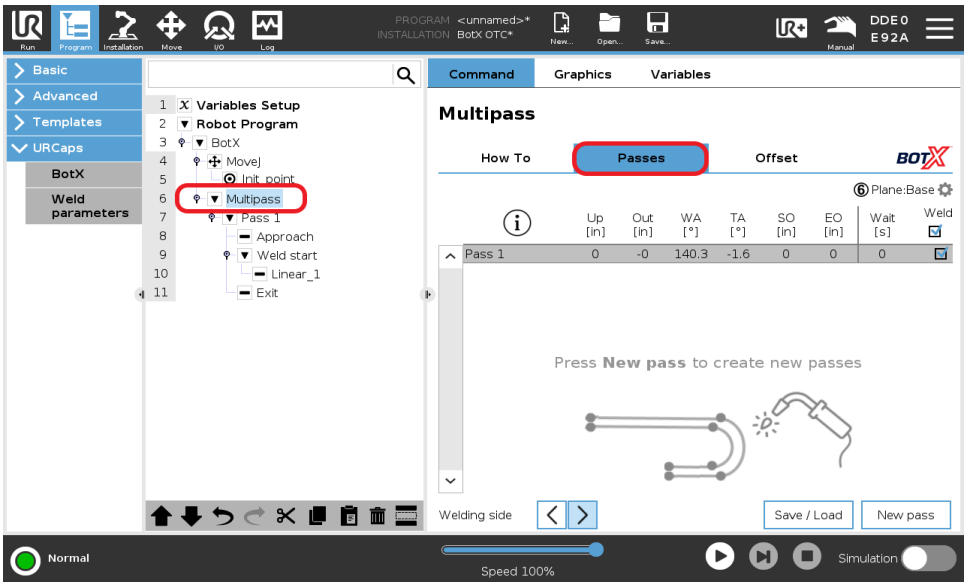
2. Select **Multipass** from the right-side menu.



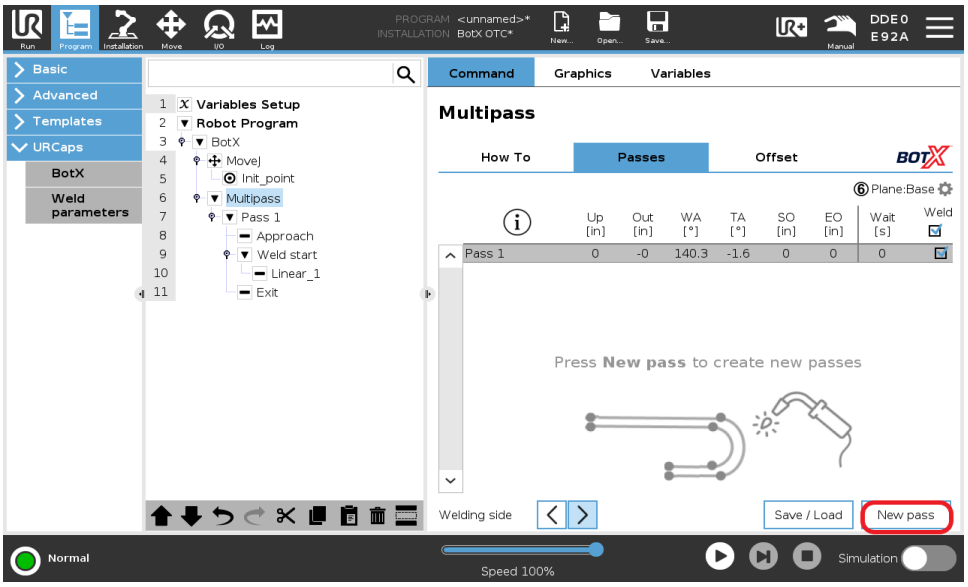
3. Select the **Multipass node** in the program tree and review the on-screen instructions in the **How-To** tab shown below:


Basic
Advanced
Templates
URCaps
BotX
Weld parameters
Command
Graphics
Variables
Multipass
How To
Passes
Offset
Multipass
Introduction 2
* Go to Passes - New pass, to automatically generate a new pass from a previous one, using given parameters.
* Use the table under Passes, to get an overview of the passes.
* You can also use the table to edit passes, and to manage which passes should be welded.
Step 2
Make as many passes as you need
* Generate a new pass from the previous automatically.
* Edit it if you want.
* Weld it.
* Repeat.
Step 3
The finished multipass program
* Save it and weld all passes in one go the next time.
Normal
Speed 100%
Simulation

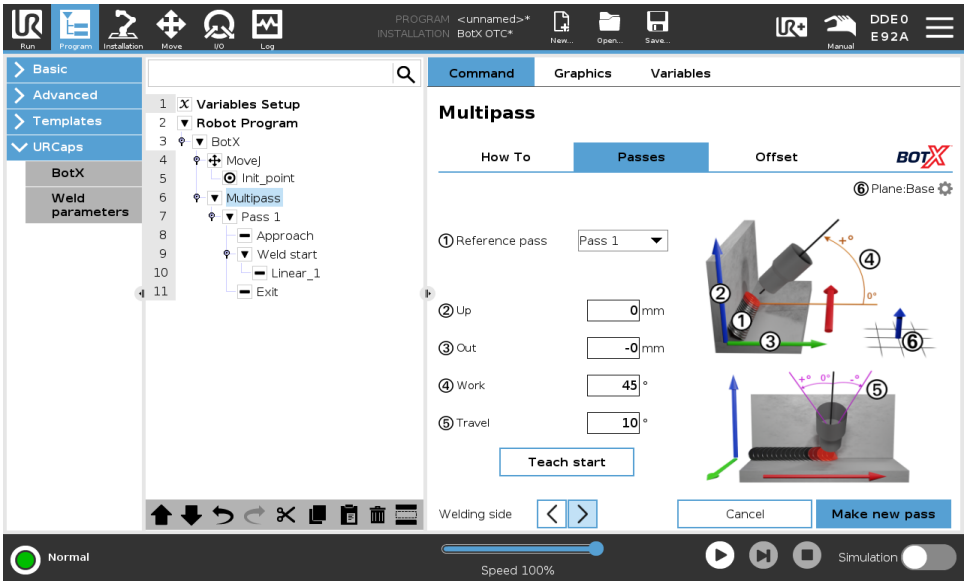
4. After reviewing the steps, select **Pass 1 node** in the program tree. Follow the guided programming to assign the appropriate waypoint to the Approach, Weld Start, Weld Path, and Exit nodes. Once all Pass 1 nodes are white, select the **Multipass node**. On the right-hand side menu select the **Passes** tab.



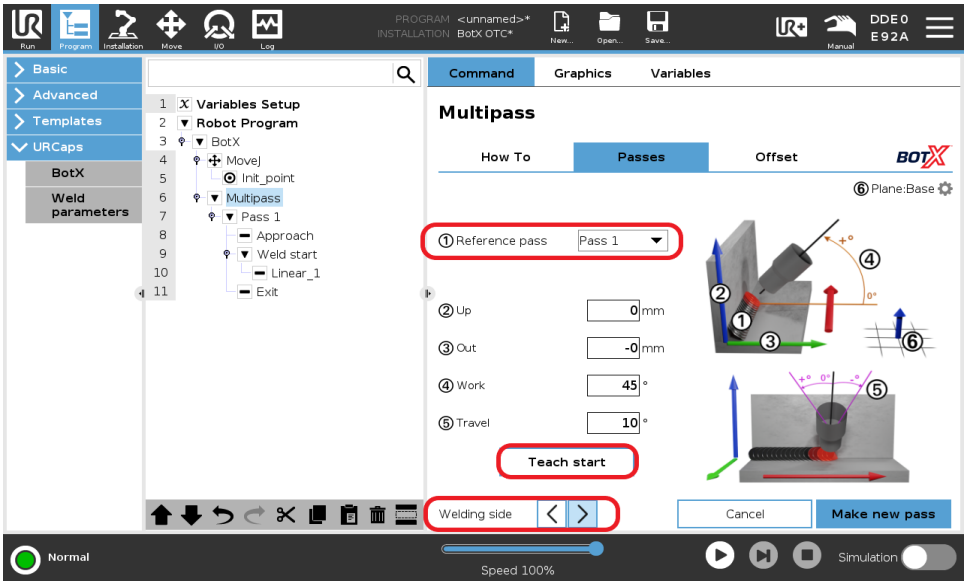
5. Select the **New pass** button on the lower right of the screen.



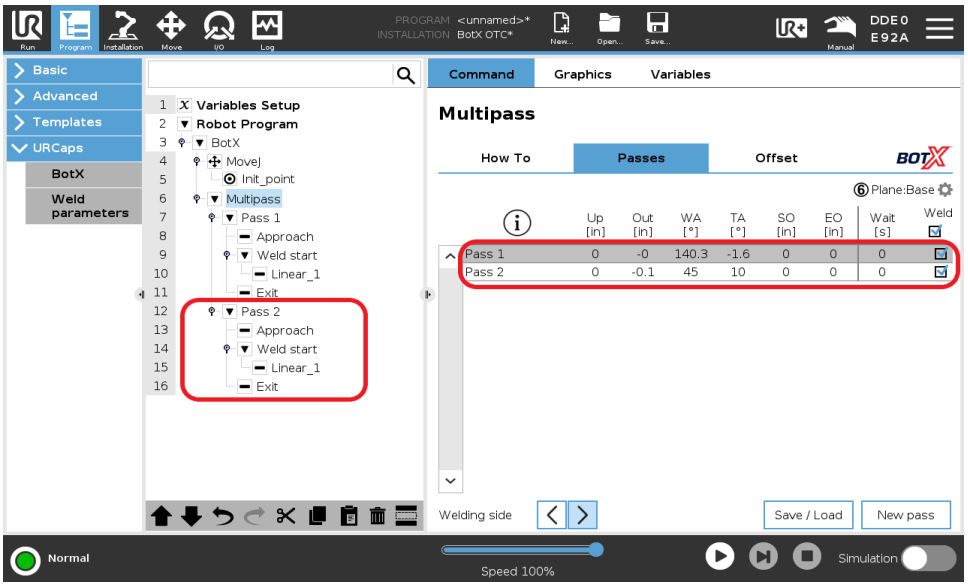
6. In the pass window follow the on-screen selections to determine the offset in the desired direction for the next pass. Once the offsets are input, select **Make a new pass** in the lower right of the screen.



Make sure to select the correct **Reference pass** and **Welding Side** during your selections. If a new start location is needed use the **Teach start** button to assign a new way point. Using 3D Viewer would help you understand if the selections made are accurate see section 6.17.

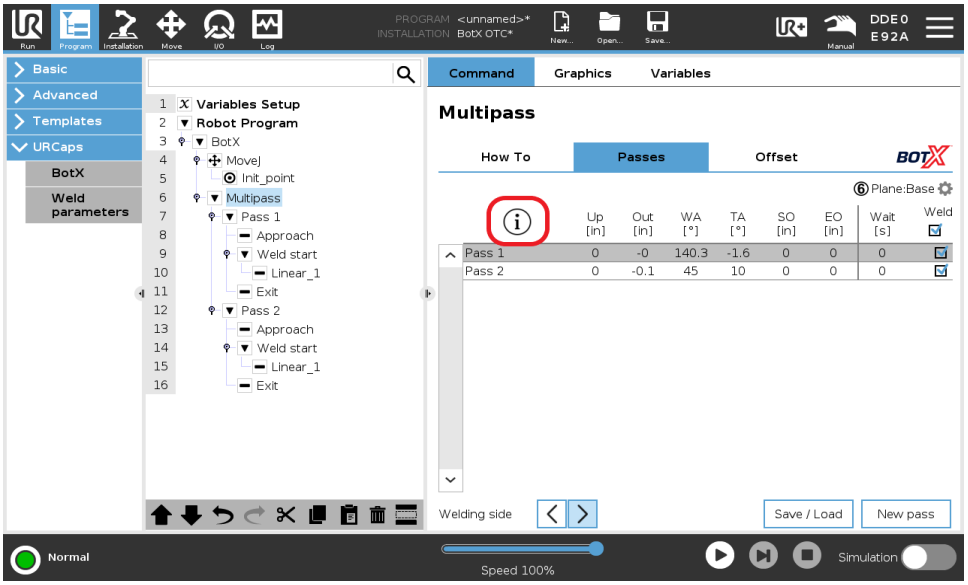


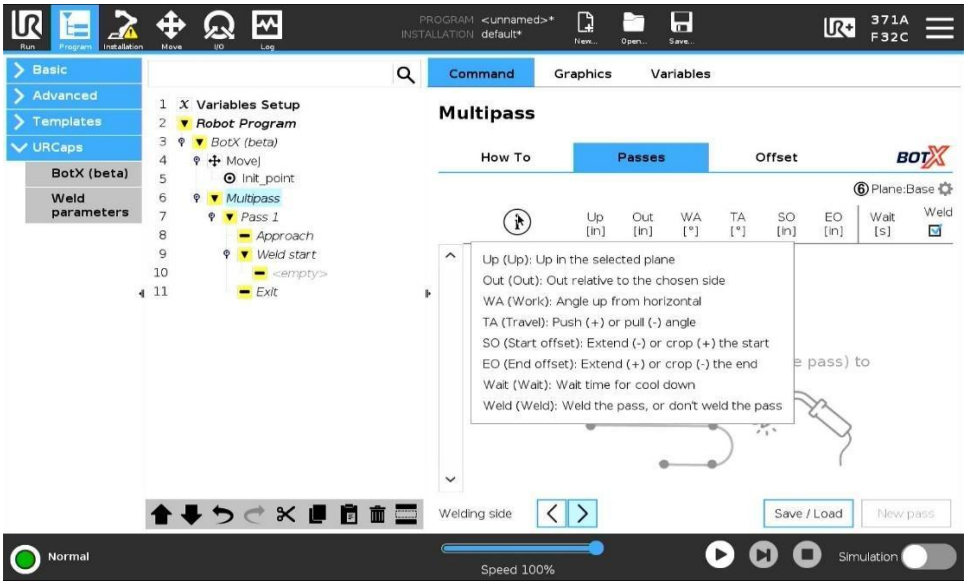
7. When making a new pass is selected the system will add a new pass to the program tree and to the list of passes.



Continue using step 7 until the desired weld passes are programmed.

NOTE: To understand what the chart abbreviations are use the on-screen information button.



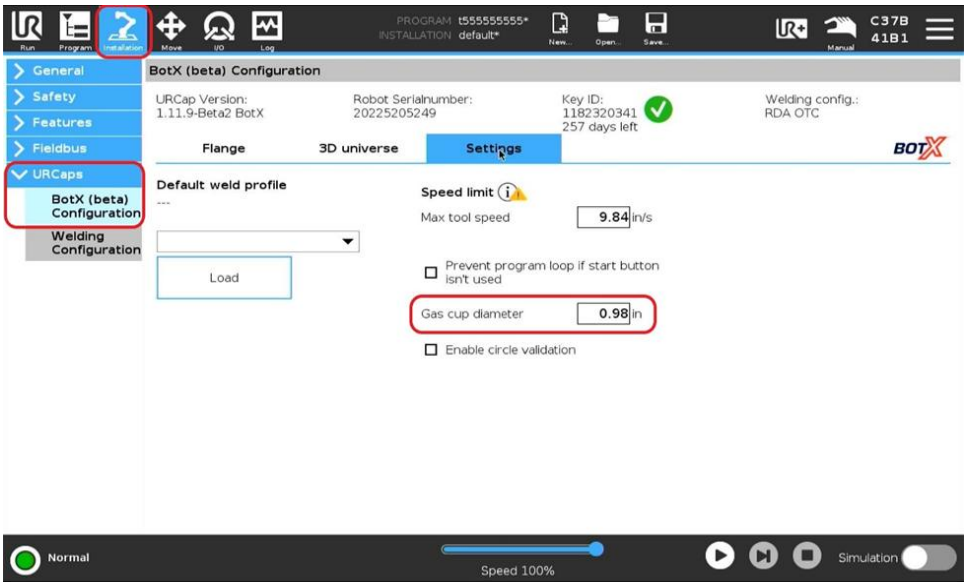


6.10 Touch Sense “Bump”

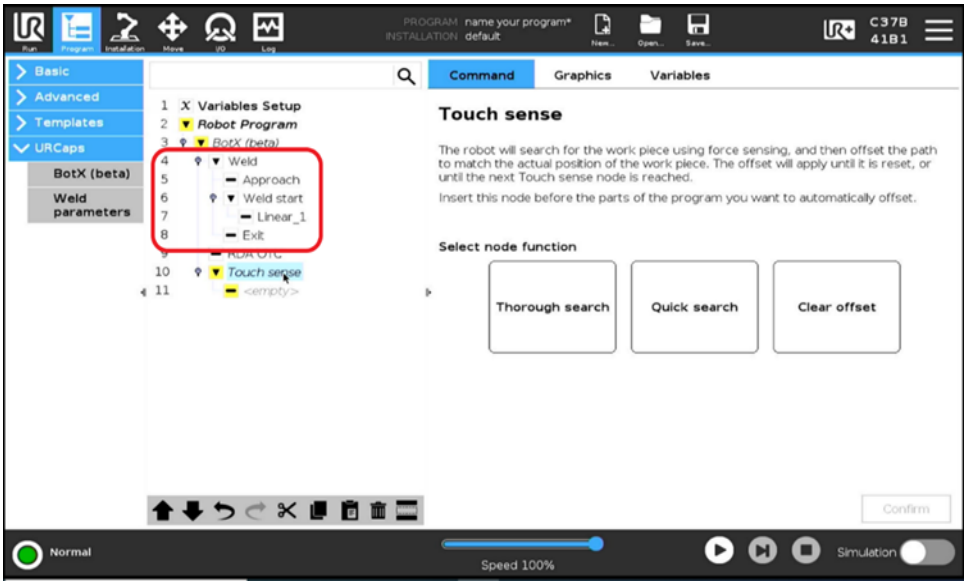
Touch Sense “Bump” is a force-based locating tool to search for and identify the workpiece when there are minor deviations in the placement of the workpiece. This node creates a search program that will run each time a program is run.

1. Before using touch sense, go to the **Installation** tab > **URCaps** > **BotX Configuration** > Settings.

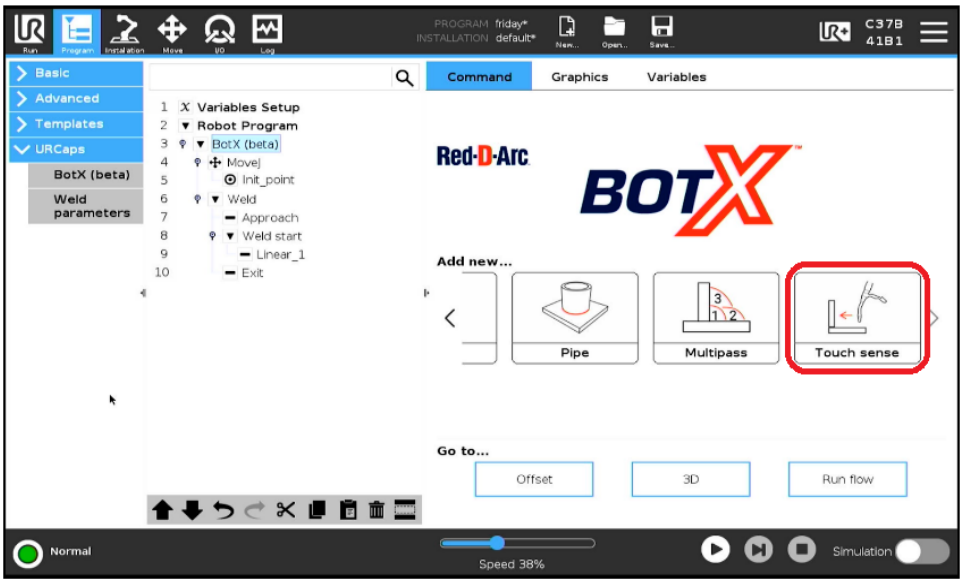
2. Measure the nozzle diameter at the largest part of the nozzle, as this is the place of the nozzle that will be used for sensing.



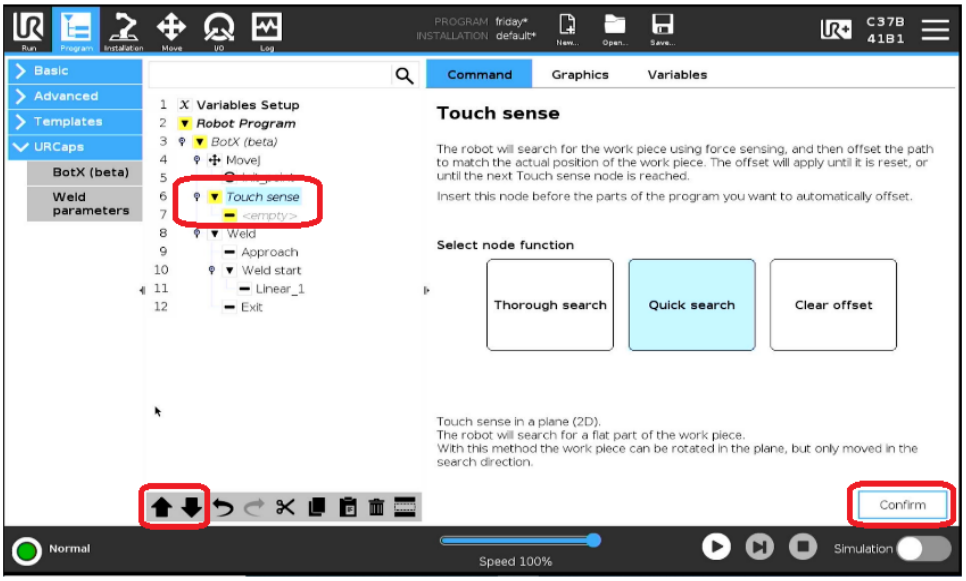
3. Create a weld.



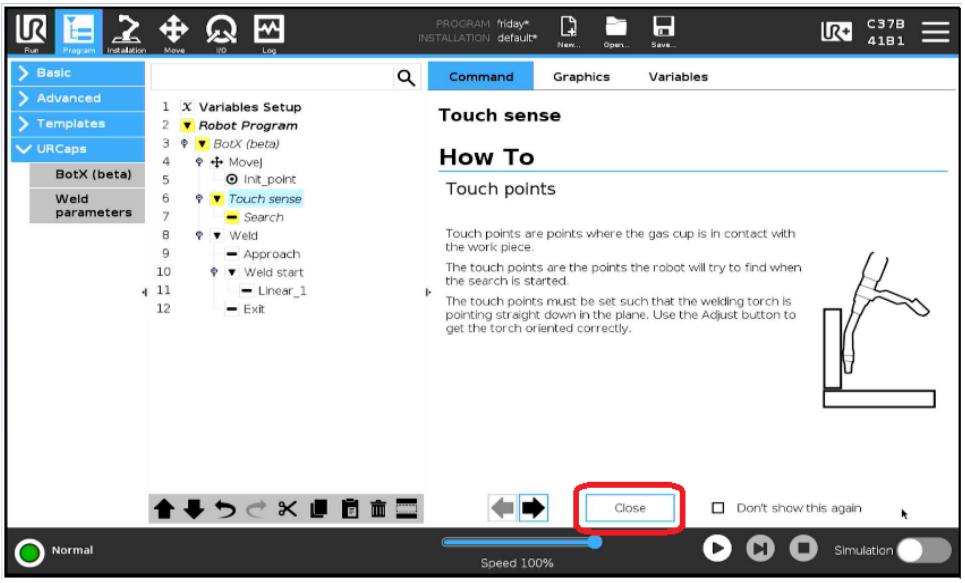
4. Once a weld piece has been created, add in Touch Sense by selecting the BotX Node and choosing Touch Sense from the Add New… carousel.



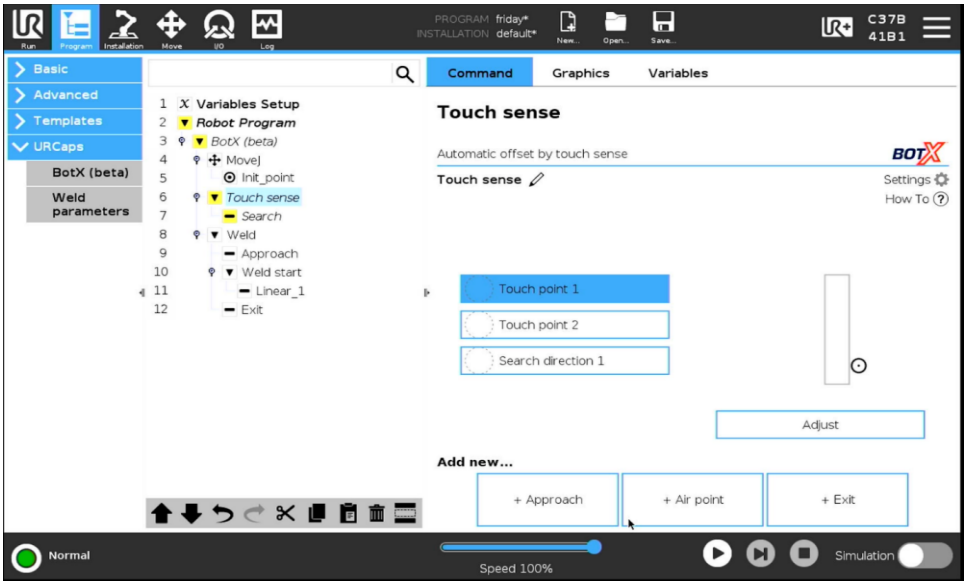
NOTE: The Touch Sense node will be added to the bottom of the weld tree; it will need to be moved up in the program tree before the weld segment that it needs to sense. Use the arrows at the bottom of the screen to do so.



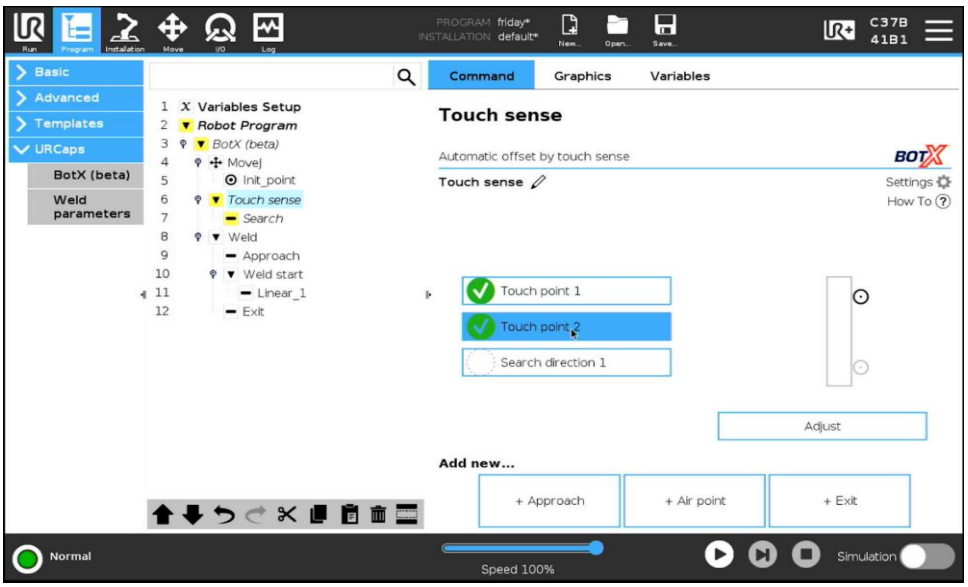
NOTE: Quick Search uses one direction of travel to locate the work piece. Click quick search to add the programming node to the Work Tree.



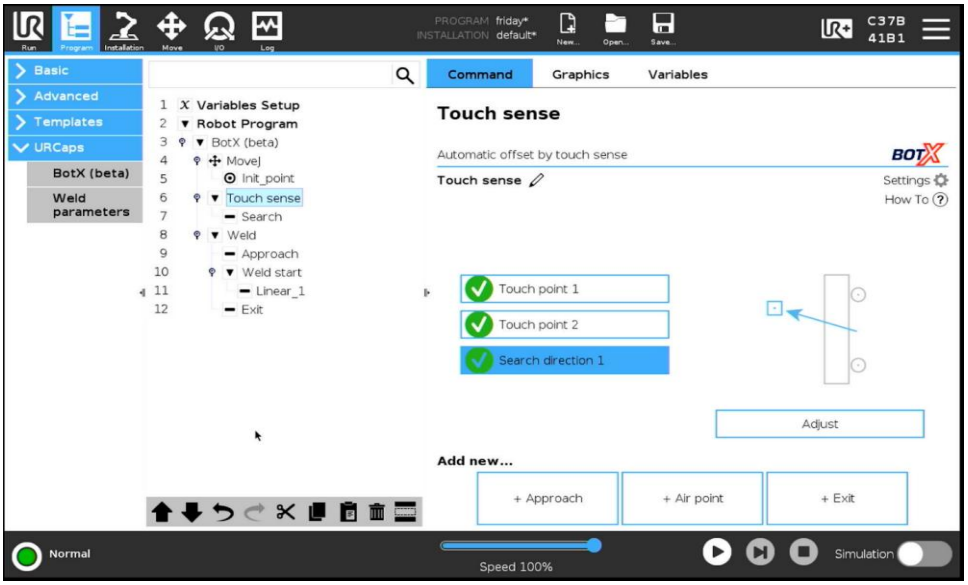
5. After selecting Confirm for quick search, a ‘How To’ Tutorial will appear, select close to move on to Touch Sense Programming.



6. Find a plane of the workpiece that is flat. This could be a plate or a flat edge. Point the torch straight down, click adjust to have the robot arm orient itself. Once the torch is straight down, touch the flat part of the gas cup to the flat part of the workpiece. Click the Blue Button on the smart tool to save Touch Point 1.



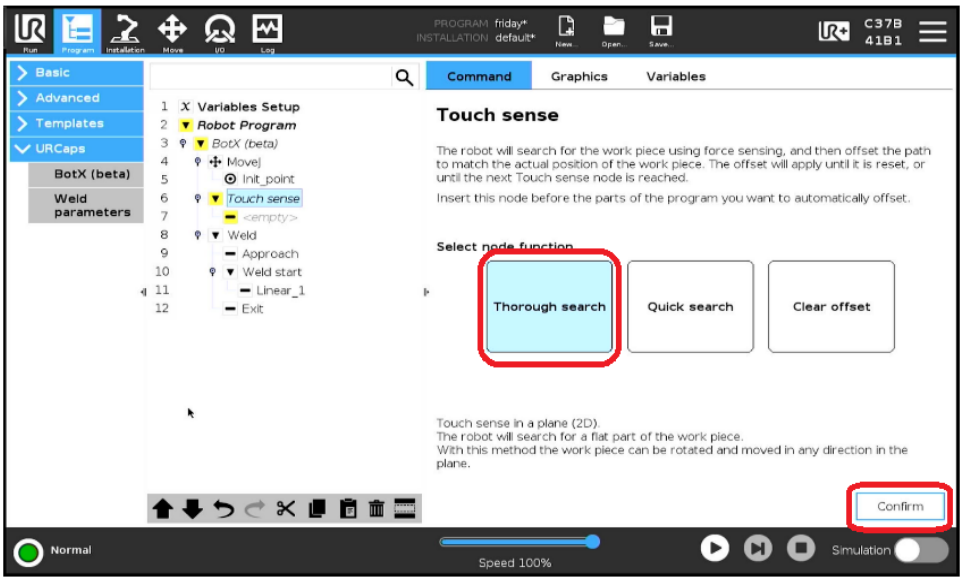
7. Set up the Torch in the same way but in another position along the same plane of the workpiece. Use the adjust button to orient the torch. Once the torch is touching the workpiece click the blue button to save Touch Point 2.

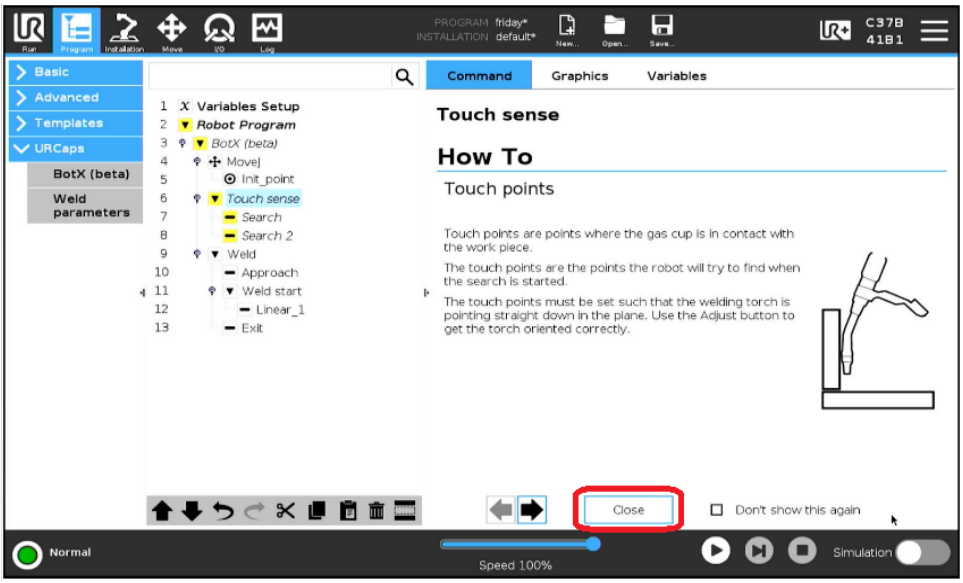


8. Now set a point to indicate the search direction. Set the point away from the touch points in the general direction you want the robot to search.

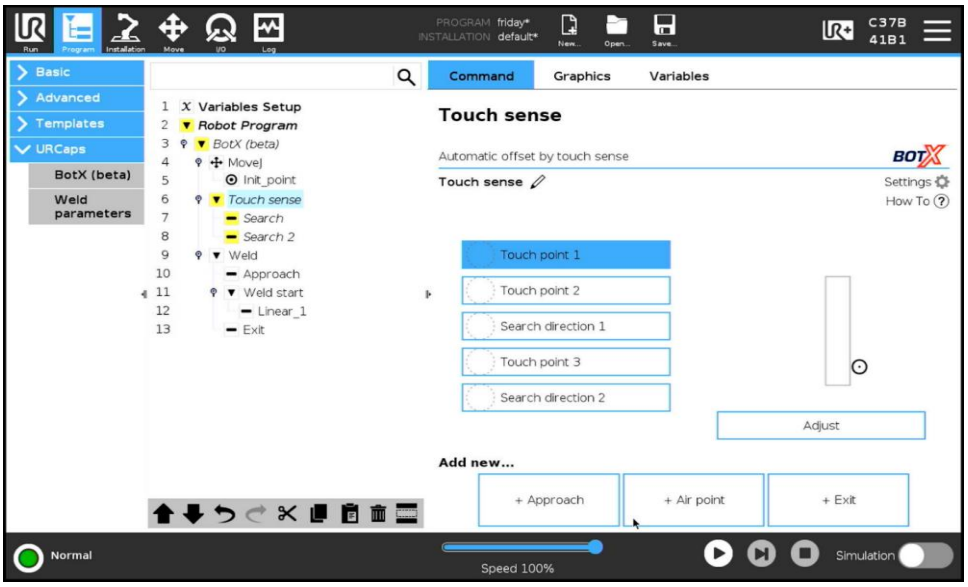
9. Though Search

10. Select Thorough search and click confirm.





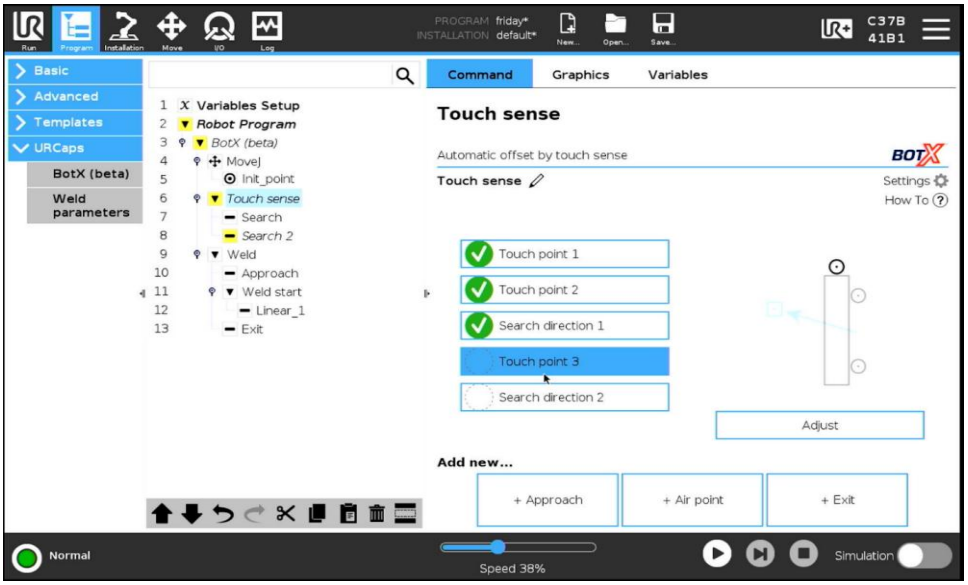
11. After clicking confirmation, a How-to Tutorial will appear. Click Close to continue programming.



12. Find a plane of the workpiece that is flat. This could be a plate or a flat edge. Point the torch straight down, click adjust to have the robot arm orient itself. Once the torch is straight down, touch the flat part of the gas cup to the flat part of the workpiece. Click the Blue Button on the smart tool to save Touch Point 1.

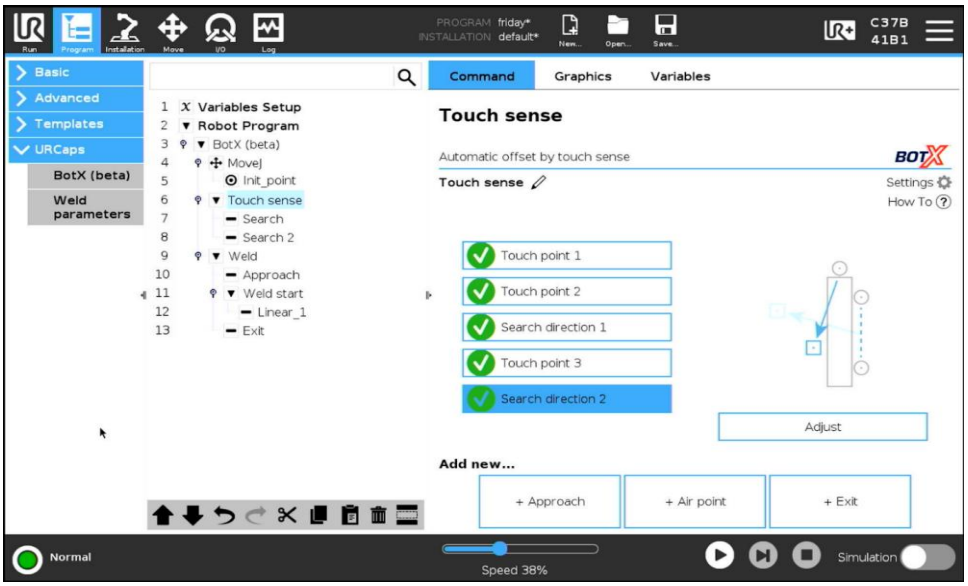
Repeat this process for the 2nd Touch Point.

13. Now set a point to indicate the search direction. Set the point away from the touch points in the general direction you want the robot to search.



14. Set Touch Point 3 so that the gas cup touches the other part of the workpiece. Click the blue button on the smart tool to save Touch Point 3.

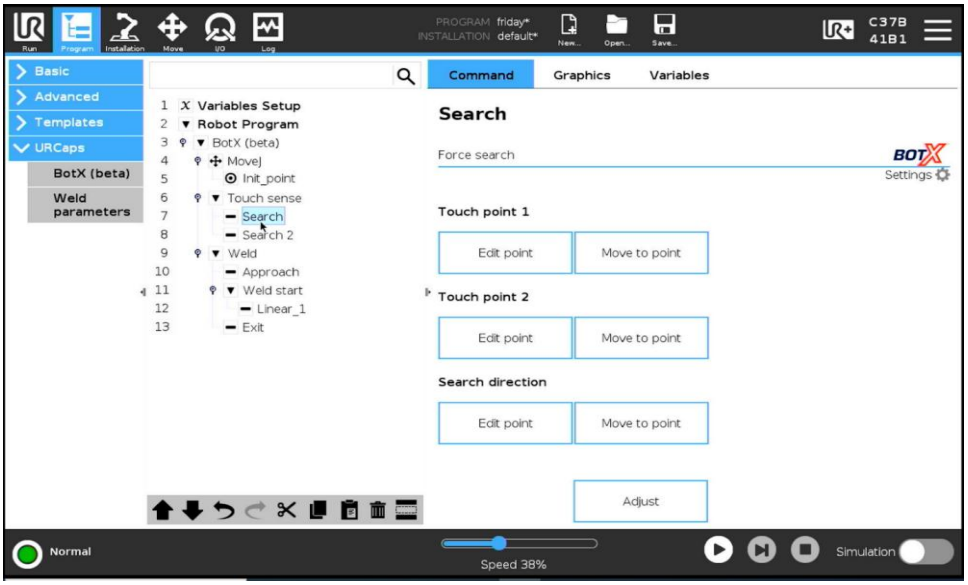
Use the adjust button to orient the torch straight down.



15. Now set a point which indicates Search Direction 2. Set the point away from Touch Point 3 in the general direction you want the robot to search. Click the Blue Button to save Search Direction 2.

NOTE: Here it is important that Search Direction 2 is roughly parallel to the line going from Touch Point 1 to Touch Point 2.

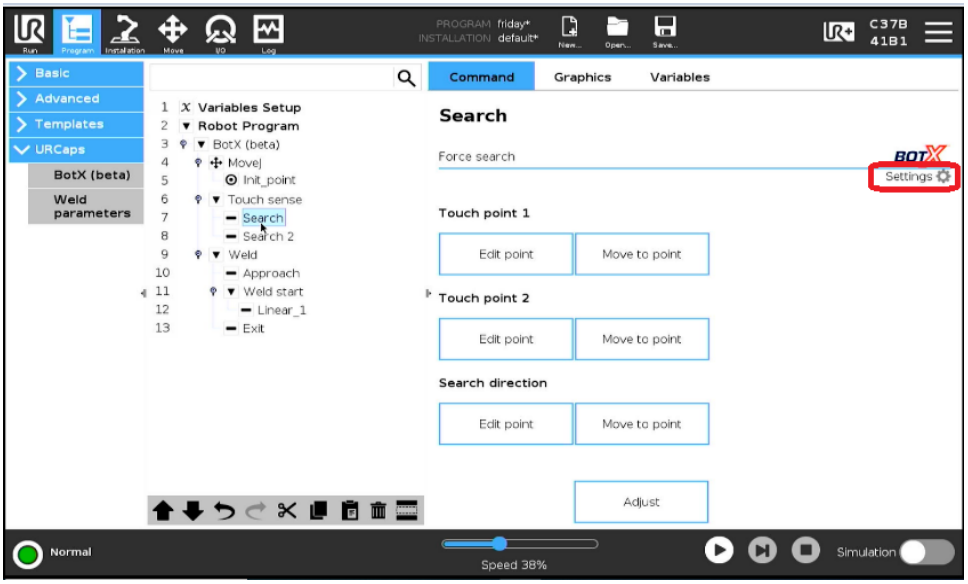
6.11 Touch Sense Settings

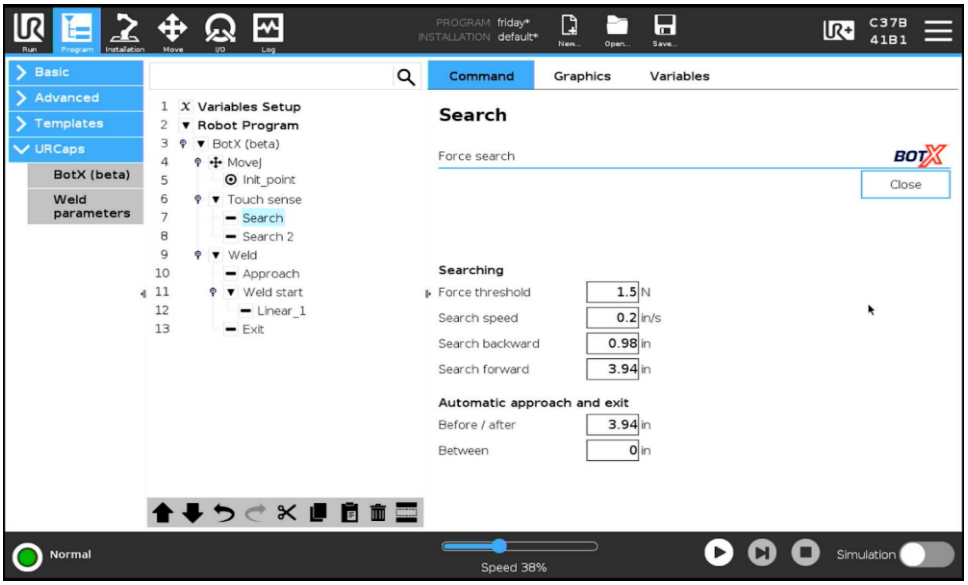


NOTE: Within the Search Node: Touch Points and Search Directions points can be edited.

Touch Sense Settings:

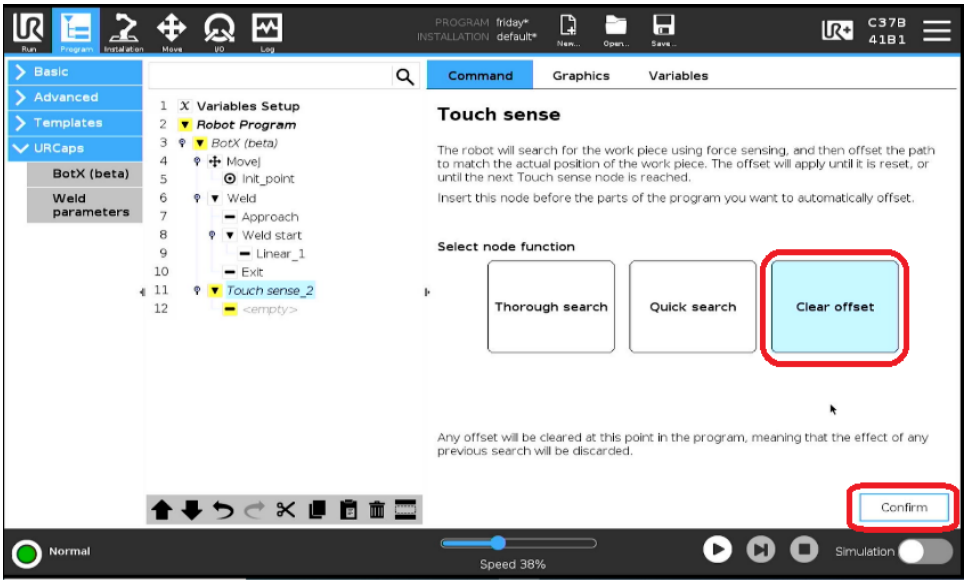
1. Within the search node, select settings gear.

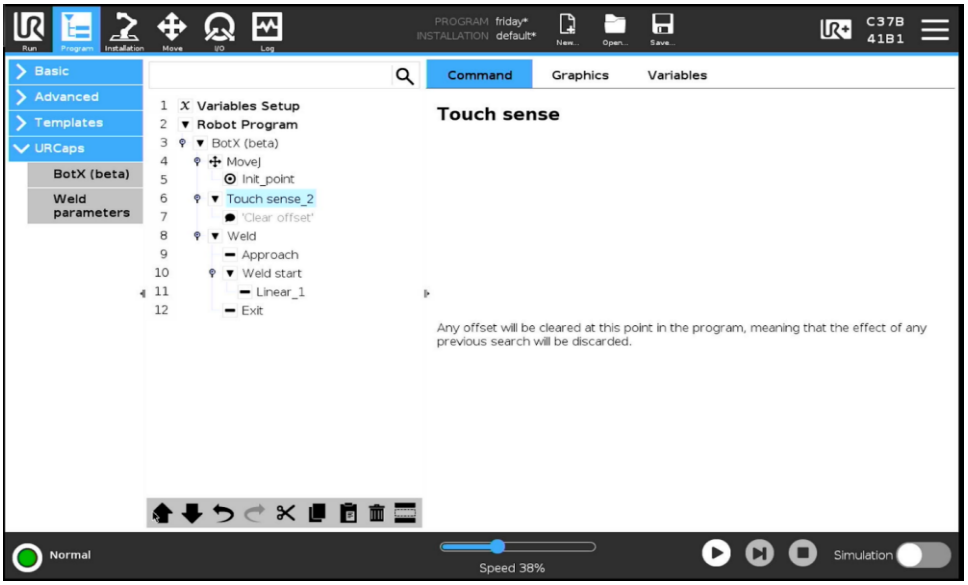




Identifier:	Description:
Force threshold	Touch sensitivity. The robot will keep searching until it senses a force that exceeds this value.
Search speed	Robot speed while searching.
Search backward	This defines the distance between the touch point taught and the point at which the robot starts searching.
Search forward	This defines the distance between the touch point taught and the point at which the robot stops searching. If the robot reaches this point without finding the Touch point, it will report an error.
Before / after	Before and after a search procedure, the robot will visit a point above the first and last points it visits. This distance defines the height of this point.
Between	If this distance is more than 0, the robot will visit a point above the first and second search points. This distance defines the height of that point.

2. Touch Sense - Clear Offset

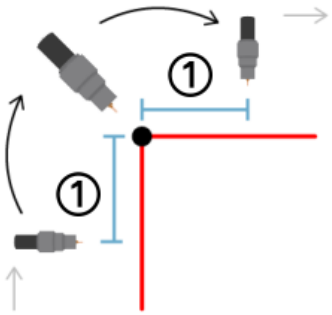




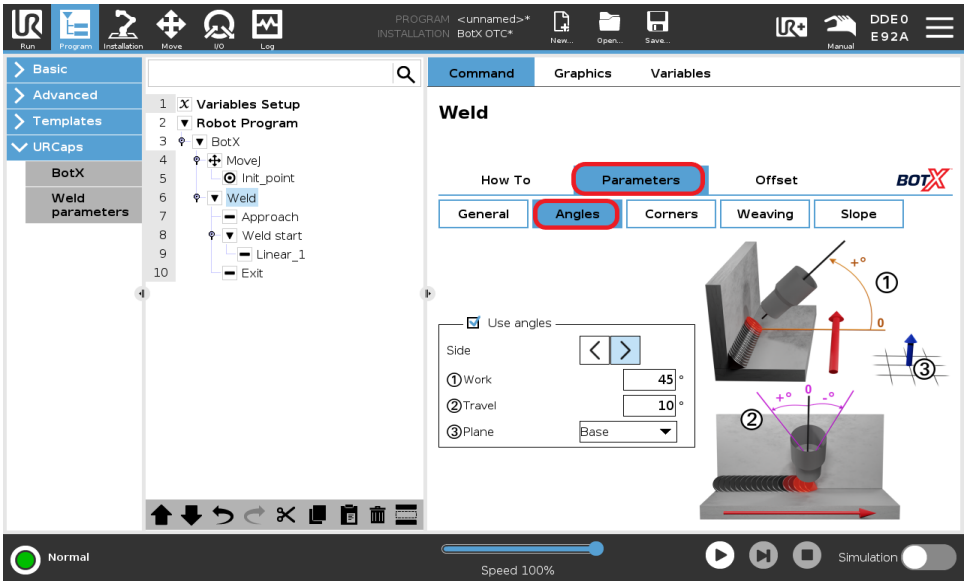
6.12 Programming a Corner

The BotX Corner tool can be used for inside and outside corner programming.

1. To program a corner weld only put **ONE** waypoint on the **45 deg** of the corner desired (see screenshot example below).

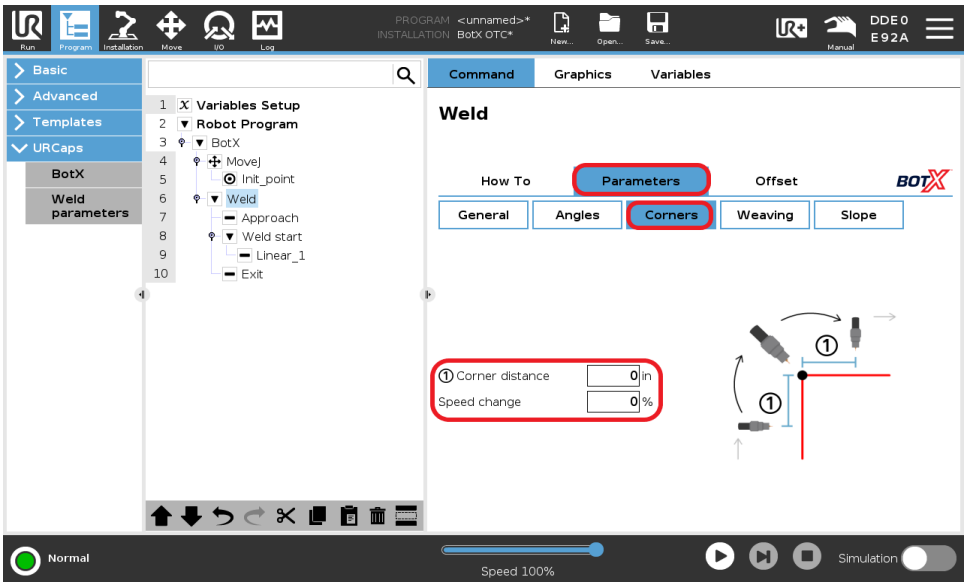


2. Once completed, navigate to the Parameters tab and turn on the Angles feature.



NOTE: This corner function only works if Angles are turned on proceed to 6.17 if use of Angles is not desired.

3. Once Angles are on go to the Corners tab and fill in the desired information for 1) Corner distance and Speed Change.

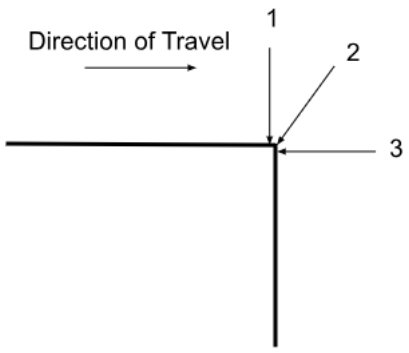


Corner distance is the distance from the corner where the motion of the tool will change angles. Depending on the location and clearance of the corner 0.13 inches is a good place to start. Testing different distances is required for all applications.

Speed change is a percentage change in weld travel speed (found in the Parameters > General tab) around the corner. Positive and negative values can be used.
Test different speed(s) for the desired weld quality and size required for the application.

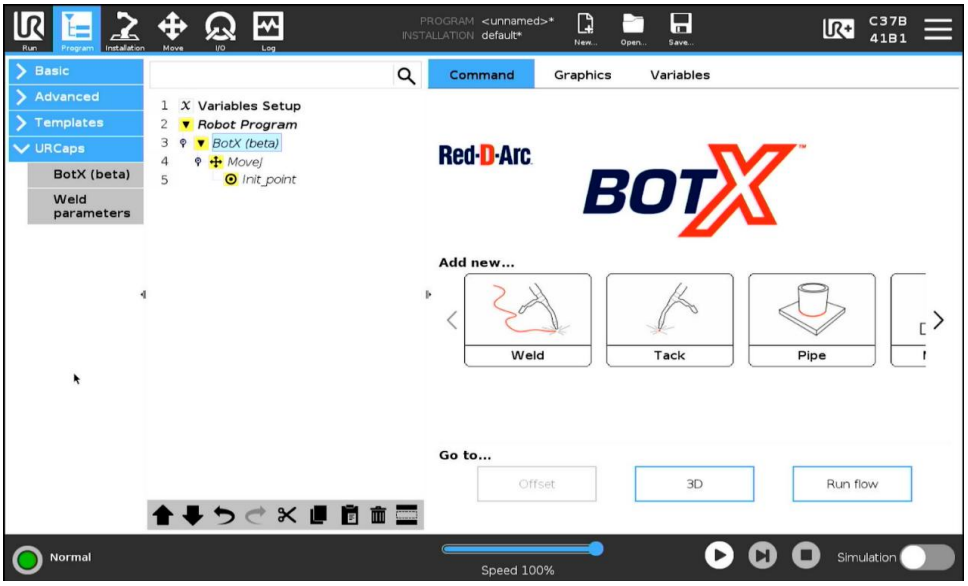
6.13 Alternative Corner Programming

Alternatively, **when using angles is not possible**, the best practice when programming around a corner is to use 3 points. One at the start of the corner, one on the 45 of the corners and one at the end of the corner. *Do not use circle moves to do this unless the radius is greater than 0.625 inches.*



6.14 Programming A Complex Weld

A complex weld is a combination of circular and linear welds to create any shape or pattern desired.



1. Select the **BotX** Node in the Tree

2. Select the **Weld** node.
   We will use smart tools to combine linear and circular way points to create complex shapes and patterns.

3. Create an approach point.

4. Create Weld Start Point, this will always be created using the **Blue Button**. Even when creating a circle or using the red buttons to create a curve.

5. Move into Weld Path.

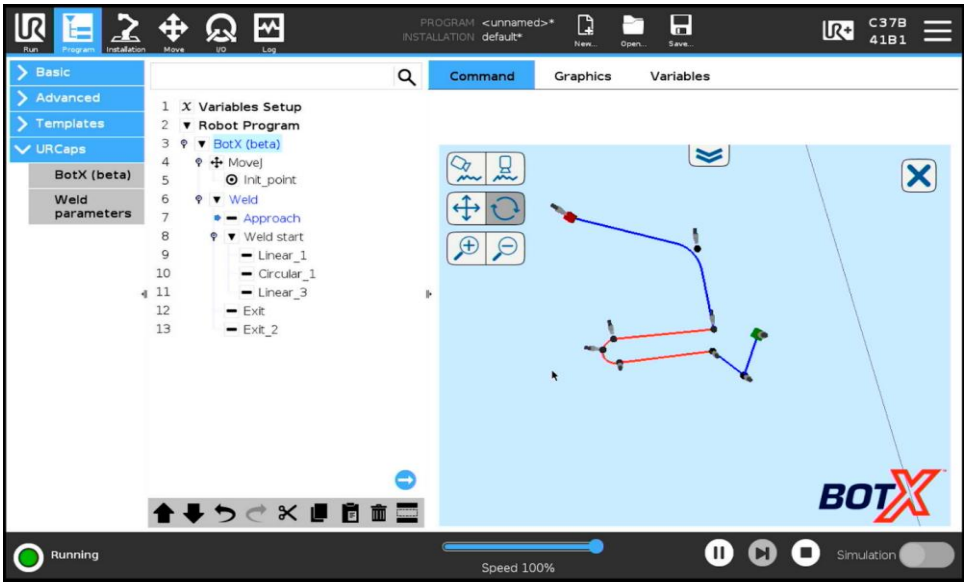
The **Blue Button** will create linear points, where the robot arm will travel on a straight path until it reaches that point.

The **Red Button** will create a circle or curve, each “circle” requires at least 2 points, a via and an end point.

While in weld path, continue to use the **Blue Button** to create straight weld paths and the red button to create curves, mix and match as needed to create desired weld shape.

6. Create exit points.

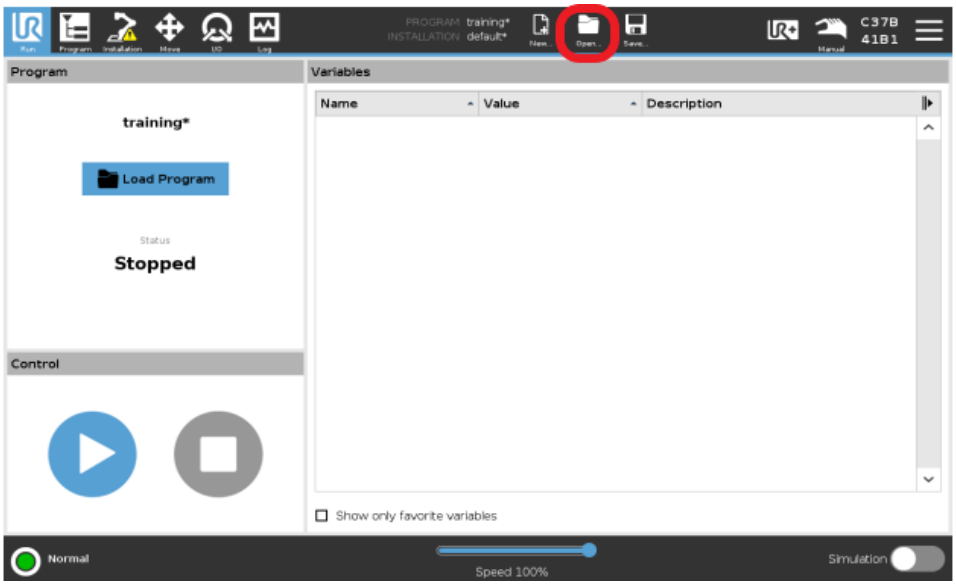
NOTE: You can use the 3D world to check the weld segments.



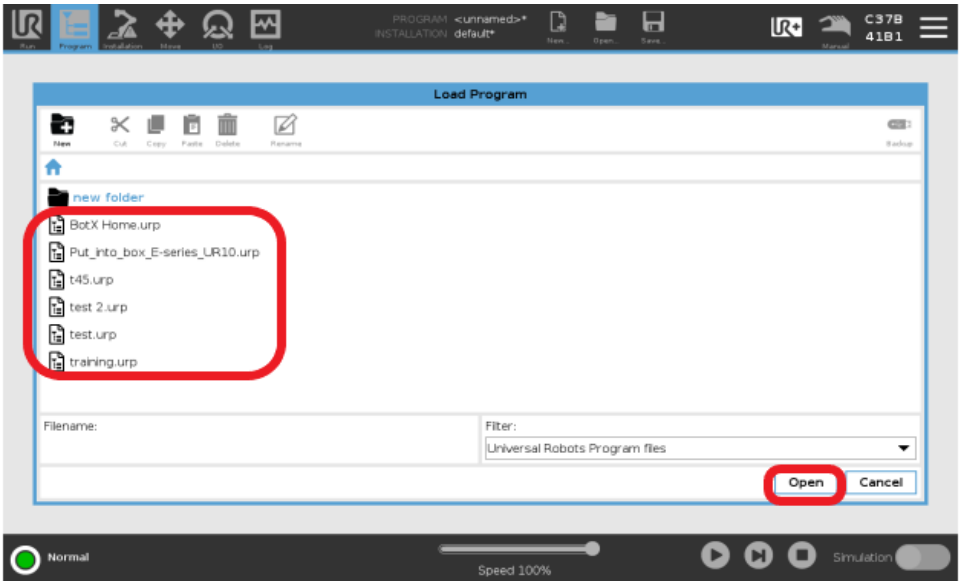
Tip: Each way point is an opportunity to change and adjust the torch angle, when creating complex weld sequences, it may be beneficial to create multiple points to slowly change the torch angle as the arm works through a weld node sequence.

6.15 Opening Programs

1. Select the **Open** file in the top center of the screen. Alternatively using the blue “Load Program” on the main page will open the list of programs available as well.

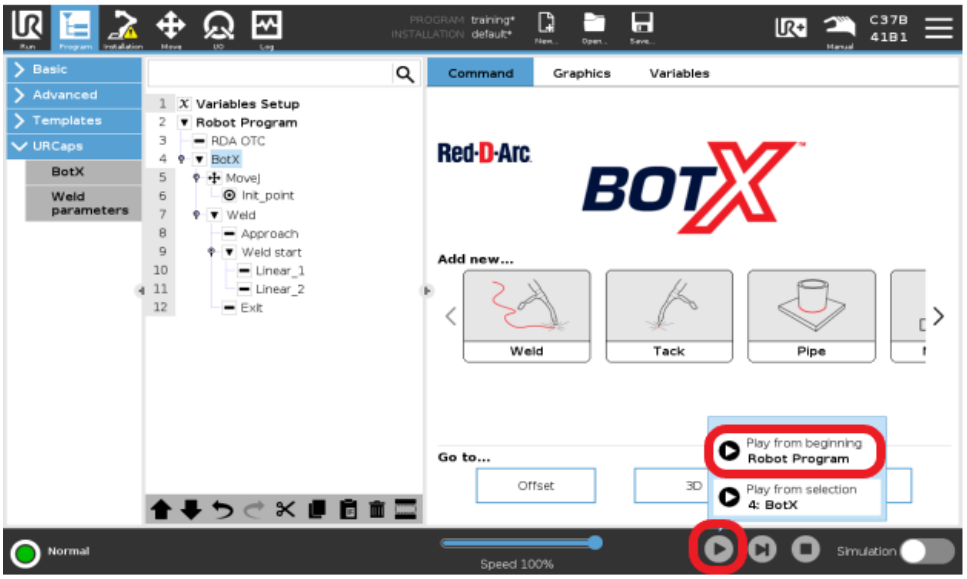


2. Select the name of the desired Program from the list and select **Open.**

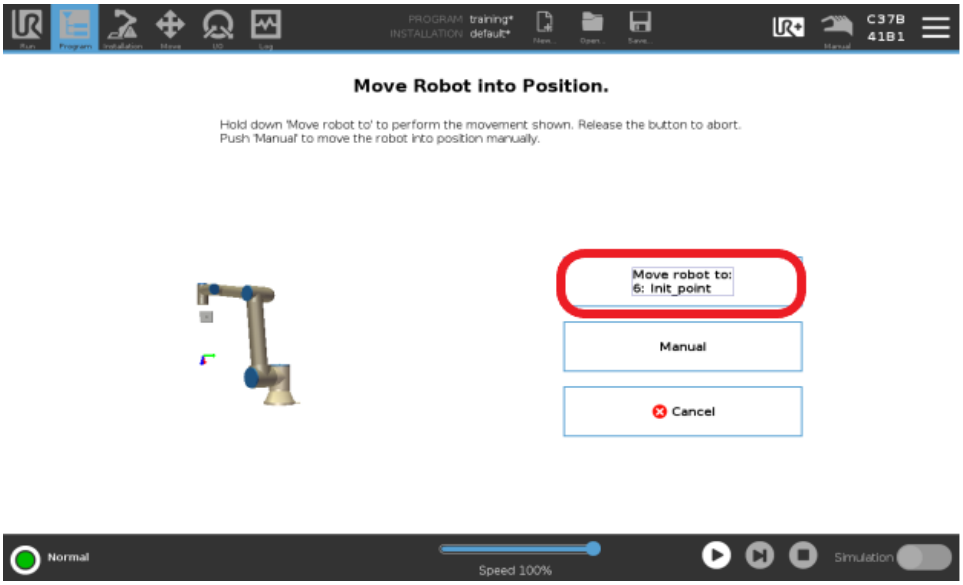


6.16 Running a Program

1. Press the play button at the bottom of the UR pendent.
   Select 'Play from the beginning of **Robot Program**.'

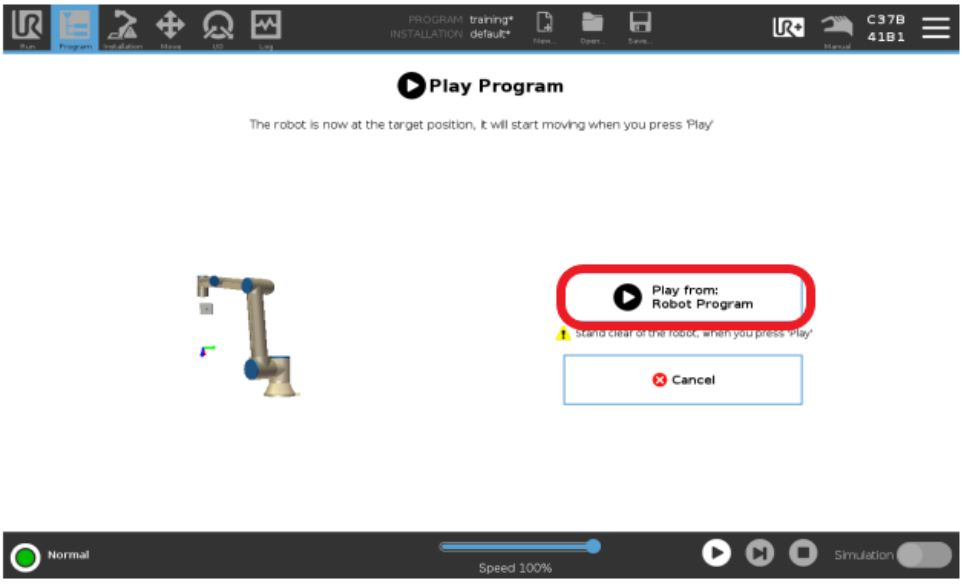


2. On the new screen press and **hold** ‘Move robot to 6: Init_point.’

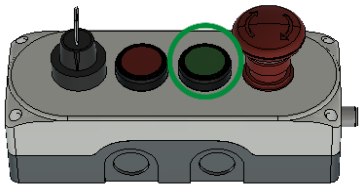


3. Press ‘Play from: Robot Program:

Once this is pressed it sends the program to the **operator box**. The **Green Button** will flash.



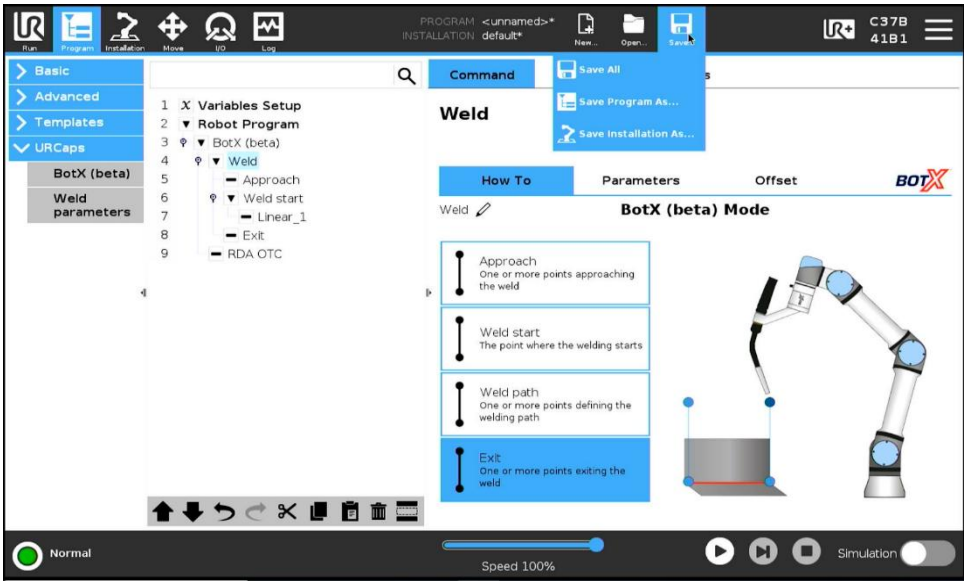
4. To play, press the **Green Button** on the operator box to start the program and continue to use the operator box to play the program as needed.



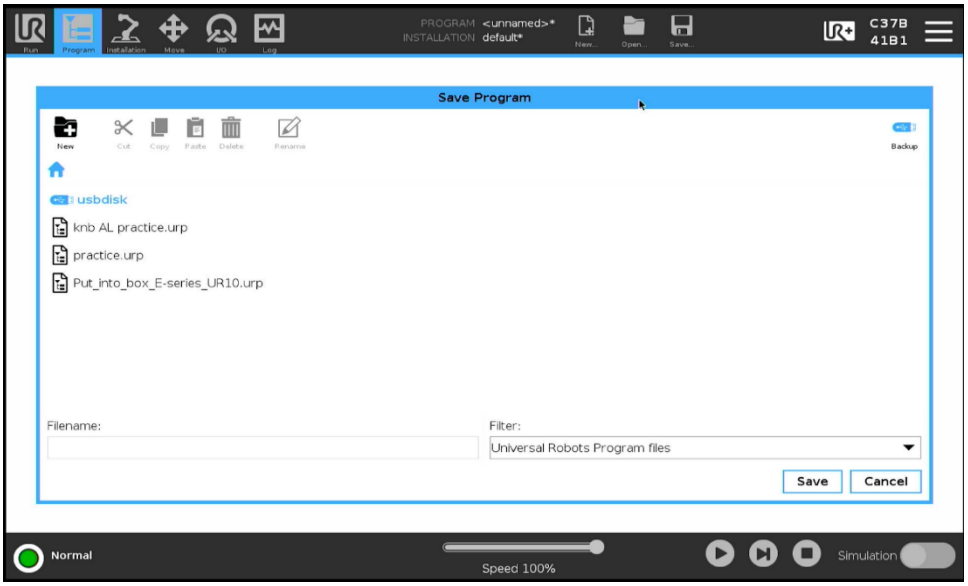
6.17 Saving a Program

1. Select the **Save** icon at the top center of the screen.

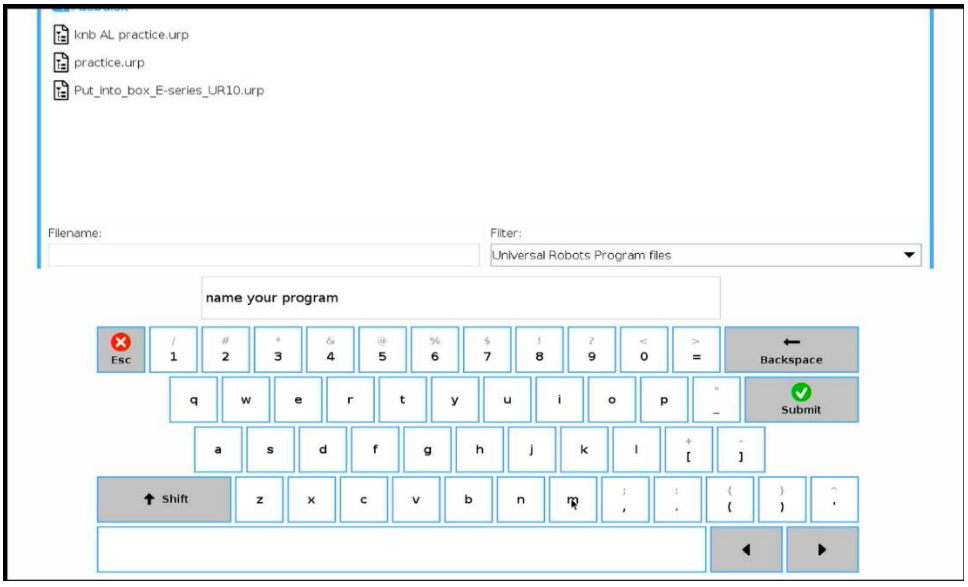
2. Select **Save** (If this is the first time saving a program, select **Save Program As…)**



3. Click on the Filename:

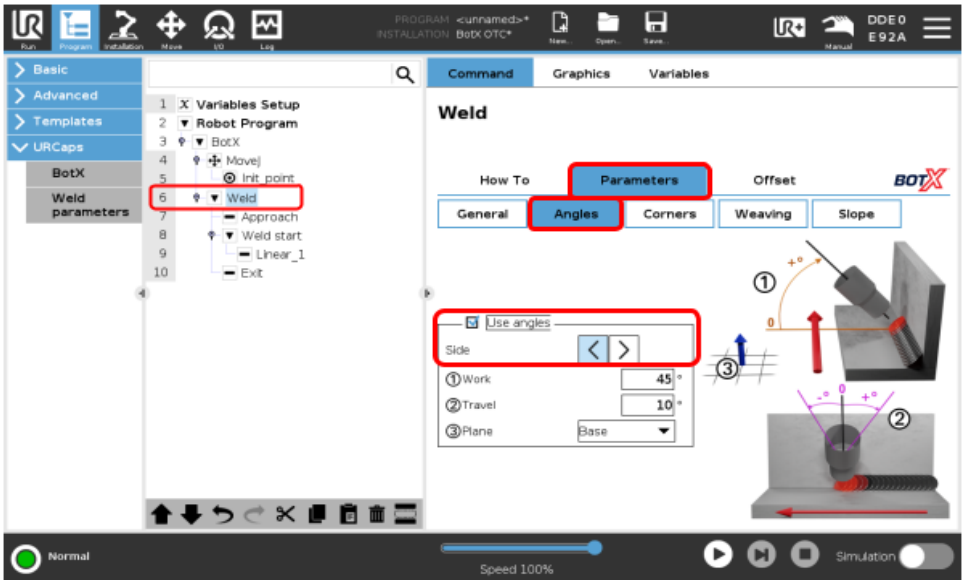


4. The Keyboard will appear allowing you to type in a name for the program.

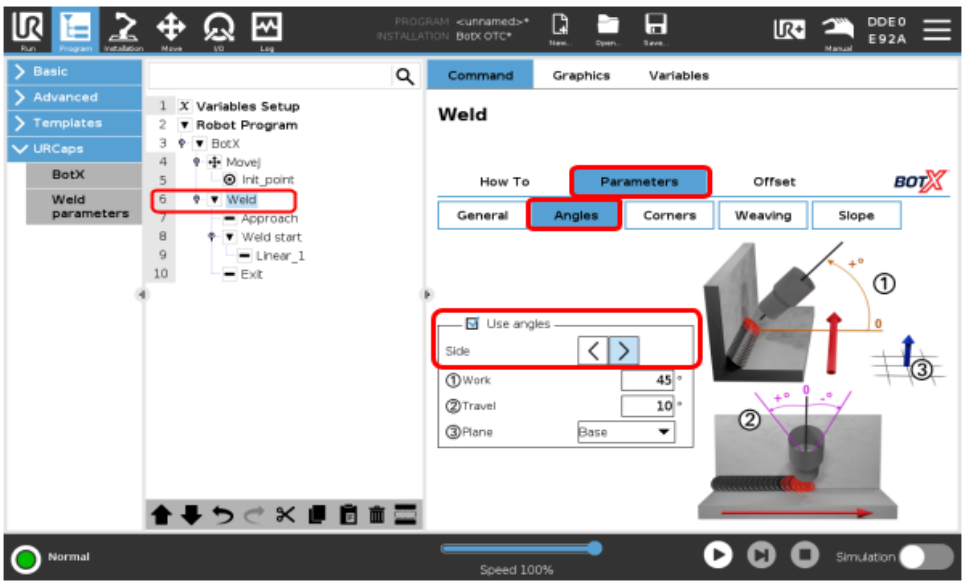


6.17 Programming Torch Angles

1. Select the **Weld > Parameters > Angles.**



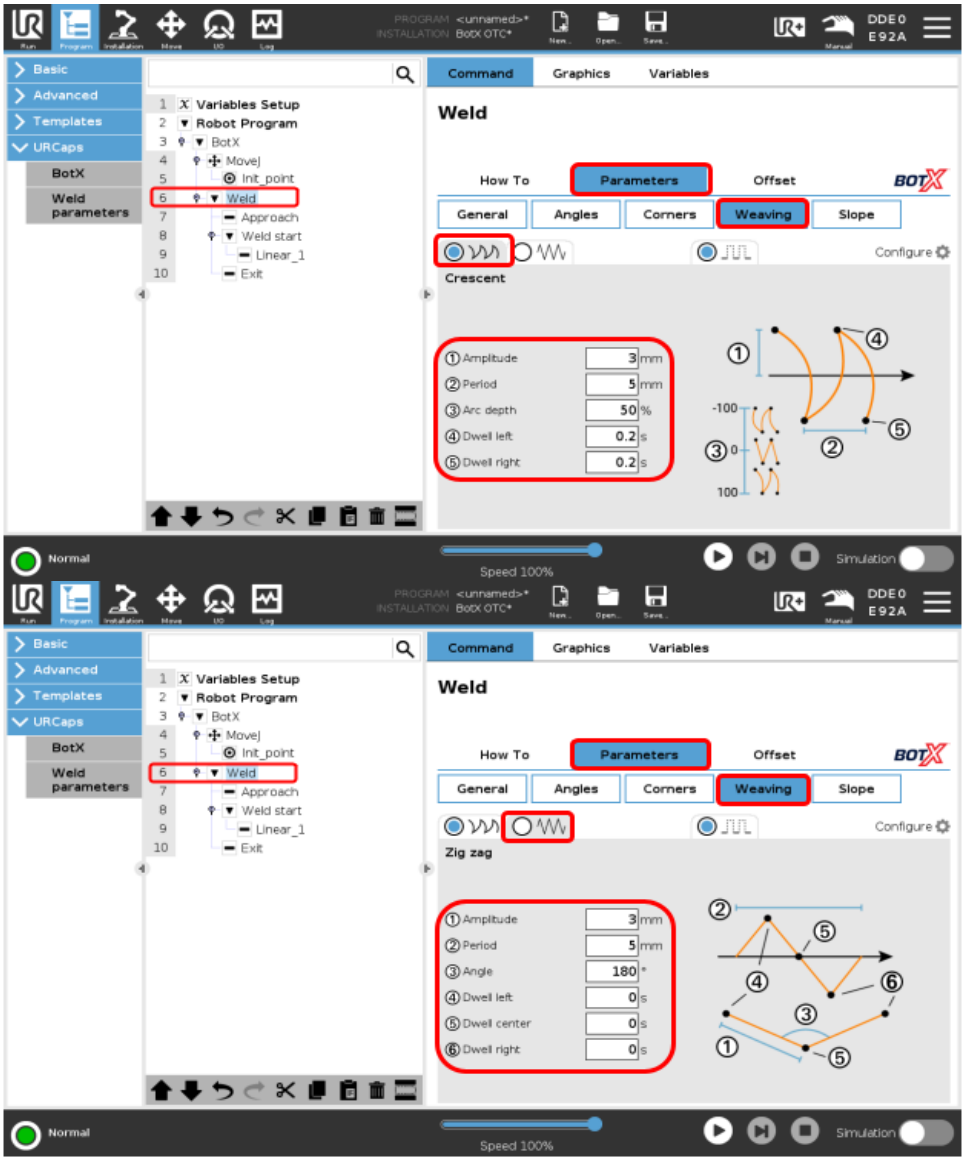
2. Select the **Use angles** check box.
3. Select the arrow for the direction of travel of the weld.
4. Set the work and travel angles as desired.



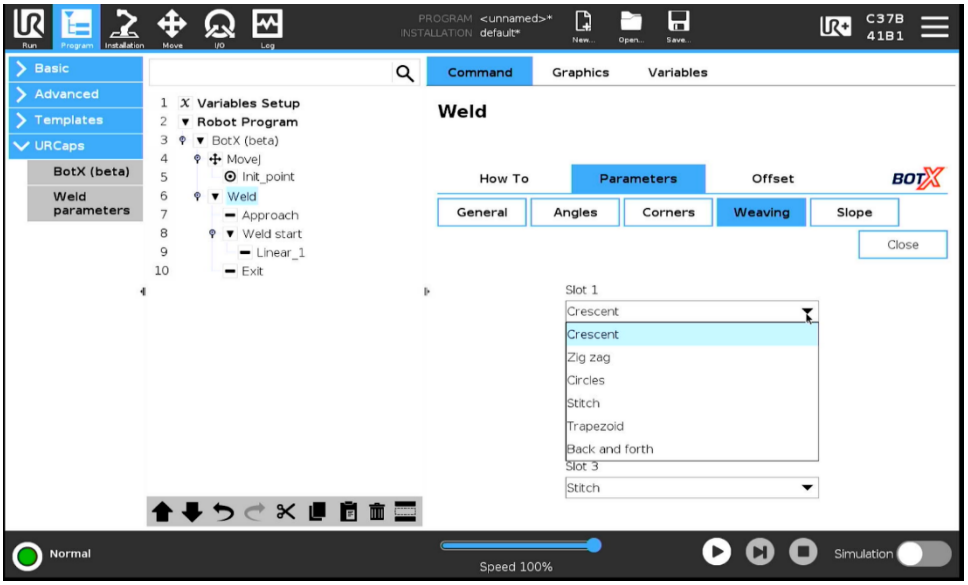
Note: You can use 3D world to check angles.

6.18 Weaving Programming

1. Select the **Weld** node in the program tree.
2. Select **Parameters > Weaving.**
3. Select from either weaving pattern (crescent, zig zag)
4. Set the inputs according to the onscreen diagram for desired result.

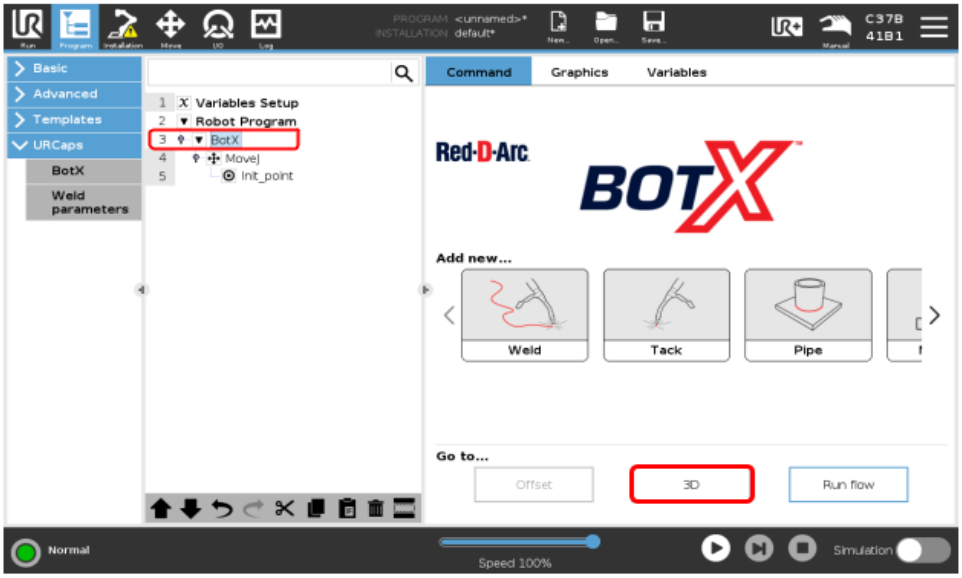


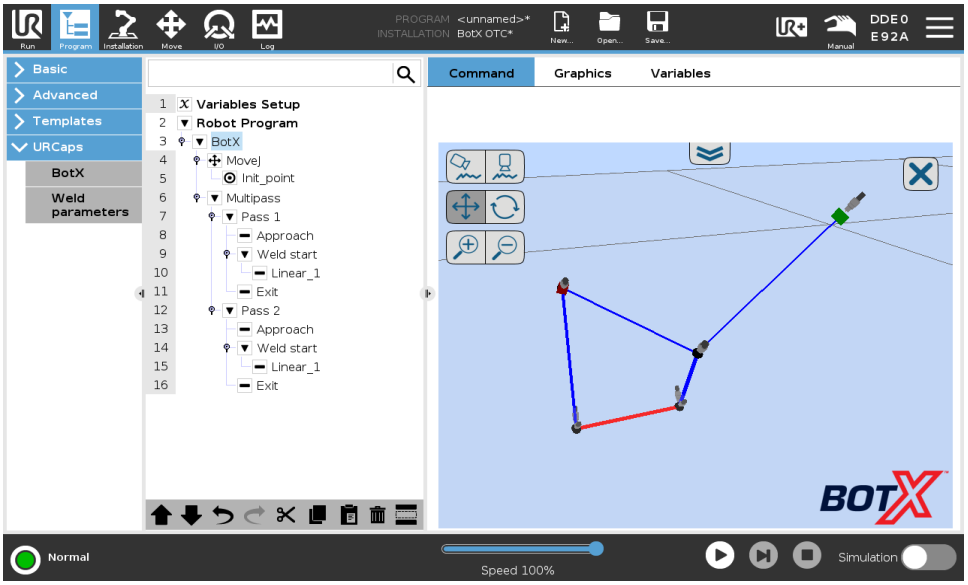
Additional Weave Patterns can be found under “Configure” as shown below:

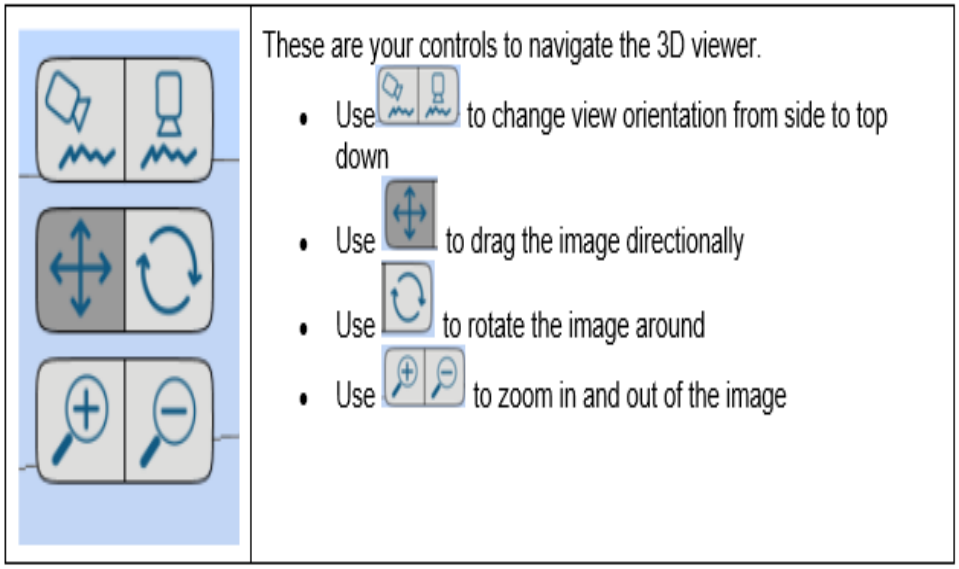


6.19 Using 3D Viewer

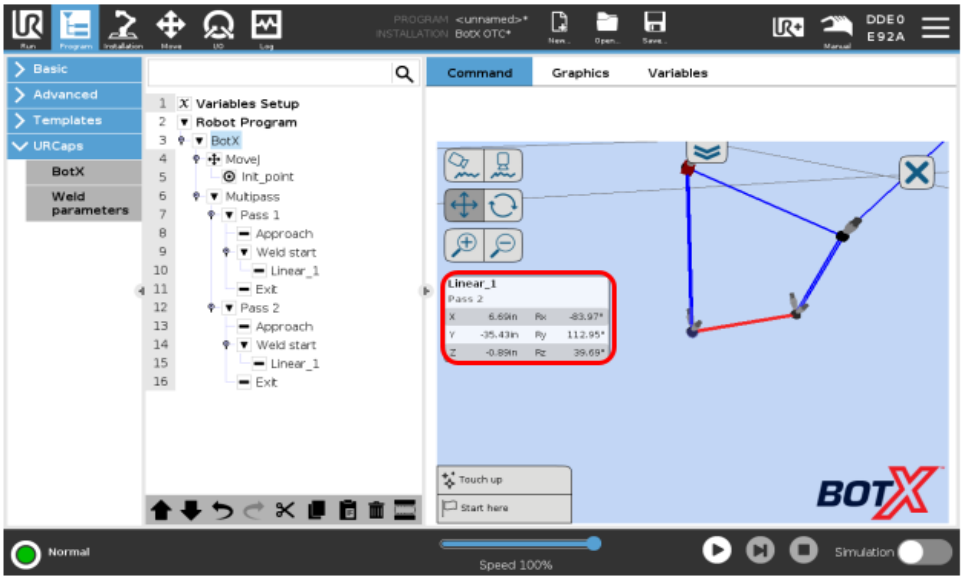
1. To access the 3D viewer, select the **BotX** node.
2. Select **3D** at the bottom center of the right screen.







NOTE: When using the 3D viewer each waypoint can be selected and provide x, y, z location and the name of the waypoint in the Program Tree

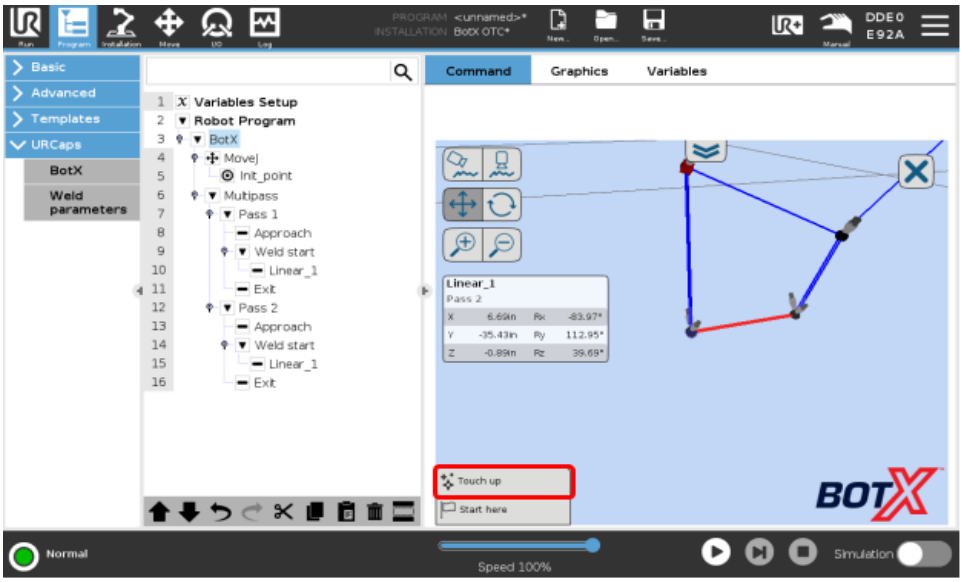


6.20 Touch Up Waypoints in 3D Viewer

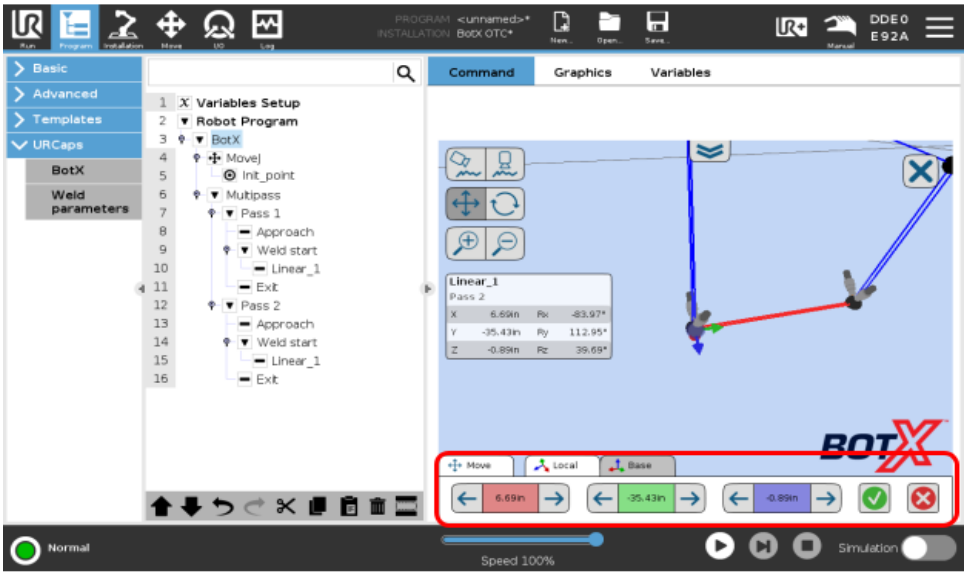
The following sections outline the two options to touch up and reteach waypoint data.

Option 1

1. Select **Touch Up** in the bottom left corner of the 3D viewer.

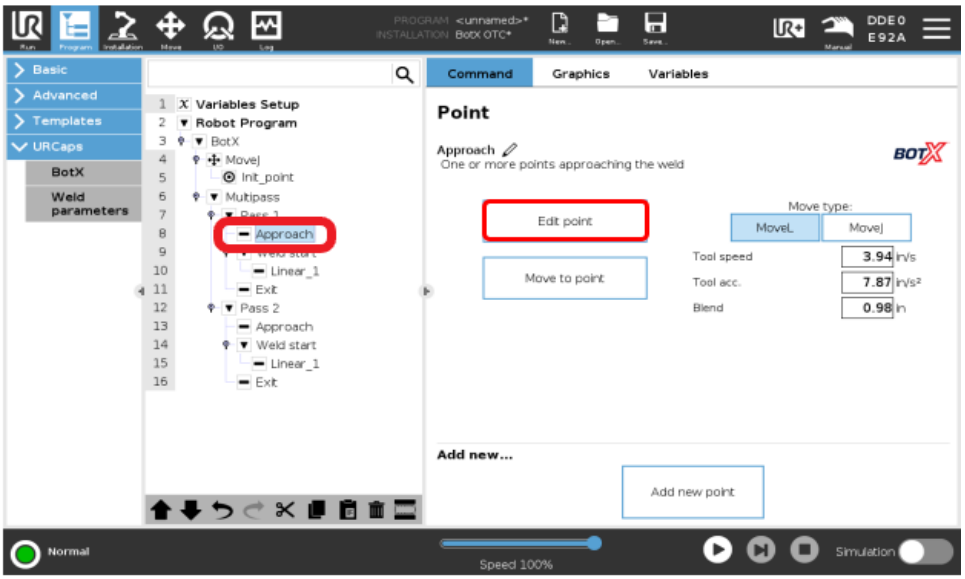


Use the tabs and arrows to touch up the point in the required direction. The adjustments will be visible in the 3D Viewer as they change.



Option 2: Touch Up in Program Tree

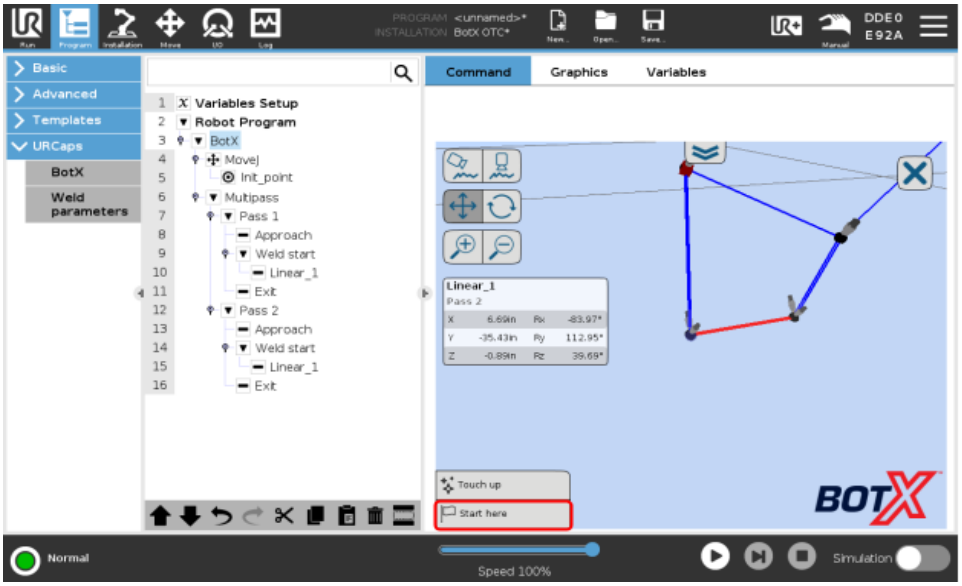
1. Select the line-item node that requires touch up.
2. Select **Edit Point**
3. A secondary window will open, the point can be touched up using the on-screen arrows or by physically moving the arm to the new location. **Press the Green check mark on screen to save and confirm the new waypoint for both cases.**



Option 3: Start here:

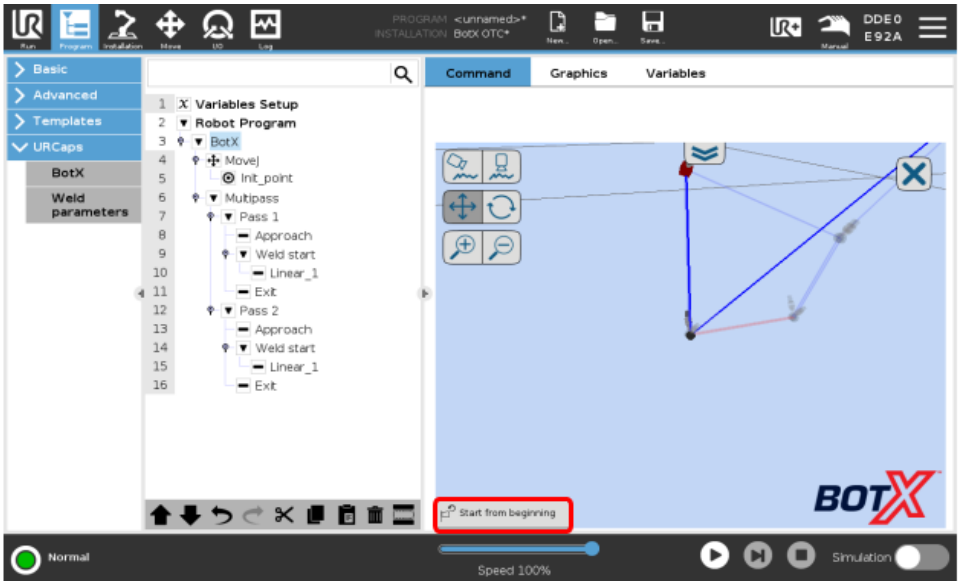
If there is a desired location to start other than the beginning of the program, it uses the **Start Here** function found in the 3D Viewer.

1. Select the waypoint in the 3D Viewer and select **Start Here** in the lower left corner.



The portion of the program that will be inactive will be grayed out. As shown below:

Use the **Start from Beginning** button to return to running the entire program.

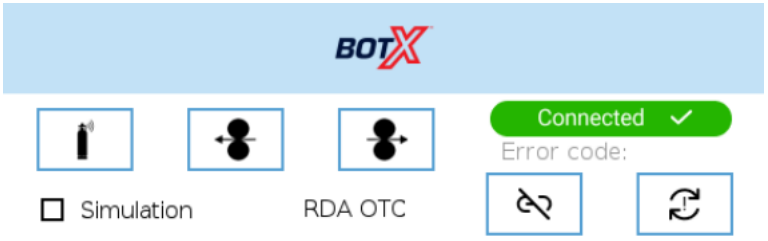


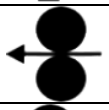
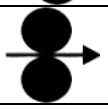
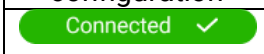
NOTE: When using the 'Start Here' function the Universal Robot arm will take the path of simplest/fastest calculation when going to the selected location and going home.

Note: Be aware of unexpected trajectory.

6.21 UR+ Button Functions

The UR+ toolbar can be found at the top right of the pendent. The toolbar provides quick access to the following weld equipment controls.



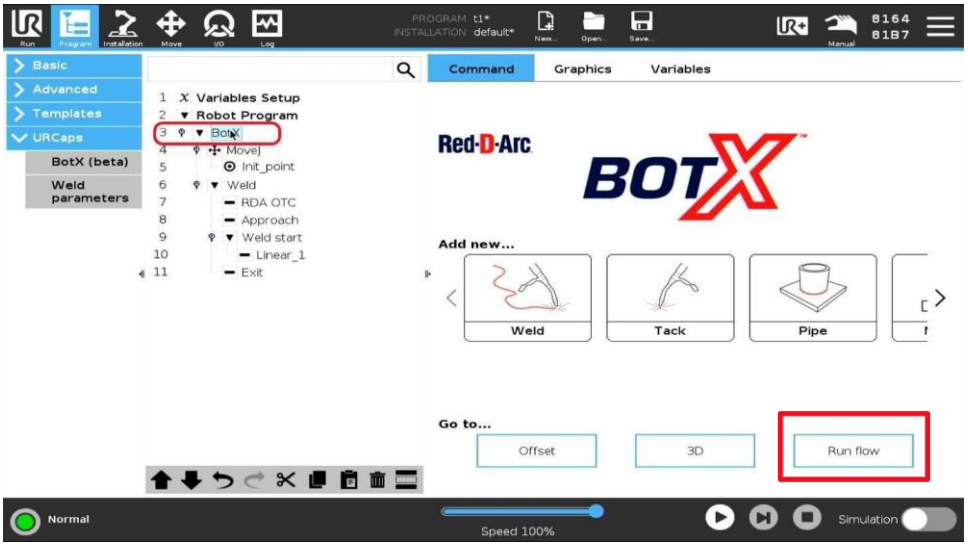
Identifier:	Description:
	Gas test: If enabled, the button will turn on the gas for the present amount. of time depending on the power source.
	Wire retract: If enabled, the button will start reversing the wire.
	Wire inch: If enabled, the button will start inching the wire.
Simulation checkbox	The checkbox determines if simulation is to be used. The checkbox will also send the state to the power source if connected.
Active Welding configuration	Reflects that actual active welding configuration.
	Describes the connection to the activated power source. Connected.
	Describes the connection to the activated power source. Disconnected.
	Connect: If visible and enabled, it will try to connect to the active power source using the IP defined on the installation page.
	Disconnect: If visible and enabled, will disconnect the active power source.
	Error reset: If visible and enabled, will send a reset error signal to the active power source.
	If an error has shown on the power source, please consult a BotX Specialist. This may be reset using the error reset.

6.22 Run Flow Functions

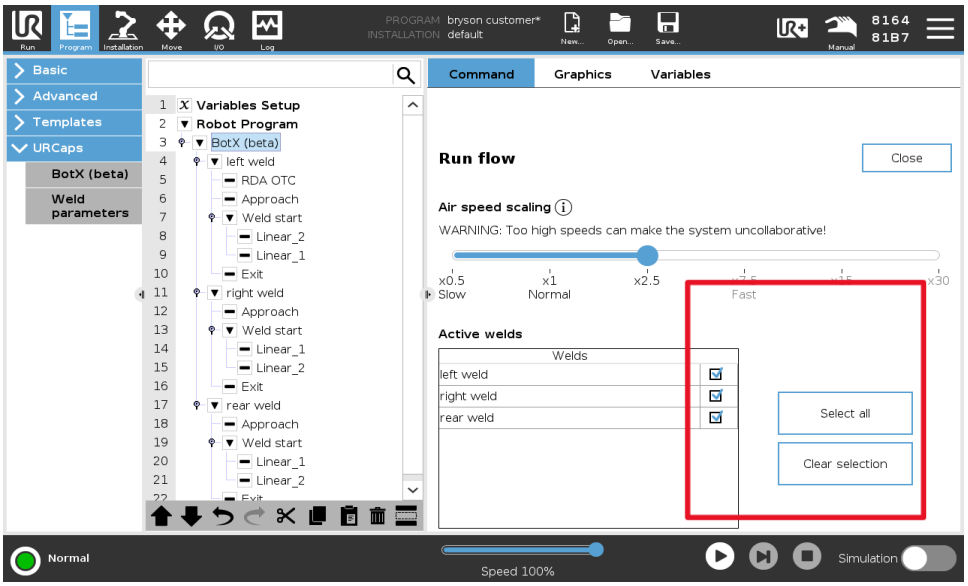
Run flow provides some short cuts to change the program execution, allowing you to turn welds on/off.

1. Select **BotX** in the left-hand menu as shown below:

2. Then select the **Run Flow** at the bottom right-hand corner as shown below:



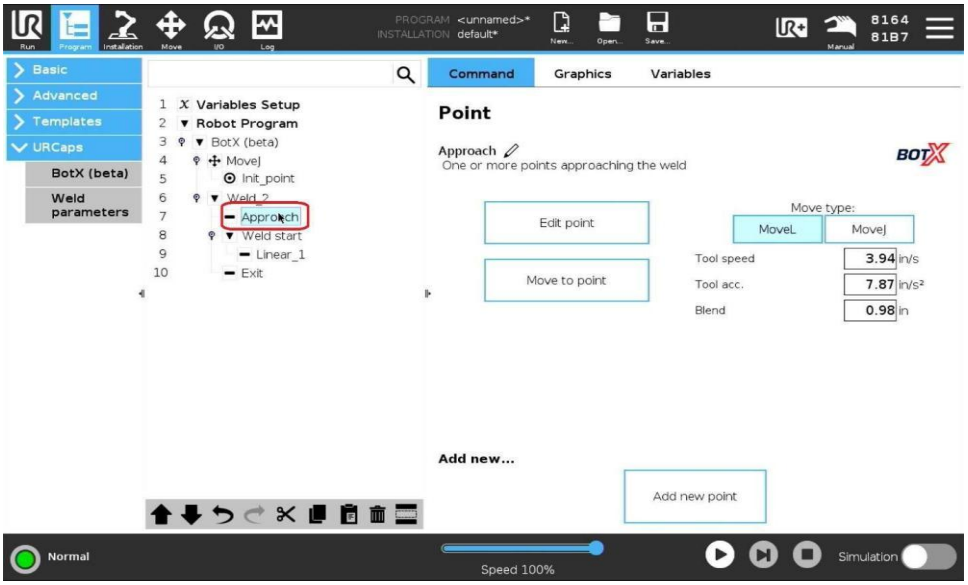
3. You can select each weld, select all or clear selection by clicking the appropriate boxes as shown below:



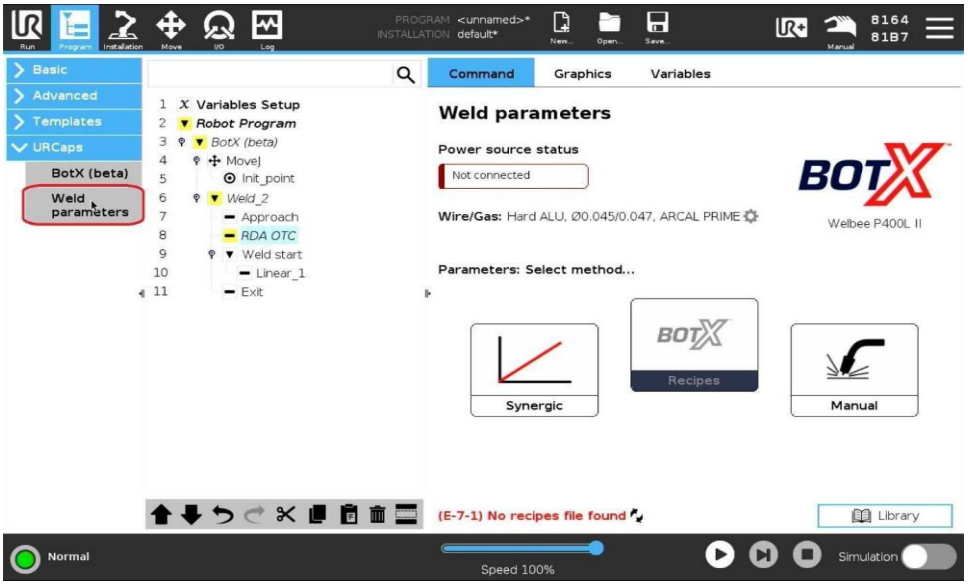
6.23 Adding Weld Parameters

Weld parameters node can be added anywhere in the program. However, it is recommended that you place them above the desired weld as shown in the steps below:

1. Highlight the **Approach**

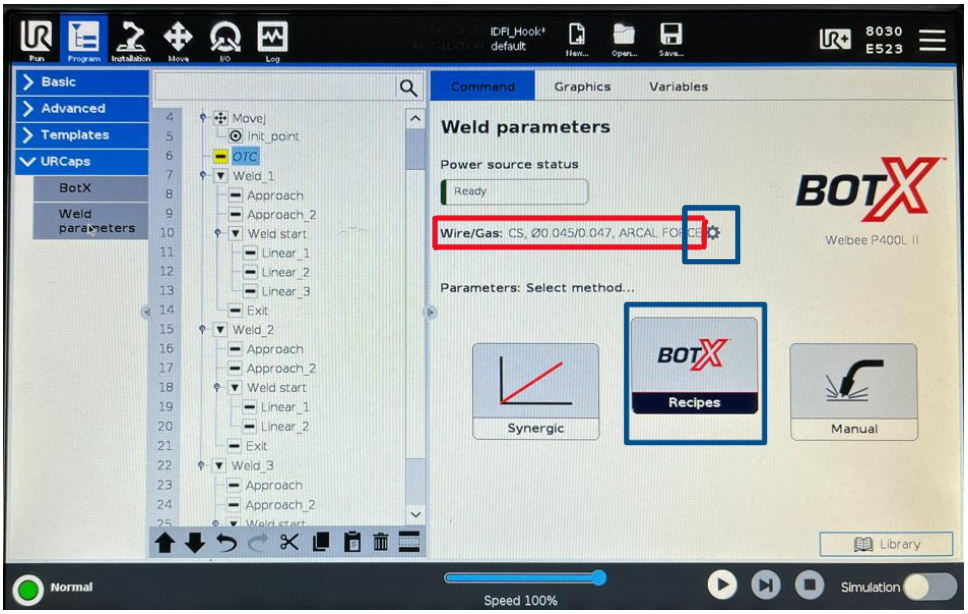


2. Select **Weld Parameters** as shown below:

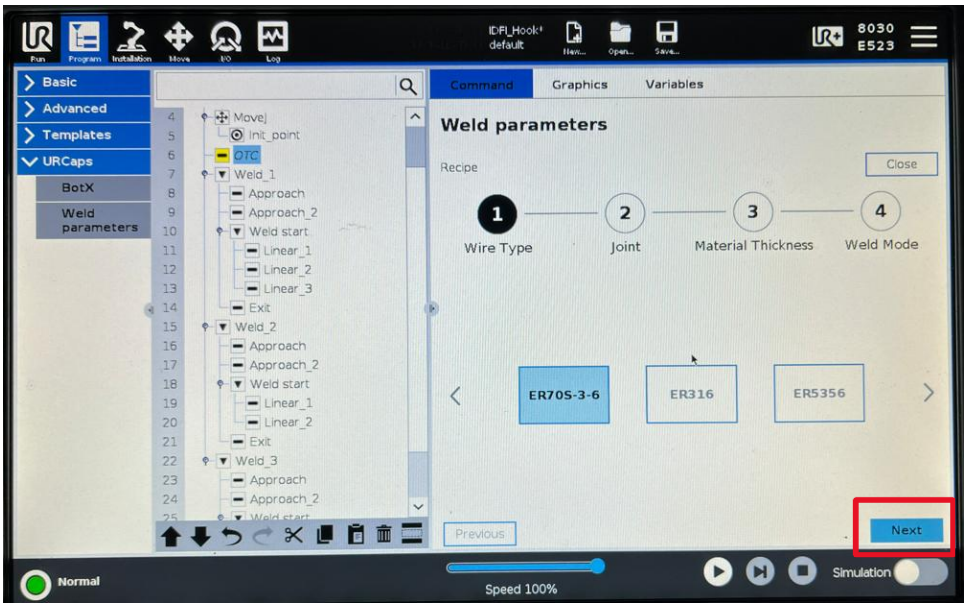


3. Using the navigation arrows to move the **OTC** node to the top of the desired weld node as shown below: (This example is using just one **OTC** node for the 3 welds shown)

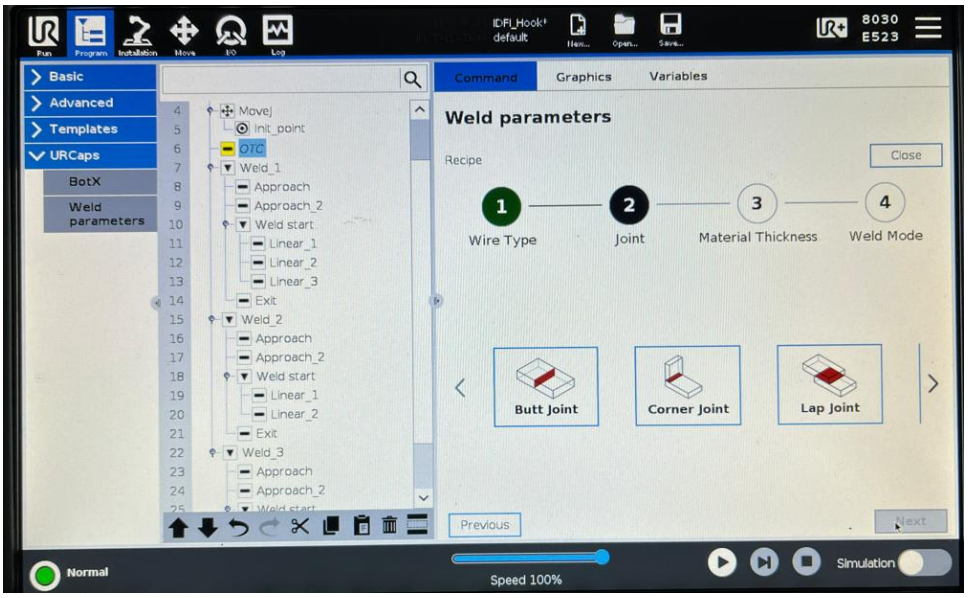
You will notice it auto populates the **Wire/Gas** information from previous usage. You can change it as required by clicking the **Gear** or by selecting the BotX recipes.



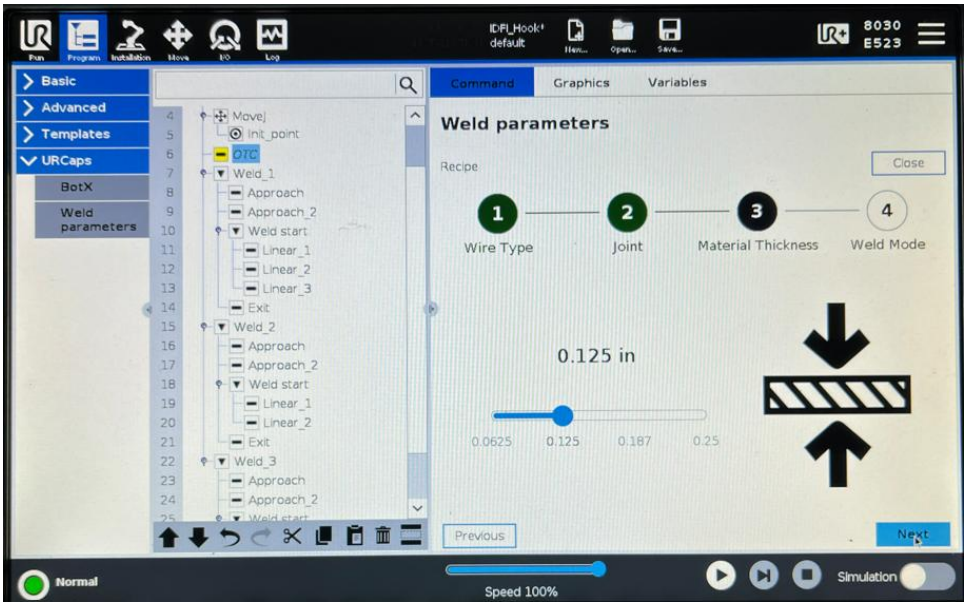
1. Once you select the **BotX Recipes,** you will be able to select the weld wire type than select the **Next** tab.



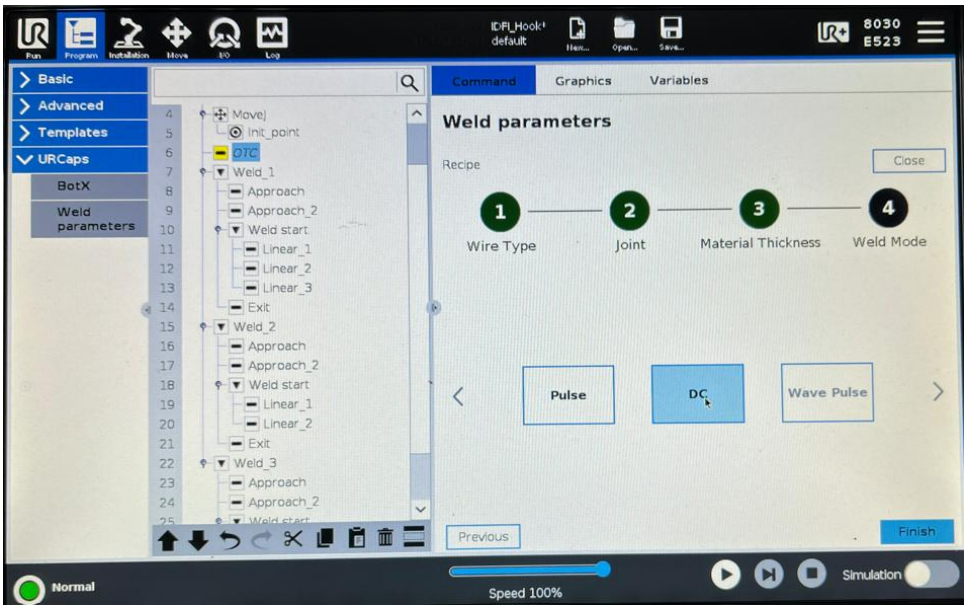
2. You will then be able to select the **Joint** than select the **Next** tab.



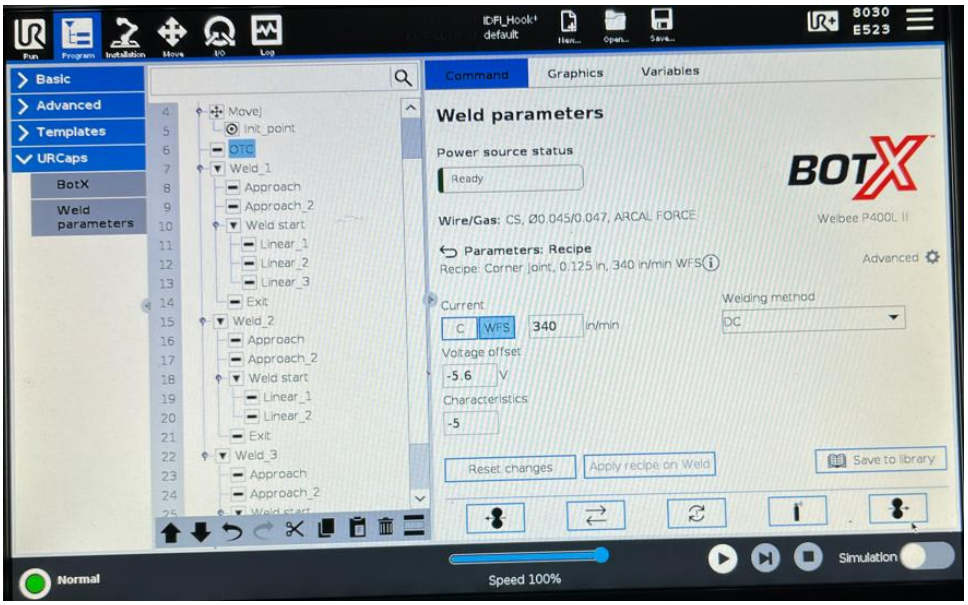
3. You will then select the **material thickness**, then select the **Next** tab.



4. You will then select the **Weld Mode**, then select the **Next** tab.



5. You will get a screen like the one shown below with all welding parameters loaded based on your selected inputs.



Section 7: Warranty and Troubleshooting

7.1 Useful Inks and Equipment Manuals

Red-D-Arc – BotX

- BotX Webpage
- RDA APP
- Red-D-Arc Website
- BotX Service and Support Link

Airgas

- Airgas Home

Universal Robots

- Universal Robots Website
- UR Online Manuals
- UR10e Information - Downloads
- UR20 Information - Downloads
- UR Tech. Support Link

OTC/Daihen

- OTC Daihen Website
- Welbee II

Flextur

- Website Link

Tregaskiss

- Website Link
- Torch Parts/Manual Link

7.2 Rental and Lease Warranty

With all rentals and leases your equipment is covered and we typically deploy a swap out of equipment if we are unable to diagnose. While our focus is on getting your operations back up and into production, the equipment will be evaluated by our service team. Our certified technicians will diagnose and repair, if it is **considered intentional damage**, we **will charge for the repair/s.**

The items not included are the consumable parts such as contact tips, diffuser, nozzle, torch, drive rolls and guides. These items can be purchased via Airgas or Red-D-Arc as required.

7.2 Sale Warranty

The standard warranty is broken down by the equipment manufacturer as we follow their suggested warranty periods.

The Universal Robots warranty is one year period from the date of sale. The robot and controller do require following the preventative maintenance program found in section 8 in this manual. We also offer an additional warranty period of an additional year for purchase, please contact your local Airgas or Red-D-Arc salesperson for details.

The OTC weld equipment comes with a Three-year warranty, this includes the Welbee II 400/500 and CM-743U wire feeder. This doesn't include the consumable parts such drive rolls and guides. These items can be purchased via Airgas or Red-D-Arc as required.

We also cover all other items for a period of one year, this includes items such as the operations box, light Horn, torch mounting, robot mounting and electronic cabling.

We do not cover the consumable items related to the welding torch, such as contact tips, diffuser, or nozzle, these items can be purchased via Airgas or Red-D-Arc as required.

Section 8: Maintenance and Inspection

8.1 UR Inspection and Cleaning Plan

Robot

Below is a check list of inspections that Universal Robots recommends be performed according to the marked time interval. If upon inspection, the referenced parts are not in an acceptable state, please contact your local Airgas or Red-D-Arc.

Items to check			Monthly	Semi-annually	Annually
1	Check blue lids *	V		X	
2	Check blue lid screws	F		X	
3	Check flat rings	V		X	
4	Check robot cable	V		X	
5	Check robot cable connection	V		X	
6	Check Robot Arm mounting bolts *	F	X		
7	Check Tool mounting bolts *	F	X		
8	Check screws/bolts on joints *	F		X	

V = Visual inspection F = Functional inspection * = Must also be checked after heavy collision

The purpose of the functional inspection is to ensure that screws, bolts, tools and robot arm are not loose.

For cleaning you can wipe away any dust/dirt/oil observed on the Robot Arm using a cloth and one of the following cleaning agents: Water, Isopropyl alcohol, 10% Ethanol alcohol or 10% Naphtha. If the robot is operating in a harsh environment, for example in cutting fluid, coolant, etc. Universal Robots do recommend regular cleaning.

DO NOT USE BLEACH. Do not use bleach in any diluted cleaning solution.

In rare cases, very small amounts of grease can be visible from the joint. This does not affect the function, use, or lifetime of the joint.

NOTE: Never use compressed air to clean the Robot Arm as it can damage components.

Teach Pendant

It may become necessary to clean the Teach Pendant screen. A standard mild industrial cleaning agent without a thinning agent or any aggressive additives is recommended. Do not use an abrasive material to wipe down the screen.

Control Box

Control box contains two filters, one on each side of Control Box.

1. Gently remove the outer plastic frame, by pulling where the red arrows are shown. The frame will tilt out.
2. Remove the filter to clean it. Clean using low pressure air or replace filters if necessary. Remember to clean each side. Replace it if it is very dirty and damaged.

3. Listen to the fan when running, if it sounds abnormal, contact your service provider or replace.

NOTE: Never use compressed air to clean inside the Control Box as it can damage components

Please refer to the following article for full explanation on cleaning your robot parts: https://www.universal-robots.com/articles/ur-articles/cleaning-of-robot-arm/

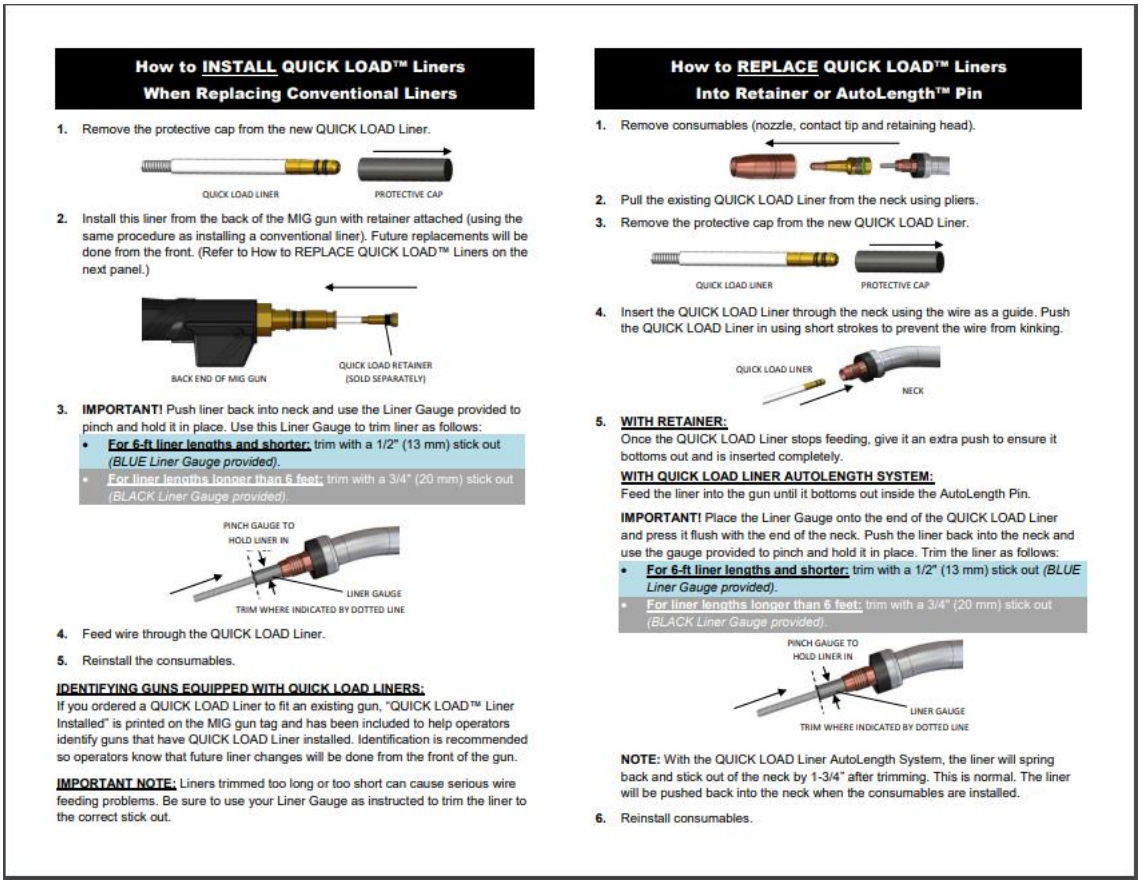
8.2 Welding Torch Consumables and Maintenance

Item	Location	Daily	Weekly	Monthly	Quarterly	Yearly
Contact Tip	Torch	X				
Air Filters	Robot Cabinet		X			
Nozzle[1]	Torch		X			
Retaining Head[2]	Torch			X		
Liner[3]	Torch				X	
Drive Rolls[4]	Feeder					X

1. Change nozzle if spatter does not readily come off
2. Change the retaining head if the gas ports become clogged
3. Change the liner if the wire does not feed smoothly
4. Change the drive rolls if slippage is noticed

Tregaskiss Quick Load Liner Installation

To change a quick load liner on the BotX system stretch the Universal Robots arm out to form a mostly straight torch. Follow the OEM instructions below.



How to INSTALL QUICK LOAD™ Liners When Replacing Conventional Liners

1. Remove the protective cap from the new QUICK LOAD Liner.

2. Install this liner from the back of the MIG gun with retainer attached (using the same procedure as installing a conventional liner). Future replacements will be done from the front. (Refer to How to REPLACE QUICK LOAD™ Liners on the next panel.)

3. **IMPORTANT!** Push liner back into neck and use the Liner Gauge provided to pinch and hold it in place. Use this Liner Gauge to trim liner as follows:
   - **For 6-ft liner lengths and shorter:** trim with a 1/2" (13 mm) stick out *(BLUE Liner Gauge provided)*.
   - For liner lengths longer than 6 feet: trim with a 3/4" (20 mm) stick out *(BLACK Liner Gauge provided)*.

4. Feed wire through the QUICK LOAD Liner.
5. Reinstall the consumables.

IDENTIFYING GUNS EQUIPPED WITH QUICK LOAD LINERS:
If you ordered a QUICK LOAD Liner to fit an existing gun, "QUICK LOAD™ Liner Installed" is printed on the MIG gun tag and has been included to help operators identify guns that have QUICK LOAD Liner installed. Identification is recommended so operators know that future liner changes will be done from the front of the gun.

IMPORTANT NOTE: Liners trimmed too long or too short can cause serious wire feeding problems. Be sure to use your Liner Gauge as instructed to trim the liner to the correct stick out.

How to REPLACE QUICK LOAD™ Liners Into Retainer or AutoLength™ Pin

1. Remove consumables (nozzle, contact tip and retaining head).

2. Pull the existing QUICK LOAD Liner from the neck using pliers.
3. Remove the protective cap from the new QUICK LOAD Liner.

4. Insert the QUICK LOAD Liner through the neck using the wire as a guide. Push the QUICK LOAD Liner in using short strokes to prevent the wire from kinking.

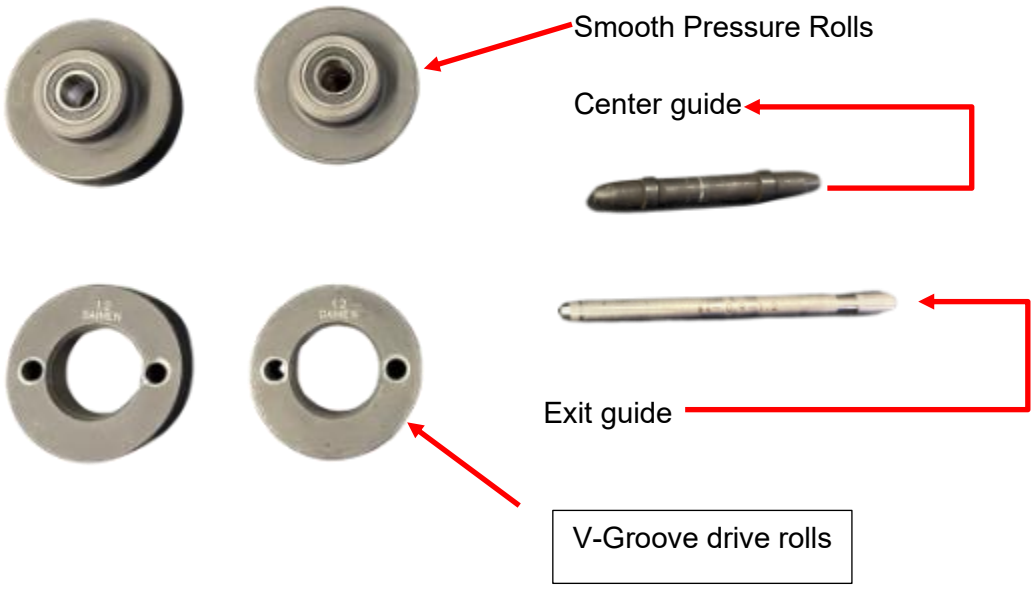
5. **WITH RETAINER:**
Once the QUICK LOAD Liner stops feeding, give it an extra push to ensure it bottoms out and is inserted completely.
WITH QUICK LOAD LINER AUTOLENGTH SYSTEM:
Feed the liner into the gun until it bottoms out inside the AutoLength Pin.
IMPORTANT! Place the Liner Gauge onto the end of the QUICK LOAD Liner and press it flush with the end of the neck. Push the liner back into the neck and use the gauge provided to pinch and hold it in place. Trim the liner as follows:
   - **For 6-ft liner lengths and shorter:** trim with a 1/2" (13 mm) stick out *(BLUE Liner Gauge provided)*.
   - For liner lengths longer than 6 feet: trim with a 3/4" (20 mm) stick out *(BLACK Liner Gauge provided)*.

NOTE: With the QUICK LOAD Liner AutoLength System, the liner will spring back and stick out of the neck by 1-3/4" after trimming. This is normal. The liner will be pushed back into the neck when the consumables are installed.

6. Reinstall consumables.

8.4 OTC CM-743-U Drive Roll Installation

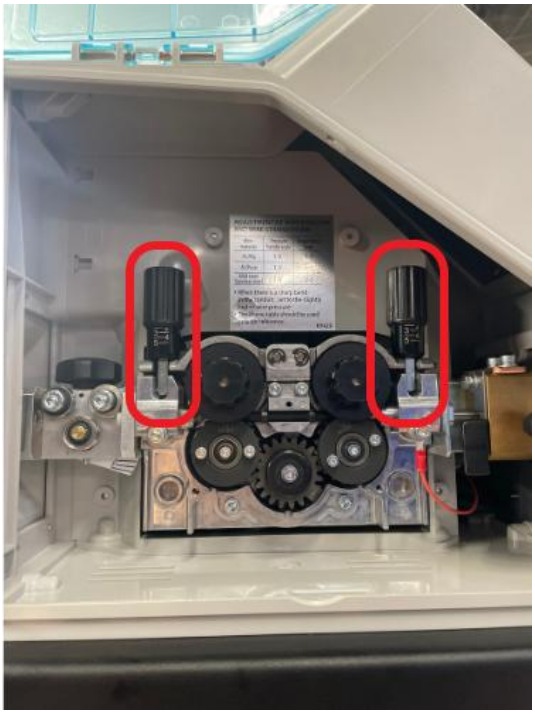
Steel Drive Roll Components



Steel Drive Roll Installation

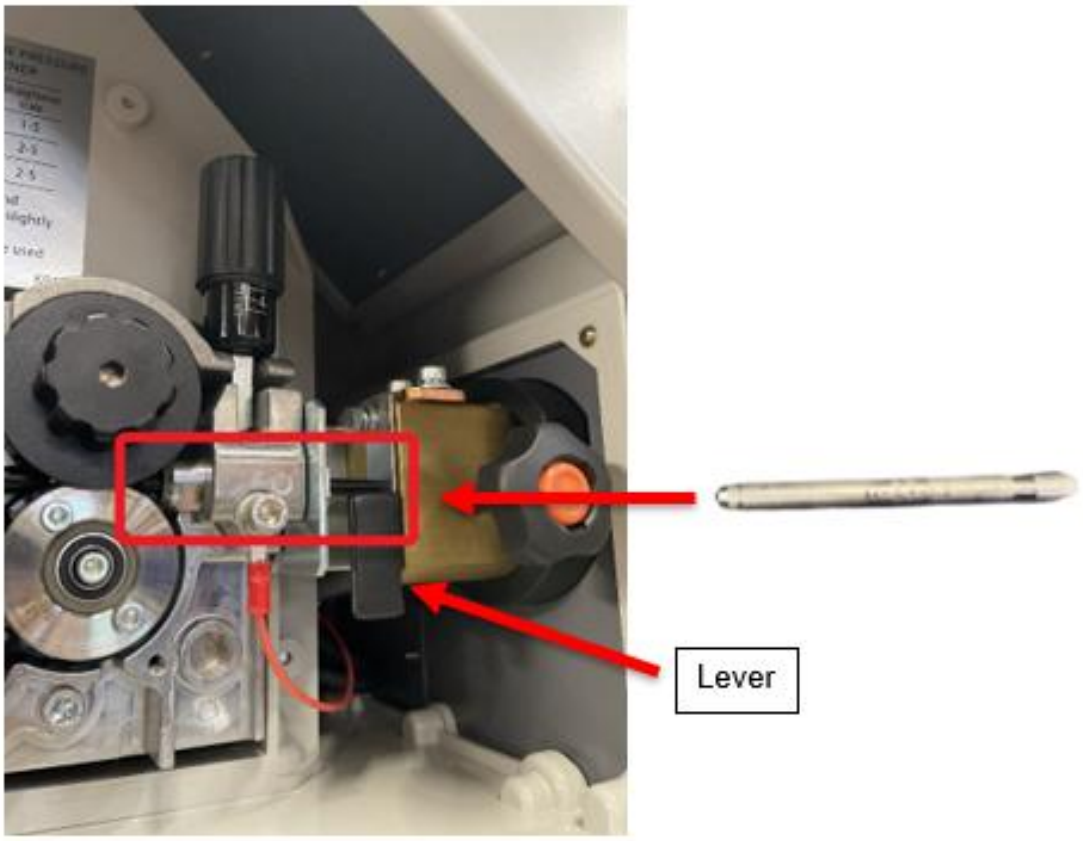
1. Lift the side blue panel and lock it into place behind the upper lip of the wire feeder.

2. Pull down on the tension knobs to release the top drive rolls from engagement.



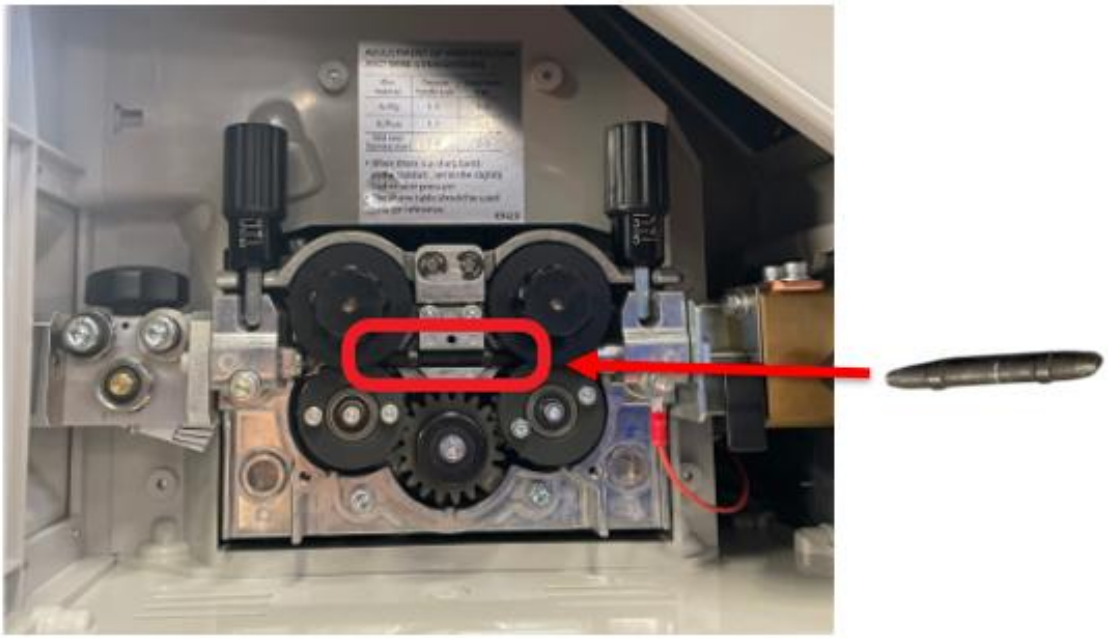
4. Remove the top drive roll retainer knobs, then remove the gear and use a 3mm Allen to secure the black smooth surface pressure rolls to the gears.

5. After, insert the silver, metal, wire exit guide into the brass block and secure with the black lever.



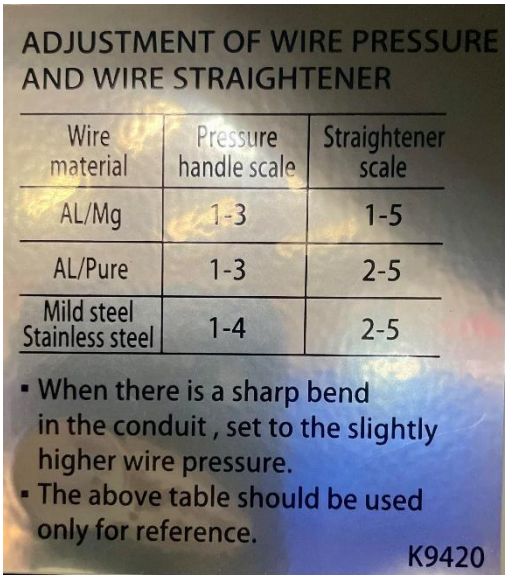
6. Remove the lower gear and drive rolls and use a 3mm Allen to secure the V-groove rolls to the gears. Be sure that the desired wire diameter is facing out and readable on the drive rolls.

7. Replace the gears into the wire feeder and add the black, metal, center guide.



8. Close the top rollers by reengaging the tension knobs and replace the blue shield.

NOTE: Double check the tension knob and set the tension according to the chart in the wire feeder.



ADJUSTMENT OF WIRE PRESSURE AND WIRE STRAIGHTENER

Wire material	Pressure handle scale	Straightener scale
AL/Mg	1-3	1-5
AL/Pure	1-3	2-5
Mild steel Stainless steel	1-4	2-5

- When there is a sharp bend in the conduit , set to the slightly higher wire pressure.
- The above table should be used only for reference.

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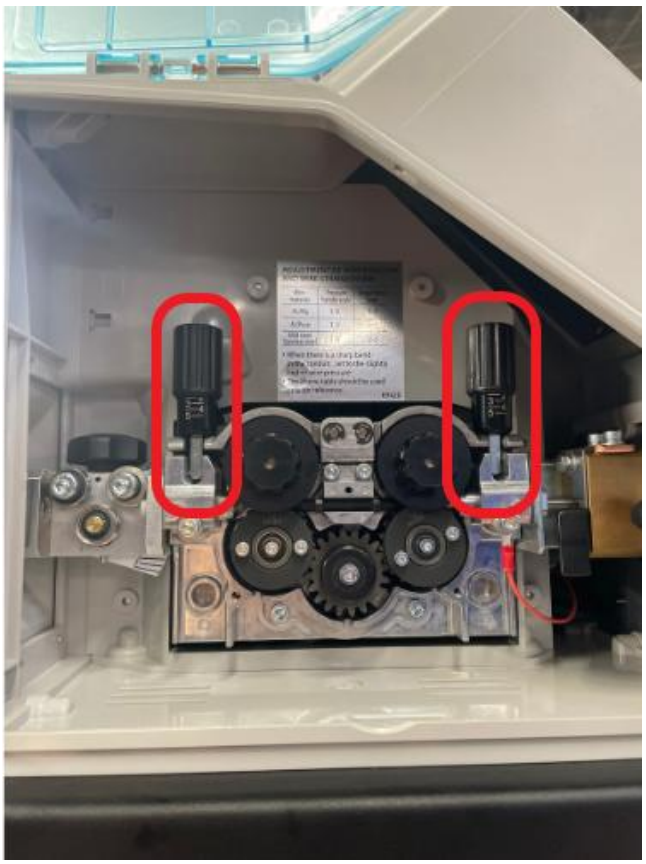
Aluminum Drive Roll Components

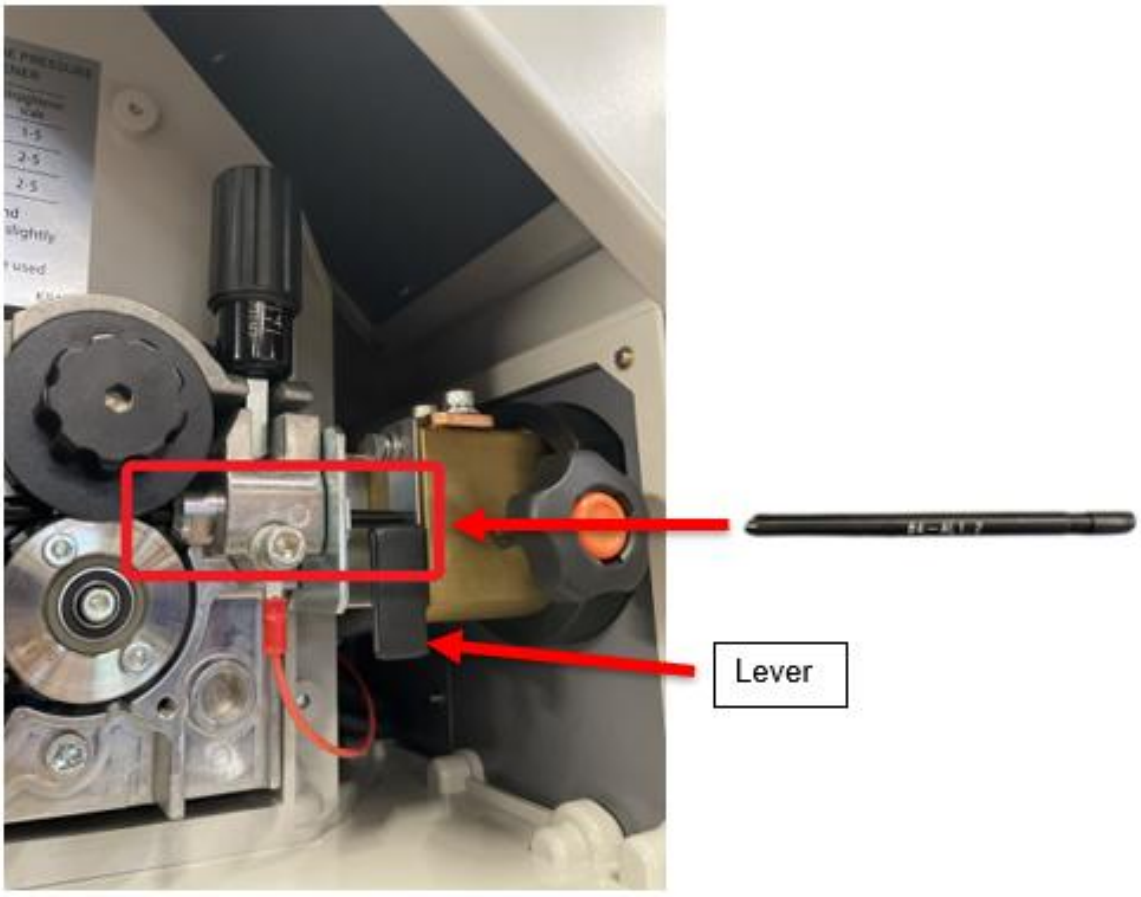
1. Lift the side blue panel and lock it into place behind the upper lip of the wire feeder.

2. Pull down on the tension knobs to release the top drive rolls from engagement.



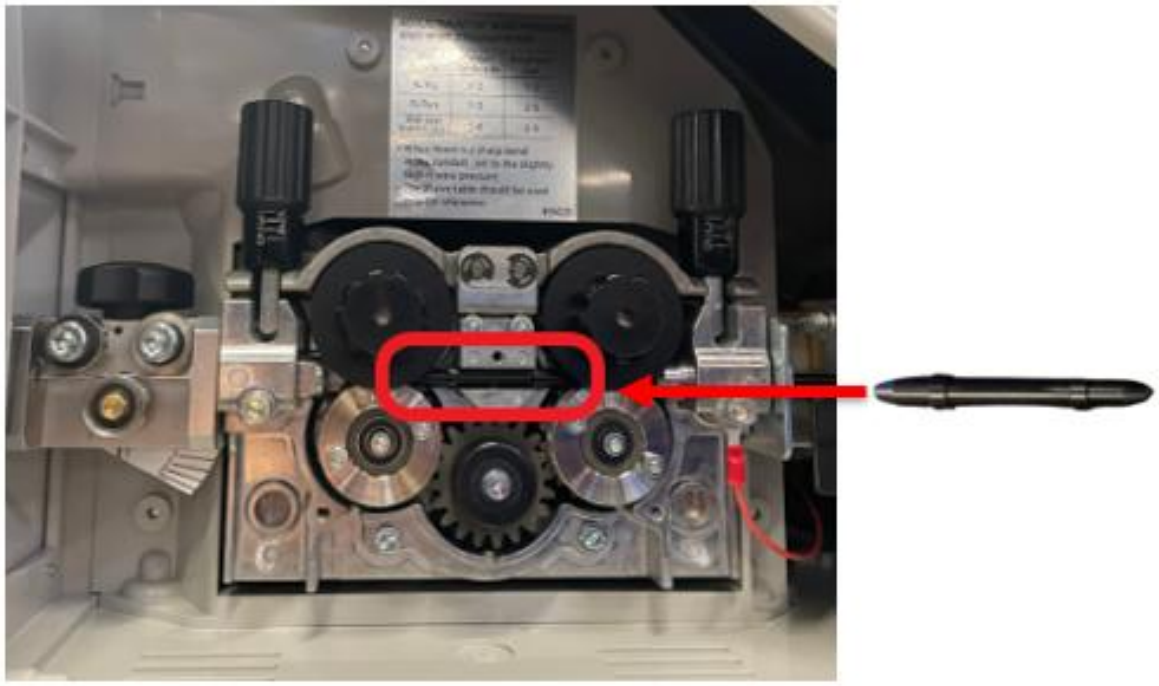
3. Remove the top drive roll retainer knobs, then remove the gear and use a 3mm Allen to secure the silver U-groove rolls to the gears.

4. Insert the black plastic wire exit guide into the brass block and secure with the black lever. This guide is labeled AL.



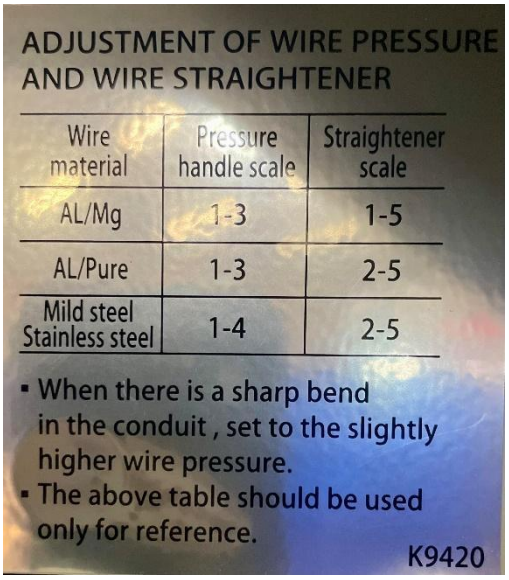
5. Remove the lower gear and drive rolls and use a 3mm Allen to secure the U-groove rolls to the gears. Be sure that the desired wire diameter (0.035 or 0.045) is facing out and readable.

6. Replace the gears into the wire feeder and add the black, plastic, center guide.



7. Close the top rollers by reengaging the tension knobs and replace the blue shield.

Note: Double check the tension knob and set the tension according to the chart in the wire feeder.



ADJUSTMENT OF WIRE PRESSURE AND WIRE STRAIGHTENER

Wire material	Pressure handle scale	Straightener scale
AL/Mg	1-3	1-5
AL/Pure	1-3	2-5
Mild steel Stainless steel	1-4	2-5

- When there is a sharp bend in the conduit , set to the slightly higher wire pressure.
- The above table should be used only for reference.

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8.5 Welding Table

Periodically use visual inspection to check the welding table slats for wear and spatter that has bonded to the surface.

Use 3-in-1 multipurpose oil to clean the table surfaces and tooling. Use a cloth to buff the surface and clean any access oil before welding on the surface.

The table slats are dual sided. If the table slats are damaged remove them from the table base, flip them, and re-secure with the hardware.

NOTE: Once a month, turn the system OFF and visually examine the cable connections for and wear, slices, or burns on the coatings. If a damaged cable is discovered take a photo and reach out to your local Red-D-Arc contact for further instructions and replacement of the cable before powering the system back on.

Section 9: Risk Assessment

9-1: Risk Assessment Definitions

System risk assessment performed per the requirements of ANSI/RIA R15.06-2012 (ISO10218-2) Part 2 robot systems and integration, Article 5.11.2a Collaborative robot operation general requirements.

System risk assessment conducted accordingly to RIA TR R15.306-2016, User and task-based risk assessment methodology utilizing the task-based template below (Figure 1) and (Figure 2).

It is the User/Owner responsibility to review to determine if other measures are required to mitigate hazards applicable to their operation and use of the equipment. This is considered a Field Risk Assessment typically referencing the Design Risk Assessment provided.

Figure 1: Task Based Template

User	Task	Hazard			Initial Risk			
		Type	Origin	Consequence	Severity	Exposure	Avoidance	Category

Figure 2: Risk Level Decision Matrix

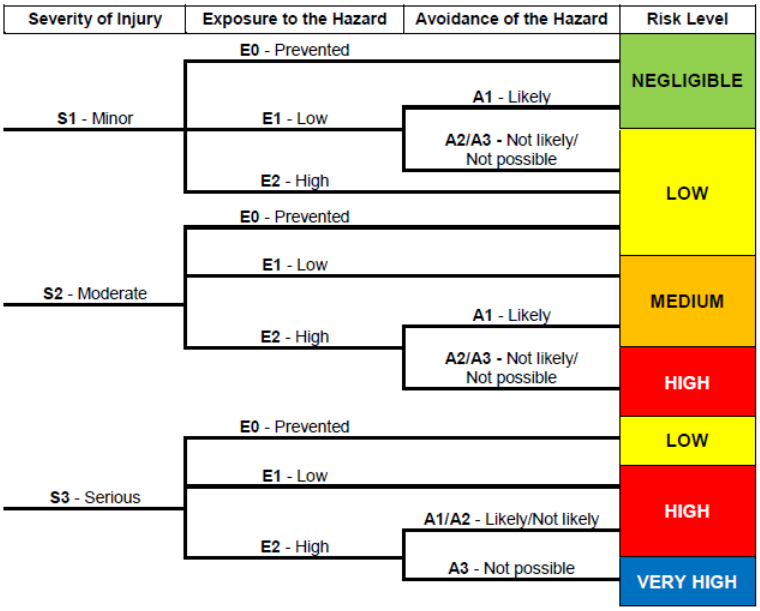

Figure 3: Table of injury severity, exposure and avoidance factors

Factor	Rating	Criteria (Examples) – choose most likely *Read criteria from the top for each factor*
Injury Severity	Serious S3	Normally non-reversible; likely will not return to the same job after recovery from incident: – fatality – limb amputation – long term disability – chronic illness **If any of the above are applicable, the rating is SERIOUS**
	Moderate S2	Normally reversible; likely will return to the same job after recovery from incident: – broken bones – severe laceration – short hospitalization – short term disability – lost time (multi-day) – fingertip amputation (not thumb) **If any of the above are applicable, the rating is MODERATE**
	Minor S1	First aid; no recovery required before returning to job: – bruising – small cuts – no loss time (multi-day) – does not require attention by a medical doctor **If any of the above are applicable, the rating is MINOR**
Exposure[1]	Prevented E0	– Exposure to hazard(s) is eliminated/ controlled/ limited by inherently safe design measures. – Use of guards prevents exposure or access to the hazard(s) (see Part 2, 5.10). If an interlocked guard is selected, the following bullet must also be met. – If functional safety is used as a risk reduction measure, the implemented functional safety performance (PL) meets or exceeds the required functional safety performance (PL_r). See Part 2, 5.2. **If any of the above are applicable, the rating is PREVENTED**
	High E2	– Typically more than once per day or shift – Frequent or multiple short duration – Situations which could lead to increases in the duration of a task, not to include teaching tasks **If any of the above are applicable, the rating is HIGH**
	Low E1	– Typically less than or once per day or shift – Occasional short durations **If either of the above are applicable, the rating is LOW**
Avoidance	Not possible A3	– Insufficient clearance to move out of the way and safety-rated reduced speed control is not used – The robot system or cell layout causes the operator to be trapped, with the escape route toward the hazard – Safeguarding is not expected to offer protection from the process hazard (e.g. explosion or eruption hazard) **If any of the above are applicable, the rating is NOT POSSIBLE**
	Not likely A2	– insufficient clearance to move out of the way and safety-rated reduced speed control is used – obstructed path to move to safe area – hazard is moving faster than reduced speed (250 mm/sec) – inadequate warning/reaction time – the hazard is imperceptible **If any of the above are applicable, the rating is NOT LIKELY**
	Likely A1	– sufficient clearance to move out of the way – hazard is incapable of moving greater than reduced speed (250 mm/sec). – adequate warning/reaction time – positioned in a safe location away from the hazard **If any of the above are applicable, the rating is LIKELY**

9-2: Risk Assessment

User	Task	Hazard			Initial Risk				Safety Recommendations	Safeguards Used	Mitigated Risk			
		Type	Origin	Consequence	Severity	Exposure	Avoidance	Category			Severity	Exposure	Avoidance	Category
All Users	Arc Welding	Operational	Weld Equip.	Arc Flash Eyes	S2	E2	A2	Med.	PPE, Operator training, and Arc screens	PPE, Operator training, and Arc screens	S1	E1	A1	Low
Programmer	Arc Welding	Service	Weld Equip.	Arc Flash Eyes	S2	E1	A1	Low	PPE, Operator training, and Arc screens	PPE, Operator training, and Arc screens	S1	E1	A1	Neg.
Maintenance	Arc Welding	Service	Weld Equip.	Arc Flash Eyes	S2	E1	A1	Low	PPE, Operator training, and Arc screens	PPE, Operator training, and Arc screens	S1	E1	A1	Neg.
Bystander	Arc Welding	Environmental	Weld Equip.	Arc Flash Eyes	S2	E1	A1	Low	PPE, Operator training, and Arc screens	PPE and Arc Screens	S1	E1	A2	Neg.

User	Task	Hazard			Initial Risk				Safety Recommendations	Safeguards Used	Mitigated Risk			
		Type	Origin	Consequence	Severity	Exposure	Avoidance	Category			Severity	Exposure	Avoidance	Category
All Users	Arc Welding	Operational	Weld Equip.	Arc Flash Skin	S2	E2	A2	Med.	PPE, Operator training, and Arc screens	PPE, Operator training, and Arc screens	S1	E1	A1	Low
Programmer	Arc Welding	Operational	Weld Equip.	Arc Flash Skin	S2	E1	A1	Low	PPE, Operator training, and Arc screens	PPE, Operator training, and Arc screens	S1	E1	A2	Neg.
Maintenance	Arc Welding	Service	Weld Equip.	Arc Flash Skin	S2	E1	A1	Low	PPE, Operator training, and Arc screens	PPE, Operator training, and Arc screens	S1	E1	A2	Neg.
Bystander	Arc Welding	Environmental	Weld Equip.	Arc Flash Skin	S2	E1	A1	Low	PPE, Operator training, and Arc screens	PPE and Arc Screens	S1	E1	A2	Neg.
All Users	Arc Welding	Operational	Weld Equip.	Weld Smoke/Fumes	S2	E2	A2	Med.	PPE, Operator training, exhaust methods and ventilation	PPE, Operator training, exhaust methods and ventilation	S1	E1	A2	Low
Programmer	Arc Welding	Operational	Weld Equip.	Weld Smoke/Fumes	S2	E1	A1	Low	PPE, Operator training, exhaust methods and ventilation	PPE, Operator training, exhaust methods and ventilation	S1	E1	A1	Neg.
Maintenance	Arc Welding	Service	Weld Equip.	Weld Smoke/Fumes	S2	E1	A1	Low	PPE, Operator training, exhaust methods and ventilation	PPE, Operator training, exhaust methods and ventilation	S1	E1	A1	Neg.
Bystander	Arc Welding	Environmental	Weld Equip.	Weld Smoke/Fumes	S2	E1	A1	Low	PPE, Operator training, exhaust methods and ventilation	PPE, exhaust methods and ventilation	S1	E1	A1	Neg.
All Users	Arc Welding	Operational	Weld Equip.	Noise	S2	E2	A2	Med.	PPE and Operator training	PPE and Operator training	S1	E1	A2	Low
Programmer	Arc Welding	Operational	Weld Equip.	Noise	S2	E1	A2	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Arc Welding	Operational	Weld Equip.	Noise	S2	E1	A2	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Bystander	Arc Welding	Environmental	Weld Equip.	Noise	S1	E1	A1	Low	PPE and Operator training	PPE and Awareness training	S1	E1	A1	Low
All Users	Arc Welding	Operational	Weld Equip.	Burn	S2	E2	A1	Med.	PPE and Operator training	PPE and Operator training	S2	E1	A1	Low
Programmer	Arc Welding	Operational	Weld Equip.	Burn	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Arc Welding	Operational	Weld Equip.	Burn	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Bystander	Arc Welding	Environmental	Weld Equip.	Burn	S2	E1	A1	Low	PPE and Operator training	PPE	S1	E1	A1	Neg.

User	Task	Hazard			Initial Risk				Safety Recommendations	Safeguards Used	Mitigated Risk			
		Type	Origin	Consequence	Severity	Exposure	Avoidance	Category			Severity	Exposure	Avoidance	Category
All Users	Arc Welding	Operational	Weld Equip.	Weld Spatter and Sparks causing fire with smoke	S2	E2	A1	Med.	PPE, Arc Screen, Fire Extinguishers, Sprinkler system and operator training	PPE, Arc Screen, Fire Extinguishers, Sprinkler system and operator training	S1	E1	A2	Low
Programmer	Arc Welding	Operational	Weld Equip.	Weld Spatter and Sparks causing fire with smoke	S2	E1	A1	Low	PPE, Arc Screen, Fire Extinguishers, Sprinkler system and operator training	PPE, Arc Screen, Fire Extinguishers, Sprinkler system and operator training	S1	E1	A1	Neg.
Maintenance	Arc Welding	Service	Weld Equip.	Weld Spatter and Sparks causing fire with smoke	S2	E1	A1	Low	PPE, Arc Screen, Fire Extinguishers, Sprinkler system and operator training	PPE, Arc Screen, Fire Extinguishers, Sprinkler system and operator training	S1	E1	A1	Neg.
Bystander	Arc Welding	Environmental	Weld Equip.	Weld Spatter and Sparks causing fire with smoke	S2	E1	A1	Med.	PPE, Arc Screen, Fire Extinguishers, Sprinkler system and operator training	PPE, Arc Screen, Fire Extinguishers and Sprinkler system	S1	E1	A2	Low
All Users	Nozzle Cleaning	Thermal	Weld Equip.	Burn	S1	E1	A1	Neg.	PPE and Operator training	PPE and Operator training	S1	E0	A1	Neg.
Programmer	Nozzle Cleaning	Thermal	Weld Equip.	Burn	S1	E1	A1	Neg.	PPE and Operator training	PPE and Operator training	S1	E0	A1	Neg.
Maintenance	Nozzle Cleaning	Thermal	Weld Equip.	Burn	S1	E1	A1	Neg.	PPE and Operator training	PPE and Operator training	S1	E0	A1	Neg.
All Users	Contact Tip, Nozzle and Retainer/Diffuser Change	Service	Mech. Equip.	Burn	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Contact Tip, Nozzle and Retainer/Diffuser Change	Operational	Mech. Equip.	Burn	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Contact Tip, Nozzle and Retainer/Diffuser Change	Service	Mech. Equip.	Burn	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Contact Tip, Nozzle and Retainer/Diffuser Change	Service	Mech. Equip.	Puncture/ Stabbing	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Contact Tip, Nozzle and Retainer/Diffuser Change	Service	Mech. Equip.	Puncture/ Stabbing	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Contact Tip, Nozzle and Retainer/Diffuser Change	Service	Mech. Equip.	Puncture/ Stabbing	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.

User	Task	Hazard			Initial Risk				Safety Recommendations	Safeguards Used	Mitigated Risk			
		Type	Origin	Consequence	Severity	Exposure	Avoidance	Category			Severity	Exposure	Avoidance	Category
All Users	Wire Change	Service	Weld Equip.	Puncture/ Stabbing	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Wire Change	Service	Weld Equip.	Puncture/ Stabbing	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Wire Change	Service	Weld Equip.	Puncture/ Stabbing	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Wire Change	Service	Weld Equip.	Crushing/ Pinching	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Wire Change	Service	Weld Equip.	Crushing/ Pinching	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Wire Change	Service	Weld Equip.	Crushing/ Pinching	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Equipment Jams	Service	Weld Equip.	Crushing/ Pinching	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Equipment Jams	Service	Weld Equip.	Crushing/ Pinching	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Equipment Jams	Service	Weld Equip.	Crushing/ Pinching	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Feeding and loading of Raw Materials	Environmental	Work Area	Tripping Hazard	S1	E1	A1	Low	PPE and Daily floor cleaning	PPE and Daily floor cleaning	S1	E0	A1	Neg.
Programmer	Feeding and loading of Raw Materials	Environmental	Work Area	Tripping Hazard	S1	E1	A1	Low	PPE and Daily floor cleaning	PPE and Daily floor cleaning	S1	E0	A1	Neg.
Maintenance	Feeding and loading of Raw Materials	Environmental	Work Area	Tripping Hazard	S1	E1	A1	Low	PPE and Daily floor cleaning	PPE and Daily floor cleaning	S1	E0	A1	Neg.
Bystander	Feeding and loading of Raw Materials	Environmental	Work Area	Tripping Hazard	S1	E0	A1	Neg.	PPE and Daily floor cleaning	PPE and Daily floor cleaning	S1	E0	A1	Neg.
All Users	Feeding and loading of Raw Materials	Operational	Weld Equip.	Burn	S2	E2	A1	Med.	PPE and Operator training	PPE and Operator training	S1	E1	A2	Low
Programmer	Feeding and loading of Raw Materials	Operational	Weld Equip.	Burn	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Feeding and loading of Raw Materials	Service	Weld Equip.	Burn	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Feeding and loading of Raw Materials	Service	Weld Equip.	Puncture/ Stabbing	S2	E2	A1	Med.	PPE and Operator training	PPE and Operator training	S1	E1	A2	Low
Programmer	Feeding and loading of Raw Materials	Service	Weld Equip.	Puncture/ Stabbing	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Feeding and loading of Raw Materials	Service	Weld Equip.	Puncture/ Stabbing	S2	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.

User	Task	Hazard			Initial Risk				Safety Recommendations	Safeguards Used	Mitigated Risk			
		Type	Origin	Consequence	Severity	Exposure	Avoidance	Category			Severity	Exposure	Avoidance	Category
All Users	Cobot Motion	Operational	Cobot	Crushing/ Pinching	S2	E2	A1	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Programmer	Cobot Motion	Operational	Cobot	Crushing/ Pinching	S2	E2	A1	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Maintenance	Cobot Motion	Service	Cobot	Crushing/ Pinching	S2	E2	A1	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Bystander	Cobot Motion	Operational	Cobot	Crushing/ Pinching	S2	E1	A1	Low	PPE and Awareness training	Cobot safety software with audio and visual warnings	S1	E1	A1	Neg.
All Users	Cobot Motion	Operational	Mech. Equip.	Crushing/ Pinching	S2	E2	A1	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Programmer	Cobot Motion	Operational	Mech. Equip.	Crushing/ Pinching	S2	E2	A1	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Maintenance	Cobot Motion	Operational	Mech. Equip.	Crushing/ Pinching	S2	E1	A1	Low	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A1	Neg.
Bystander	Cobot Motion	Operational	Mech. Equip.	Crushing/ Pinching	S2	E1	A1	Low	PPE and Awareness training	Cobot safety software with audio and visual warnings	S1	E0	A1	Neg.
All Users	Cobot Motion	Operational	Cobot	Entanglement	S2	E2	A2	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Programmer	Cobot Motion	Operational	Cobot	Entanglement	S2	E2	A2	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Maintenance	Cobot Motion	Service	Cobot	Entanglement	S2	E1	A2	Low	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A1	Neg.
Bystander	Cobot Motion	Environmental	Cobot	Entanglement	S2	E1	A1	Low	PPE and Awareness training	Cobot safety software with audio and visual warnings	S1	E1	A1	Neg.
All Users	Moving Elements	Operational	Mech. Equip.	Entanglement	S2	E2	A1	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Programmer	Moving Elements	Operational	Mech. Equip.	Entanglement	S2	E2	A1	Med.	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A2	Low
Maintenance	Moving Elements	Service	Mech. Equip.	Entanglement	S2	E1	A1	Low	PPE and Operator training	Cobot safety software with audio and visual warnings	S1	E1	A1	Neg.
Bystander	Moving Elements	Environmental	Mech. Equip.	Entanglement	S2	E1	A1	Low	PPE and Awareness training	Cobot safety software with audio and visual warnings	S1	E1	A1	Neg.

User	Task	Hazard			Initial Risk				Safety Recommendations	Safeguards Used	Mitigated Risk			
		Type	Origin	Consequence	Severity	Exposure	Avoidance	Category			Severity	Exposure	Avoidance	Category
All Users	Movement in work area	Environmental	Work Area	Tripping Hazard	S1	E1	A1	Low	Keep work clear and free	Good Housekeeping	S1	E1	A2	Low
Programmer	Movement in work area	Environmental	Work Area	Tripping Hazard	S2	E2	A1	Med.	Keep work clear and free	Good Housekeeping	S1	E1	A2	Low
Maintenance	Movement in work area	Environmental	Work Area	Tripping Hazard	S2	E2	A1	Med.	Keep work clear and free	Good Housekeeping	S1	E1	A2	Low
Bystander	Movement in work area	Environmental	Work Area	Tripping Hazard	S2	E2	A1	Med.	Keep work clear and free	Good Housekeeping	S1	E1	A2	Low
All Users	Torch Change	Service	Weld Equip.	Puncture/ Stabbing	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Torch Change	Service	Weld Equip.	Puncture/ Stabbing	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Torch Change	Service	Weld Equip.	Puncture/ Stabbing	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Trouble shooting	Service	Weld Equip.	Electrical Hazard	S3	E1	A1	High	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
Programmer	Trouble shooting	Service	Weld Equip.	Electrical Hazard	S3	E1	A1	High	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
Maintenance	Trouble shooting	Service	Weld Equip.	Electrical Hazard	S3	E1	A1	High	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
All Users	Trouble shooting	Service	Cobot	Electrical Hazard	S2	E1	A1	Med.	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
Programmer	Trouble shooting	Service	Cobot	Electrical Hazard	S2	E1	A1	Med.	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
Maintenance	Trouble shooting	Service	Cobot	Electrical Hazard	S2	E1	A1	Med.	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
All Users	Trouble shooting	Service	Cobot	Crushing/ Pinching	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Trouble shooting	Service	Cobot	Crushing/ Pinching	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Trouble shooting	Service	Cobot	Crushing/ Pinching	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Trouble shooting	Service	Mech. Equip.	Crushing/ Pinching	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Trouble shooting	Service	Mech. Equip.	Crushing/ Pinching	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Trouble shooting	Service	Mech. Equip.	Crushing/ Pinching	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.

User	Task	Hazard			Initial Risk				Safety Recommendations	Safeguards Used	Mitigated Risk			
		Type	Origin	Consequence	Severity	Exposure	Avoidance	Category			Severity	Exposure	Avoidance	Category
All Users	Trouble shooting	Service	Mech. Equip.	Puncture/ Stabbing	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Trouble shooting	Service	Mech. Equip.	Puncture/ Stabbing	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Trouble shooting	Service	Mech. Equip.	Puncture/ Stabbing	S1	E1	A1	Low	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Equipment Cleaning	Service	Weld Equip.	Electrical Hazard	S3	E1	A1	High	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
Programmer	Equipment Cleaning	Service	Weld Equip.	Electrical Hazard	S3	E1	A1	High	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
Maintenance	Equipment Cleaning	Service	Weld Equip.	Electrical Hazard	S3	E1	A1	High	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
All Users	Equipment Cleaning	Service	Cobot	Electrical Hazard	S2	E1	A1	Med.	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
Programmer	Equipment Cleaning	Service	Cobot	Electrical Hazard	S2	E1	A1	Med.	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
Maintenance	Equipment Cleaning	Service	Cobot	Electrical Hazard	S2	E1	A1	Med.	Service performed only by qualified personnel	PPE and Lock Out Tag Out procedures	S1	E1	A1	Neg.
All Users	Equipment Cleaning	Service	Mech. Equip.	Bump/Bruise	S1	E1	A1	Neg.	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Programmer	Equipment Cleaning	Service	Mech. Equip.	Bump/Bruise	S1	E1	A1	Neg.	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
Maintenance	Equipment Cleaning	Service	Mech. Equip.	Bump/Bruise	S1	E1	A1	Neg.	PPE and Operator training	PPE and Operator training	S1	E1	A1	Neg.
All Users	Changing Weld Gases	Service	Weld Equip.	Nausea, Asphyxication, Nausea, Diziness and eye, nose and throat irritation	S2	E1	A1	Med.	PPE, Operator training and Adequate Ventilation	PPE, Operator training and Adequate Ventilation	S1	E1	A1	Neg.
Programmer	Changing Weld Gases	Service	Weld Equip.	Nausea, Asphyxication, Nausea, Diziness and eye, nose and throat irritation	S2	E1	A1	Med.	PPE, Operator training and Adequate Ventilation	PPE, Operator training and Adequate Ventilation	S1	E1	A1	Neg.
Maintenance	Changing Weld Gases	Service	Weld Equip.	Nausea, Asphyxication, Nausea, Diziness and eye, nose and throat irritation	S2	E1	A1	Med.	PPE, Operator training and Adequate Ventilation	PPE, Operator training and Adequate Ventilation	S1	E1	A1	Neg.
Bystander	Changing Weld Gases	Service	Weld Equip.	Nausea, Asphyxication, Nausea, Diziness and eye, nose and throat irritation	S2	E1	A1	Med.	PPE, Operator training and Adequate Ventilation	PPE, Operator training and Adequate Ventilation	S1	E1	A1	Neg.