MARK ROBERTS MOTION CONTROL

BOLT X

QUICK START GUIDE

QSG Product Code: MRMC-2253-00
Products Covered: MRMC-2023-00, MRMC-2080-00

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Document version: BOLTX-QSG-20012022

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Overview

Thank you for using the Bolt X High-speed Cine-bot from Mark Roberts Motion Control (MRMC). Bolt X is designed for reliable day-in, day-out use in professional studio and Outside Broadcast environments. There are two versions of Bolt X:

Bolt X On Pedestal has a stationary base which you either hold down with weights or, for more permanent installations, attach to the floor.

Bolt X On Track has a base designed for moving along Precision Track. It has removable trolley wheels for moving between sets, and can also be held down with weights at temporary locations.

Safety procedures for using industrial robots, including high speed track

Note that the words **Robot** and **Rig** are completely interchangeable and identical in meaning, for the purposes of this document.

Motion Control rigs are potentially dangerous. It is important that you and everyone else on the set understand the safety notes on the following pages in order to stay safe.

You should use this document in addition to the normal Safety Manual instructions that are applicable to all motion control rigs, such as Milos. This section emphasises the safety concerns that are especially important around high-speed, high-acceleration, industrial-grade robots which can cause severe injuries, such as Bolt X.

- Unlike traditional motion control equipment, Bolt X can get to maximum speed in the blink of an eye - too fast for someone to be able to quickly move out of the way.

⇔ If you are using Bolt X On Track then you need to take extra steps during installation and use due to the additional risks involved in using track. See the separate *Precision Track Quick Start Guide* for information on laying the track, securing it to the floor, and mounting Bolt X onto it. The notes given below for track users are marked with this symbol: ⇔.

- It is ultimately the **operator** of the rig who is responsible for the safe use of the equipment so never bypass any of the safety points listed here.
- No one other than a highly trained operator should use the robot, no matter how simple it looks or is.
- This document is for the use of robots for carrying cameras or props, not people. Additional safety steps should be taken prior to using a rig to carry people.

Assessing a site

Before setting up Bolt X you need to **assess the site**, paying particular attention to the following points:

- Is the ground or floor firm enough and level enough? You might have to use boards or bricks to create a level surface. The surface needs to be strong enough to take the weight of Bolt X itself (630 kg for Bolt X On Pedestal, 830 for Bolt X On Track) plus the weight of the track (95 kg per section). The track must either be secured to the ground or to the weight plates supplied (2 plates per section=2x80 kg). If you are using Bolt X On Pedestal for high-speed moves then 400 kg of anchor weights on each corner are recommended.
- Does the site have access? You need to make sure you can either push Bolt X into position on its wheels or carry it there using a pallet truck or forklift.
- Does the site have a power source with sufficient capacity for the robot and the correct mains voltage?
  - Bolt X On Pedestal gets its power from the YRC1000 robot controller unit which runs **415 Volt, 32A, 50/60Hz, three-phase power supply (five-wire including Neutral and Ground)**.
  - Bolt X On Track requires one **415 Volt, three-phase power supply (five-wire including Neutral and Ground)** connections. It cannot be configured to run on less without significant loss of track speed performance.
  - The RTL/Flair computer that controls Bolt X (that is, the desktop computer and the power supply brick for the RT-14 interface box are auto-switching and can run on 120-240 Volts AC.
- Does the site have unusual environmental attributes that require specialised protection from extreme temperatures, humidity, rain, or dust?

Installation safety

- Due to the large mass of the rigs and the accelerations they achieve it is important that they are securely mounted, with the recommended plates and bolts to a secure and concrete floor.

⇔ When using track, ensure that it is properly bolted to the floor. No amount of counterweight will stop the track from moving and twisting if the track isn't secured, especially with short lengths of track.

⇔ Make sure there is plenty of clearance around the length of the track for the trailing cables of the rig to slide along the floor. Ensure that they are not mounted in such a way so that they can catch on the track or robot as it moves along the full length.

- Ensure the floor can support the load and the stresses (see above).
- Ensure the power supply is properly earthed (grounded) and of the correct voltage (see above).
- If the rig is mounted to something other than the floor then the mount should be heavy and strong enough to take the forces and not move or fall over during sudden starts and stops. Use the recommended minimum thickness steel plates. Check with MRMC if you are unsure of the exact requirements for your robot.
- Check that all cables are securely fixed and are not going to catch during motion.
- Ensure the camera, lens, focus motor, accessories, power supplies/batteries, etc. are all very securely mounted and will not come off during sudden motions, to become lethal missiles.
- Ensure all safety accessories are securely attached and in working order, including emergency stops, safety sensors, etc.
- Clearly mark the area around the robot in which no persons are allowed to enter. As a bare minimum, use brightly marked tape on the floor, outside the reach of the robot, to indicate the "No Go Zone". Ideally, use physical safety barriers, and light guards/curtains.

- Keep stands, lights and accessories out of the No Go Zone, if possible. If not possible then try to take as much care with their positioning and the motion of the rig, as if they were a person. Remember a light, accidentally hit at high speed by the robot, can be just as dangerous to someone standing outside the No Go Zone as the robot is to someone standing in the zone.
- Where physical safety barriers are impractical, light guards should be used or similar alternatives such as laser scanners, to stop anyone entering the No Go Zone during motion.
- Ideally have the robot surrounded on all four sides by a safety barrier, but where that is not practical, ensure that the maximum number of sides feasible are closed off, and that any person having to stand within reach of the robot is located as far away as possible for the shot.

⇔ Never let anyone cross the robot's track when the track motor is powered up. In fact, it is a good idea to get into the routine of walking around the track instead of over it so that you don't cross the track out of habit when the track motor is powered up.

WARNING when using generators!

Bolt on Track versions MRMC-2080-00 to -02, the Regen Protection box must be used for regenerative current protection damage along with a generator of 20kW.

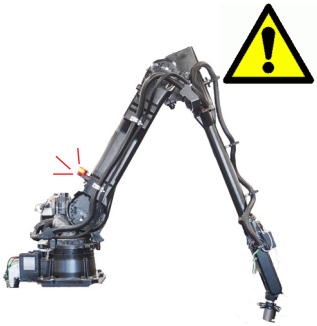
For MRMC-2080-03 and above, regenerative excess energy damage protection unit is integrated with the robot but it is recommended that a generator of 20kW or above is used with the unit.

Software setup

- Always ensure you have the right configuration for the robot you are using, such as maximum axis speeds and accelerations.
- Also check the Cartesian speed and acceleration limits are set to reasonable values.

Operational safety

- Do not use around flammable gas. All electrical equipment can generate sparks that can ignite flammable gas.
- Keep the equipment dry. The system has **not** been made weatherproof. Do not use with wet hands.
- Always run moves only when standing within easy reach of the emergency stop.
- Always tell the production company and the crew to keep away from the robot and not approach it when any of its red lights are on which indicates it is powered up. Have them sign the appropriate safety documents and disclaimers to ensure they understand this and are indemnifying MRMC if anything happens.



- Always loudly and clearly indicate to others when the rig is about to move. Shout “Rig Moving!” if no other means exists.

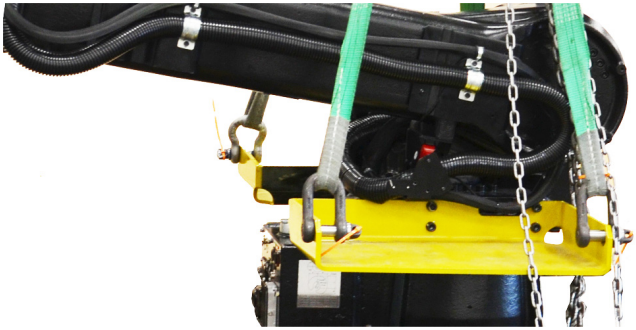
⇔ When using track motion always have someone keep an eye on the trailing rig cables to ensure they don’t get caught on anything or anyone.

- Always ensure the rig is disabled when someone has to enter the No Go Zone.
- Always run any move or adjusted move slowly at first to check the motion. Even if you have checked the move previously, if you make a minor change to it then you need to recheck it.

- Keep the software in “slow mode” unless the move has been tested and is now specifically doing a high speed pass.
- In the event that a person or Actor has to be within the no-go zone during a move (hand model etc.) ensure that they fully briefed on the safety requirements and that they know not to change their position or do anything other than the rehearsed moves without fully warning the operator. Any such person is to have a clear escape route to allow them to move safely away from the robot.
- During use, repeatedly check the rig mounting points, cables, camera mount, accessories etc. to ensure nothing has, or is, working its way loose.
- Never bypass any safety hardware or software.

Mounting the Yaskawa arm

1. Remove all packaging from the Bolt X arm and the pedestal. If not already added, attach the two mounting plates on the arm using 4 x M12 screws on each side. Ensure that each plate is mounted on the correct side.
2. Securely attach shackles on each of the four corners of the lifting plates.
3. Use the shackles to tie a lifting sling around the arm and insert the hook from the gantry hoist on to it.



4. Wheel the Bolt X base under the gantry hoist.

5. Use the gantry hoist to gently lift the arm and lower it in position on the Bolt X base aligning the screw slots.

6. Tighten the 8xM20 screws to secure the arm on the Bolt X base.

7. Remove the gantry hook and the straps from the arm. Also, remove the yellow lifting plates from the arm.

Mounting the weight wings

If you want to use Bolt X in a stationary position that is temporary (or if you don't want to damage the floor by installing anchors in it), you must weigh down the Bolt X base to keep it stable during high-speed moves. To do this you install wings on the base, which lie flat on the floor, and then put weights on the wings to securely hold down the rig.

1. Use a pallet truck for Bolt X On Pedestal to lift Bolt high enough to go over the wings (about 10 cm).

2. Lay one of the wings beside the Bolt X base and push the edge of the wing over the edge of Bolt X, lining up the four holes.

3. Lower the base close to the wing but not quite resting on it, close enough for the five retaining bolts to reach the wings through the base.
4. Insert the four retaining bolts (two on each corner of the base) and tighten. Note that some versions have locknuts.
5. Repeat steps 1 to 4 to mount the other wing.
6. Lower the base completely so it is resting on both wings.
7. Put the weights onto the wings. Bolt requires 800kg of weights on both sides.

Bolt X On Pedestal with wings and weights

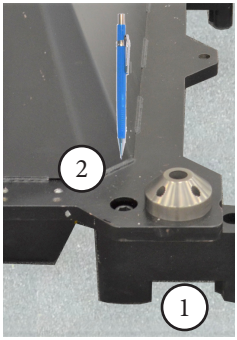
Hint

You can move Bolt X using a pallet jack without removing the wings if you want, as long as you take the weight plates off first.

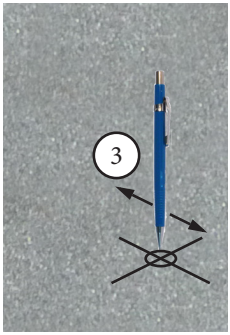
Anchoring Bolt X On Pedestal to the floor

If you are setting up Bolt X On Pedestal in a permanent (or semi-permanent) location, it is recommended that you anchor the pedestal to the floor. If this is not possible, as an alternative you can hold

it down with weights. The following procedure tells you how to anchor the pedestal to a concrete floor.



× 4 corners



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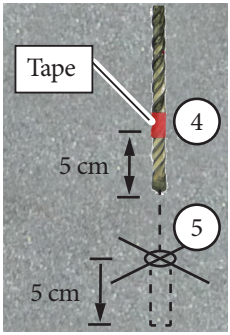


× 4 corners

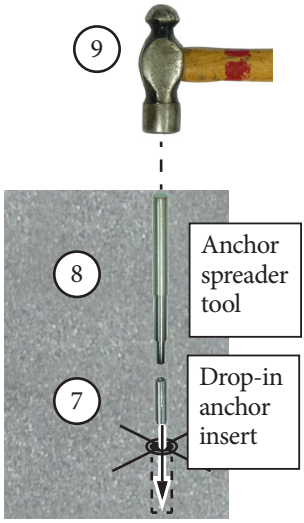
1. Temporarily put the Bolt X On Pedestal into place where you want.
2. At one corner of the pedestal, use one of the two holes to draw a circle on the concrete with a pencil, to mark the position of the hole. You can use either hole.

   Repeat for the other three corners of the pedestal.
3. Temporarily remove Bolt X On Pedestal and at one of the four circles that you have drawn, draw a cross centred on the circle, to help you precisely locate the drill bit.

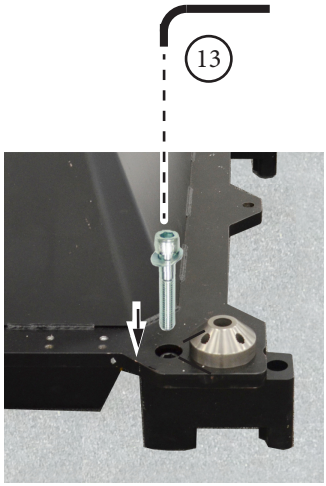
   Repeat for the other three corners.
4. On the 20mm diameter drill bit, put tape around the bit 5 cm from the tip. This will help you gauge the depth of the hole in the next step.
5. At one of the corner circles, drill a hole 5 cm deep into the concrete, centred on the cross. When the tape on the drill bit reaches the floor, drilling is complete.

   Repeat for the other three corners.
6. Clean the four holes.

7. At one of the holes insert the drop-in anchor insert, threads upward, all the way to the bottom.
8. Insert the anchor spreader tool into the drop-in anchor insert.
9. Hit the top of the anchor spreader tool with a hammer until the anchor is fully spread in the concrete.
10. Remove the anchor spreader tool.
11. Repeat steps 7 to 10 for the other three corners.
12. Put Bolt X On Pedestal in place over the holes.
13. Insert the four retaining bolts (M16) through the corners of the base and into the drop-in anchor inserts, and tighten.

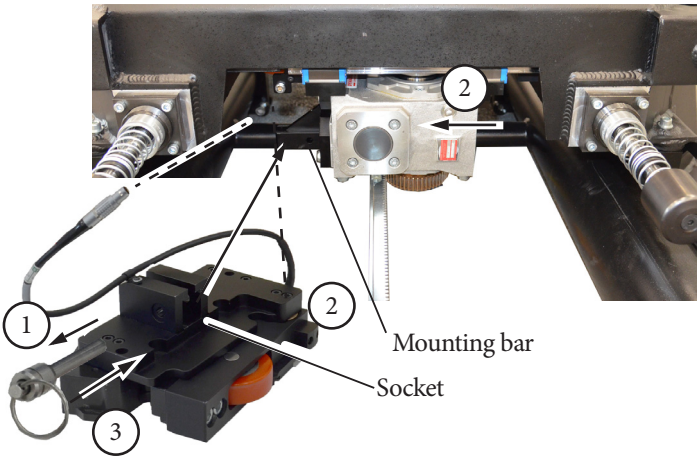


× 4 corners



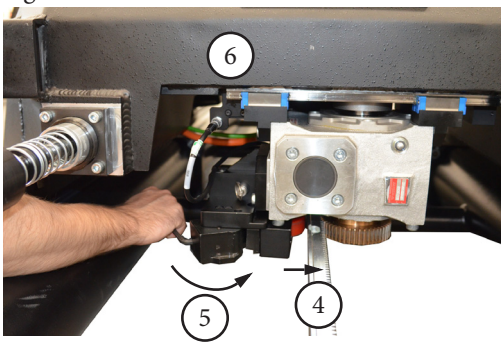
Notes

Attaching the track motor pinch wheel to Bolt (Family of Robots) On Track



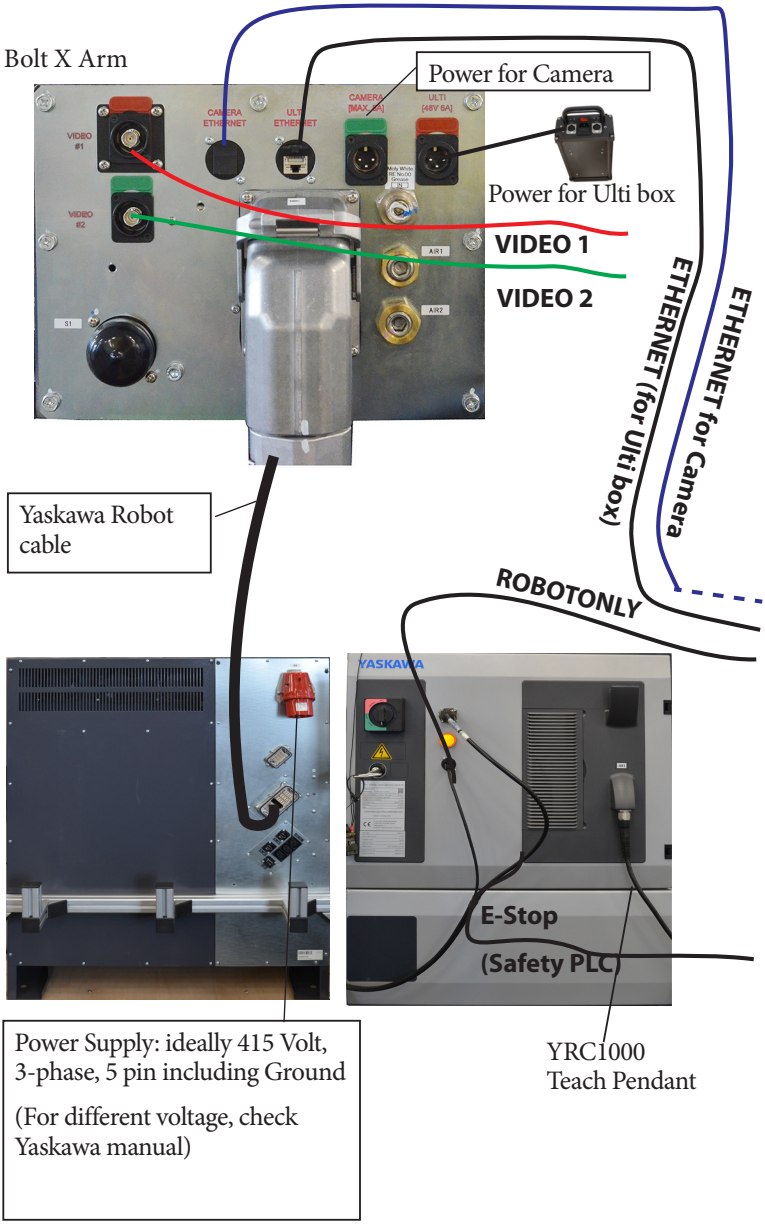
1. On the separately supplied pinch wheel assembly, remove the brass retaining pin by pulling on the ring.
2. Mount the pinch wheel assembly onto the track motor on the rig underside, by sliding the track motor gear against the rack and putting the pinch wheel Socket onto the track motor Mounting bar.
3. Replace the retaining pin in the pinch wheel assembly by pushing on the ring (not the sleeve), to hold the assembly in place on the track motor.
4. Ensure that the track motor gear is held firmly against toothed side of the rack. If it is not, then push the pinch wheel assembly slightly towards the rack so that the rubber wheel presses firmly against the smooth side of the rack. Check that the space between the black plastic block behind the rubber wheel and racking after mounting the pinch wheel assembly is less than 1mm.

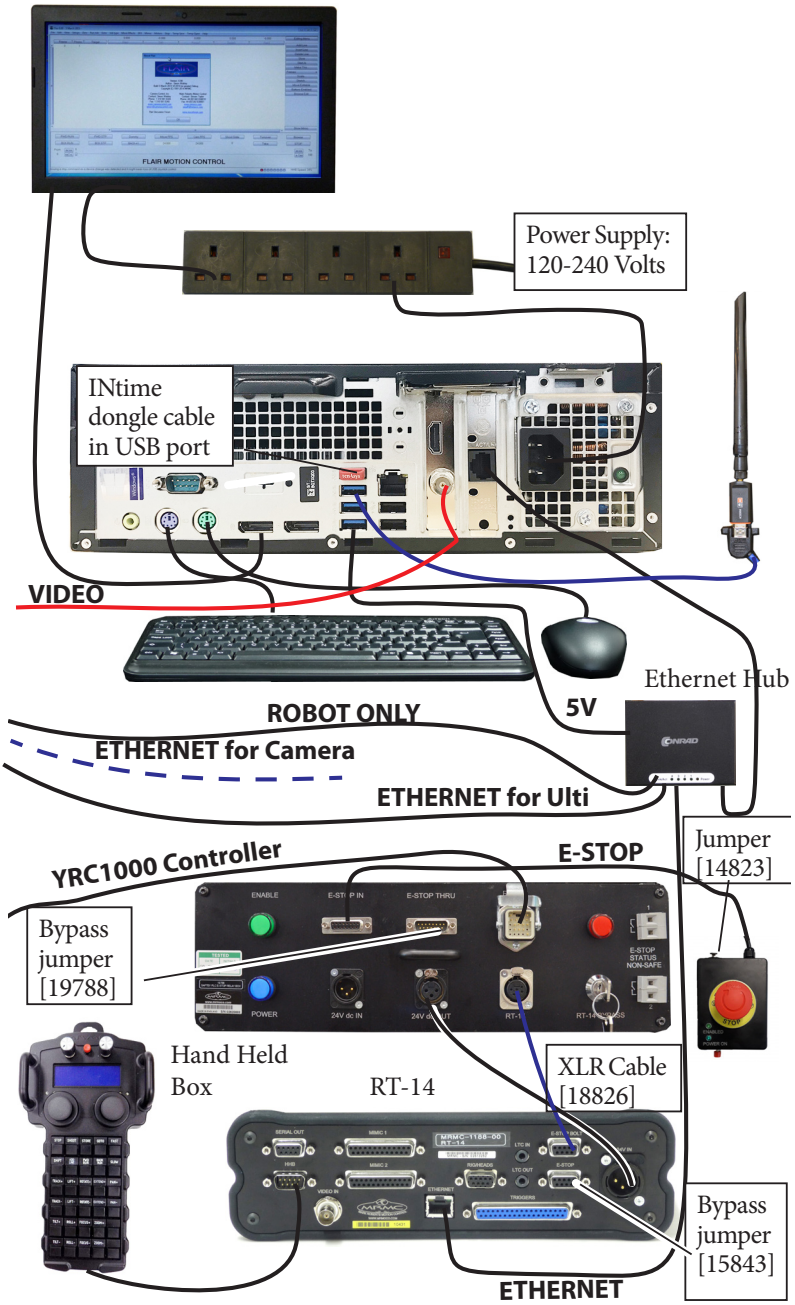
5. Insert the small side of an allen key in the cavity on the block of the pinch wheel assembly and using the allen key pull the block towards the racking.



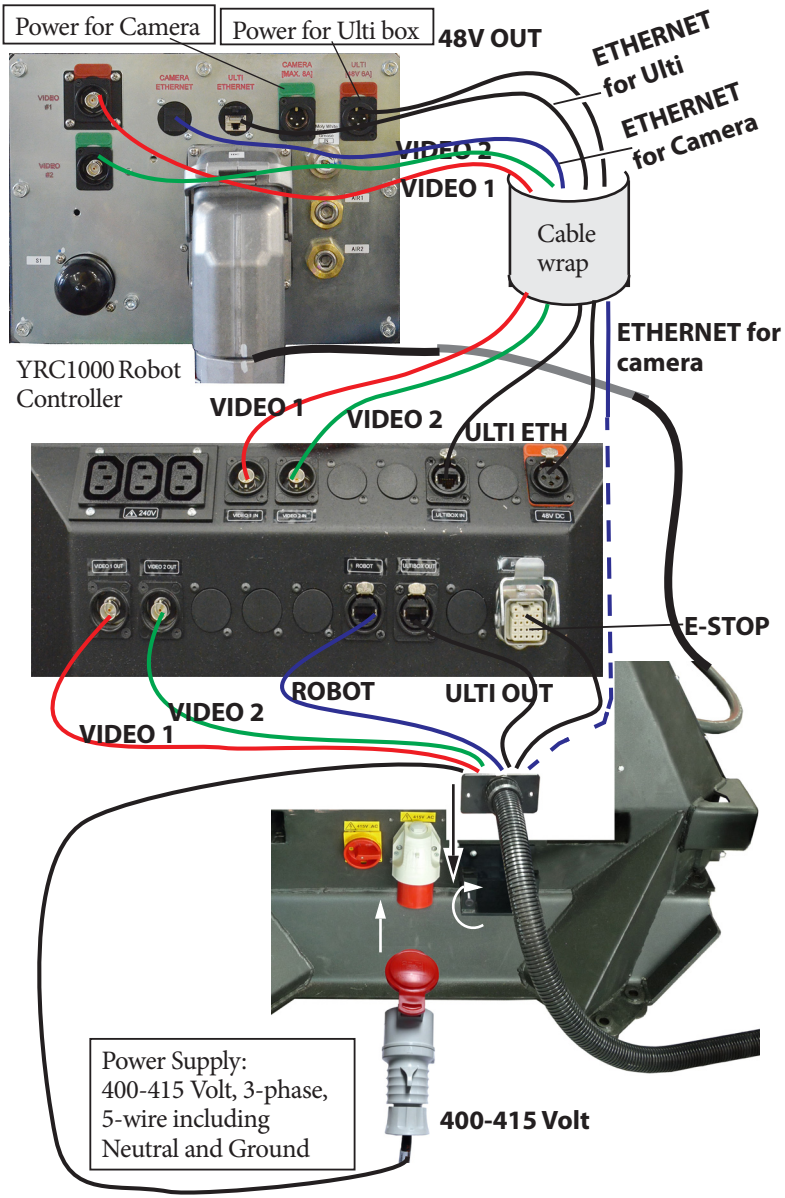
6. Plug the pinch wheel cable to the socket on the rig underside, and use cable ties to hold it securely up away from the track, if required.

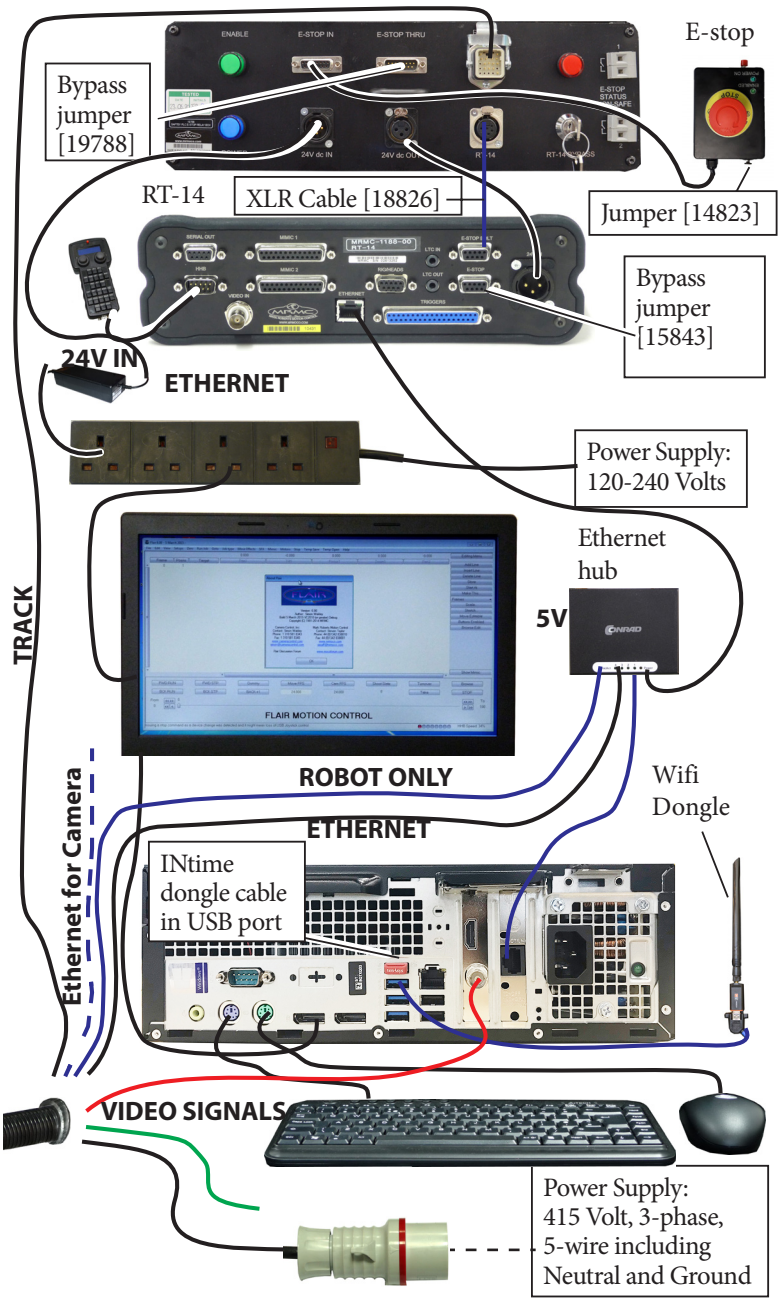
Connecting the cables — Bolt X On Pedestal




FLAIR MOTION CONTROL
Power Supply:
120-240 Volts
INtime
dongle cable
in USB port
VIDEO
Ethernet Hub
5V
ROBOT ONLY
ETHERNET for Camera
ETHERNET for Ulti
YRC1000 Controller
E-STOP
Jumper
[14823]
Bypass
jumper
[19788]
Hand Held
Box
RT-14
XLR Cable
[18826]
Bypass
jumper
[15843]
ETHERNET

Connecting the cables — Bolt X On Track




Bypass jumper [19788]
E-stop
RT-14
XLR Cable [18826]
Jumper [14823]
Bypass jumper [15843]
24V IN
ETHERNET
Power Supply: 120-240 Volts
TRACK
Ethernet hub
5V
FLAIR MOTION CONTROL
ROBOT ONLY
Wifi Dongle
ETHERNET
Ethernet for Camera
INtime dongle cable in USB port
VIDEO SIGNALS
Power Supply: 415 Volt, 3-phase, 5-wire including Neutral and Ground

Important

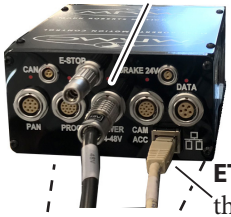
The Jumper* in the Safety PLC applies when using this robot as a single robot operation. For more information on using the Universal Robot system with multiple robots, refer to the Universal E-stop System Quick Start Guide.

The desk top E-stop box can also be daisy-chained to multiple E-stop buttons. For more information, refer to Universal E-stop System Quick Start Guide.

Bolt X arm connectors for Ulti-box and camera

The connections that go through the Bolt X arm are shown below. These are for the Ulti-box mounted on the arm, and for the camera that you mount in the cage at the end of the arm.

POWER input:
48 Volts DC



Ulti-box, which provides various connectors for camera and lens controls. For details see *Ulti-box connector summary* on page 65.

ETHERNET for the Ulti-box

Camera connections

CAMERA ETHERNET

ULTI ETHERNET

CAMERA power output 12-24VDC

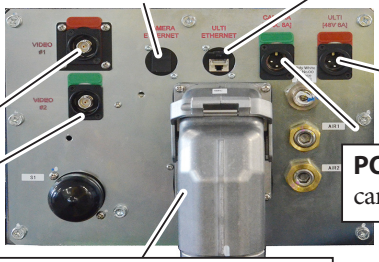
ULTI power output 48VDC

Video 1 **Video 2**

Robot arm base

ETHERNET for camera

ETHERNET for Ulti box



Power input for the Ulti-box: 48V DC

Video 1

Video 2

POWER input for camera: 12 Volts DC

POWER and ENCODER input for arm (from YRC1000 controller unit)

Regenerative current protection

Bolt X is now equipped with Regen Protection Box within the Bolt X base, which is designed to detect and discharge power surges caused by regeneration with Bolt X on Track when voltage reaches a certain level and poor regulation from the generator occurs..

LED	Description
Orange/Amber	Regenerative event is in progress. This occurs during a move with high deceleration when the robot generates more energy than it consumes. The Orange led will light while the box absorbs the excess energy during any heavy deceleration of the robot.
Red (Overtemp 1, 2 and 3)	An over-temperature event has occurred. If one of these 3 LEDs are lit, allow the robot to cool down for 20 minutes either by turning off or using at reduced velocity and acceleration. Note that if the velocity and acceleration are not reduced then the robot will continue to run unprotected and will be at the risk of damage.

LED	Description
Red (Overvoltage)	Stop running the robot and contact MRMC at support@mrmoco.com.

Note

The LCD monitor, for the regenerative protection voltage settings, is inside the base behind the fan assembly panel. The voltage setting is preset by MRMC, to switch in the regenerative resistors, when the voltage rises above 435VAC 3 phase, under a regenerative event.

DO NOT press the buttons on the display. In case of a fault contact MRMC at support@mrmoco.com. It is important that the Bolt X is connected to a supply strictly 400/415VAC. A voltage applied greater than 435VAC will result in the regenerative resistors being switched on and cause an over temperature condition.

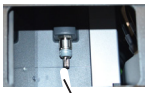
Starting up the Bolt X system

Once you have attached all the cables, you power up the Bolt X rig by switching on the components in the order described below.

1. Make sure you have secured the area around Bolt X. Put up guard rails around Bolt X (and the track) as necessary, and tell others on the set that you are now powering up the rig.

2. Release the E-stop that is plugged into the **YRC1000 teach pendant** (twist and pull) and also the E-stop that is on the **Bolt X base** (if using Bolt X On Track) by turning the red button clockwise until the button pops up. **Do not release the other E-stop by the computer stack yet.**

3. Ensure that the bypass jumper is plugged in the Bolt X base side panel. The panel can be accessed by undoing 4 x screws and removing the cover.

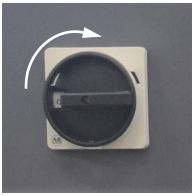


Bypass jumper

4. If the teach pendant is plugged in the side panel instead of the bypass jumper, ensure that the key in the YRC1000 teach pendant is pointing to **REMOTE** and not to **TEACH** label. (It is recommended that when moving the robot under normal circumstances, the teach pendant is replaced with the bypass jumper.)

5. Power up Bolt X itself as follows:

For Bolt X on Pedestal, power on the YRC1000 controller unit



The pendant shows the boot up sequence which normally takes about 1 minute. For more, refer to *Checking when YRC1000 is ready* on page 38.

For Bolt X On Track, turn on the power switch on the side of the Bolt X Base.

6. Power up the Ulti box. Both input and output switches on the power supply need to be switched on.
7. Power up other connected devices, if applicable, such as the Motionbase or the XL Turntable. Note that there is no particular order in which these need to be powered up.
8. Power up the Flair PC and all of its components.
9. Check INtime is running on the Flair PC.
10. Launch Flair. After software boot up is complete, ensure that the green network and node lights are illuminated in Flair. Reload if necessary.
11. Release the E-stop that is plugged into the computer stack, by turning the button clockwise until the red button pops up and then pressing the Enable button. Also make sure the key on the PLC box is in the vertical position (RED led must be off). Green LED on the E-stop box should come on.

Reset button

    11.1 The Green LED on the safety box should also come on.

    11.2 (pedestal only) The Yellow LED on the YRC cabinet should also come on.

The robot is now ready to be enabled in the software.

Bolt X start-up summary

1. Secure the area
2. Release the E-stop on the rig
5. Switch on all the equipment on the system
5. Switch on the Flair PC
6. Start Flair
7. Release the E-stop on the computer stack

In Flair:

8. **Engage Robot**
9. Send the arm to Home position, carefully
10. Zero the track (if applicable) and Lens Control Motor axes.
11. Set the soft limits

The rig is now ready to use.

Shutting down the Bolt X system

1. Move Bolt X to its Home position, for both the arm and the track (if using Bolt X On Track).

   or...

   If you are going to transport Bolt X to a new location, put the Bolt X arm into its transport position. You can do this either by using Flair (although you might have to reset the soft limits to reach the transport position).

2. In the Flair software, click on the **Disengage Robot** button.
3. In the Flair software, disengage the track by toggling off the **Track** button.
4. Press down all E-stop buttons:
   - On the computer stack
   - On the **YRC1000 controller unit** (if using Bolt X On Pedestal) or on the **Bolt X base** (if using Bolt X On Track)
5. Close the Flair software.
6. Shut down Windows on the Flair PC.
7. Turn off any peripherals. Turn off Bolt X as follows:

Turn off the power switch on YRC1000.

For Bolt X On Track, turn off the power switch on the side of the Bolt X Base.

To remove Bolt X On Track from the track see *Mounting Bolt (family of robots) on the track* in the separate *Precision Track Quick Start Guide* and follow the instructions there in reverse order, to attach the trolley wheels, detach the pinch motor wheels and remove the rig from the track bearings.

Notes

Appendix 1 **Using Weight Plates with Bolt X on Track**

If you are using a fast robot with a long arm, such as Bolt X on Track, it is recommended that you hold the track down by bolting it to the ground as above. If that is not feasible, use the weight plates to lay under and then bolt the track on to the weight plates.

They are not a full substitute for a rigid fixing to a ground anchor and will not provide the same stability. Caution should therefore be exercised when using weight plates alone to stabilise a system.

MRMC have empirically tested the Bolt X to a **maximum speed of 180deg/s** on Joint 1 of the rig. A 6-plate system will provide the required safety at this speed.

Note that this speed is highly unlikely to be practical in normal operation of the rig with weight plates only due to the movement which will occur, making it unsuitable for filming.

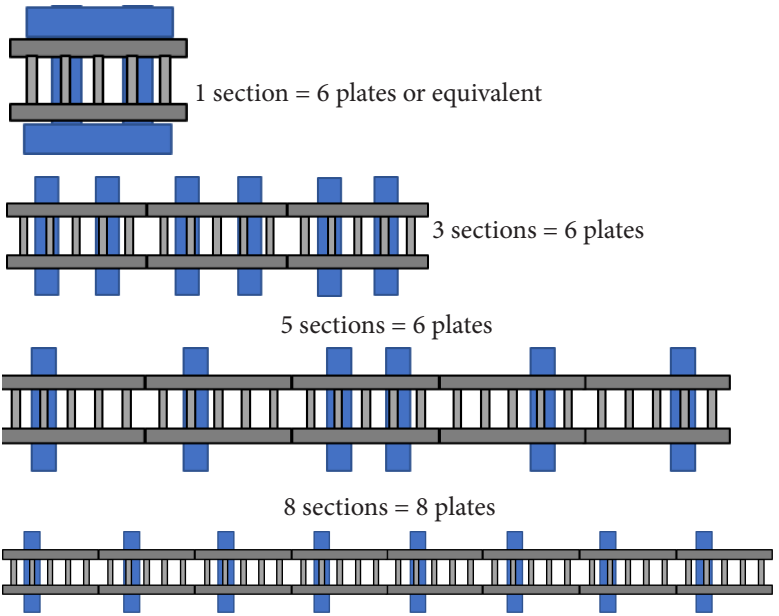
To avoid any significant gaps in the weight plate system for longer runs greater than 6 lengths an additional 1 plate per length of rail is required. For more detail on how to lay the track and weight plates, refer to *Precision Track Quick Start Guide*.

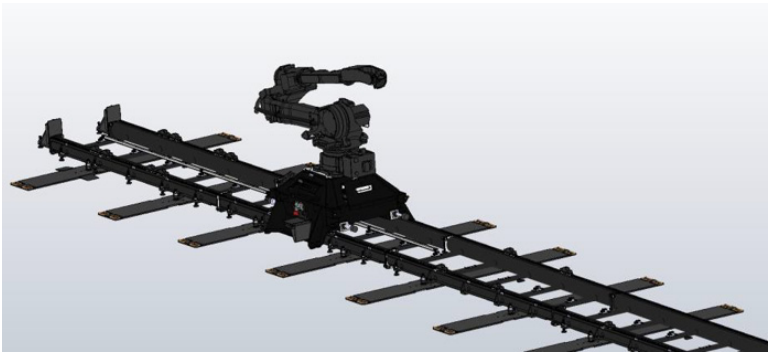
Number of plates

- Two plates for each 3m section of precision rail up to 3 sections.
- For systems with more than 3 sections of 3m rail 6 plates should be used up to a maximum of six sections, spaced evenly.
- For more than 6 sections 1 additional plate per section is required.
- For systems with less than 3 rail sections additional stabilising weights must be used, equivalent to 6 plates.

Rail Sections	Plates Required
Upto 3	Equivalent of 6 plates

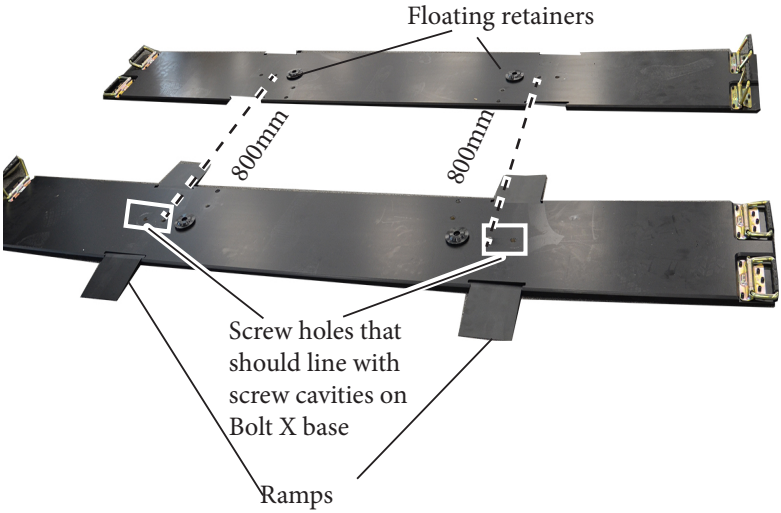
Rail Sections	Plates Required
3 to 6	6
More than 6	One plate per rail section, spaced evenly





Using Bolt X without Track (with Weight Plates)

1. Ensure that the Bolt X is not on track and can be wheeled on its jacking castors.
2. Lay the first weight plate on the floor, in a position that will be the rear of the Bolt X turret, across the “facing front” direction.



3. Lay the second weight plate on the floor in front of this and carefully position it so the threaded holes along the long centre axis of the plate are 800mm apart between the two plates. Do not use the floating retainers as they are inexact and are used only for fitting rail.
4. Add the supplied 4 x ramps to the first weight plate the Bolt X will be wheeled on to.

5. While carefully aligning and keeping the wheels straight, wheel the Bolt X over the first plate.

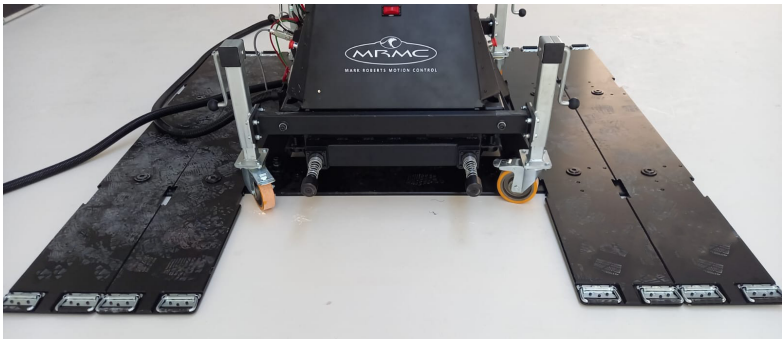
6. Once the first pair of wheels has wheeled over the first weight plate, remove the 2 x ramps from the inner edge of the weight plate and add them to the second weight plate.

7. Still keeping the wheels straight, wheel the Bolt X so it climbs the second weight plate using the ramps.

8. Drop the screws in the Bolt X base screw cavities along with the supplied nuts and, if required, adjust the weight plates below so that the screws line up. You will need to raise the jacking castors so the Bolt X Base rests on the weight plates.

9. Once the screws have lined up, lower them until they touch the ground (finger tight against the ground) and then tighten the lock nuts on them.

10. Stack 2 x weight plates perpendicular to the weight plates that are secured under the robot.



Notes

Appendix 2 **Troubleshooting**

Typical symptoms, causes, and actions

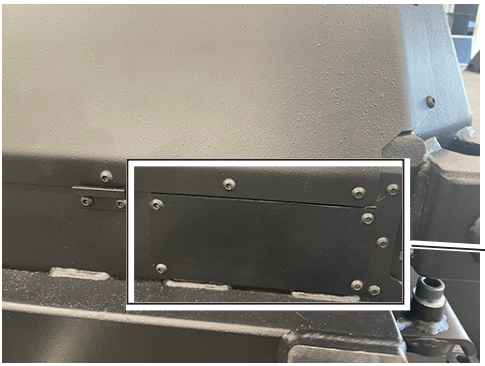
> Note
>
> The YRC1000 teach pendant should only be used for troubleshooting purposes and should not be used for normal operation of the rig. The teach pendant is not related to Flair/RTL in any way and is not an interlace to MRMC Bolt system.

Symptoms	Cause and/or action
Flair fails to establish a network connection to the Bolt X controller (YRC1000).	Try a different cable. The Ethernet cable between the Flair PC and YRC1000 (for Bolt X On Pedestal) and in the umbilical between the Flair PC and Track Base (for Bolt X on Track) needs to be a high quality, fault-free, straight-through (that is, not cross-over) Ethernet cable. Check that all cables are connected correctly (page 16 and page 18) and that all devices, including the Ethernet hubs, have power. Make sure you have allowed enough time for the Bolt X/YRC1000 unit to completely power up. When you touch the Teach pendant, the screen should turn on. Check the panel of the pendant to see that the robot is not in booting sequence. (See *Checking when YRC1000 is ready* on page 38.) Check that INTime is running. Check that the network socket where the hub is connected to the PC is under INTime.

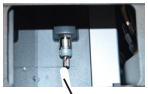
Symptoms	Cause and/or action
Bolt X axes won't move Cabled properly but there seems no power in the robot.	Make sure you have enabled Bolt in Flair/RTL (click on the **Engage Robot** button). Ensure that the Orange LED on YRC1000 is on. Switch the key in the teach pendant to **TEACH** position. Try to move the arm using the Teach Pendant: 1. On the Teach pendant, press the Servo On Ready button. The Servo On LED will start blinking. 2. Press the Deadman's handle half way. This will turn the motor on the robot on. 3. Press + or - for individual joints. Remember to replace the Teach Pendant key to **REMOTE** position after you have fixed the issue.
Robot is engaged but the axes remain grey and do not move.	Check the Second Home Position and reset. See *Second Home Position Check and Reset* on page 45.
Position error on track	If track is losing position after hard acceleration or deceleration; or when e-stop is pressed and the robot stopped quite quickly and doesn't go back to the home postion, there is a chance that coupling screw between the track motor and gearbox might be loose. Follow the procedure in *Resolving Position Error on Track* on page 54 to tighten it.

Checking when YRC1000 is ready

After powering, the YRC1000 controller should successfully boot within 2 minutes, then start Flair. If Flair doesn't connect, undo the screws on the pendant hatch plate at the lower right corner in the base.



Remove the pendant bypass and plug in the pendant.



After switching on YRC1000, on the pendant, in the Job menu, make sure no error message is displayed at the bottom of the screen. (Function buttons should be blank.)

If an error appears on the pendant display, press the **Reset** button to reset the error. If the error persists, refer to the relevant troubleshooting section in this guide to resolve the error, or contact MRMC.

Switching Bolt X to Manual Mode

You can run the Bolt X in manual mode without using Flair.

1. Ensure that YRC1000 is powered up and booted.
2. Switch the key on the pendant to 'Teach' position.
3. If the E-stop cable as well as the rest of the system are still connected, switch the key on the safety PLC to horizontal position to bypass Flair (red LED will come on).
4. Alternatively, if the safety PLC is not available, you can use Bypass Estop box [20529] and connect it directly to the umbilical.

5. Ensure that the E-stop on the pendant is released and there are no error messages on the pendant.
6. Release the desk E-stop, or the Bypass Estop, by twisting the big red button engage the robot by pressing the small reset button.

Moving the Robot in Manual Mode

1. Press the **Servo On Ready** button on the pendant. The **Servo ON** light should start blinking.
2. Press the Dead Man's Handle at the rear of the pendant half way to turn the robot on..

> Note
>
> If you release the deadman's handle, the robot will power off. Press the **Servo On Ready** button on the pendant and the deadman's handle half way again to power up the robot.

3. Use the axes buttons X to Z, shown, to move the joints on Bolt X.

Note

When moving an axis using the pendant, be careful, as the direction might be reversed with respect to Flair.

To move the Bolt X base or to switch from moving Rotate to Track, press the **Ex Axis** button. To switch to moving Rotate axis, press the **Robot** button.

4. Use the Slow and Fast button to change the speed of the axes movement.

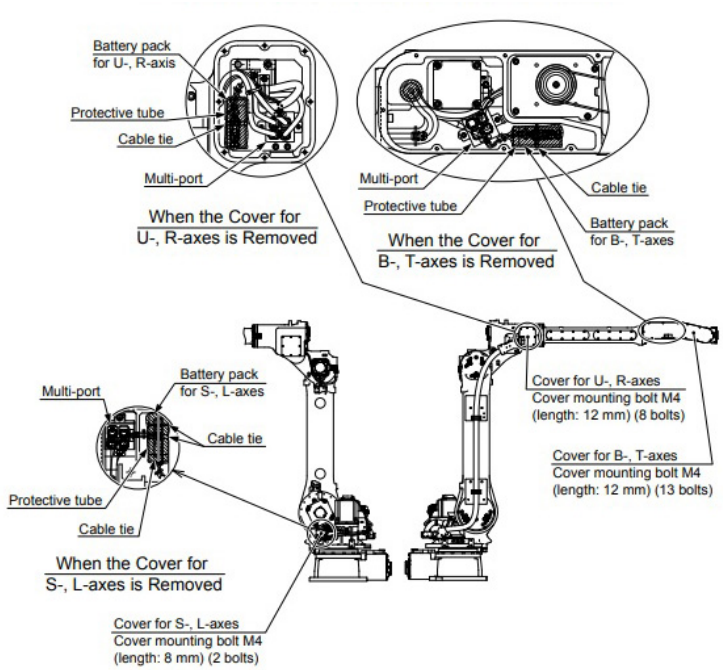
Setting Bolt X Back to Remote Mode

1. Switch the key in Safety PLC back to vertical position.
2. Switch the key in the teach pendant back to “Network” position.
3. If you are using the Bypass Estop box [20529] instead of Safety PLC, replace it with Safety PLC.
4. If you still cannot engage and move the robot in Flair, restart Flair.

Bolt X Recalibration

The robot should never lose calibration. However, the following are the examples of situations that the robot might lose calibration:

- After a hardware crash.
- The batteries inside the encoder keep the encoder position saved at all times even when the power to the robot is off. If the batteries run out then the encoder position will be lost.



Locations of battery pack

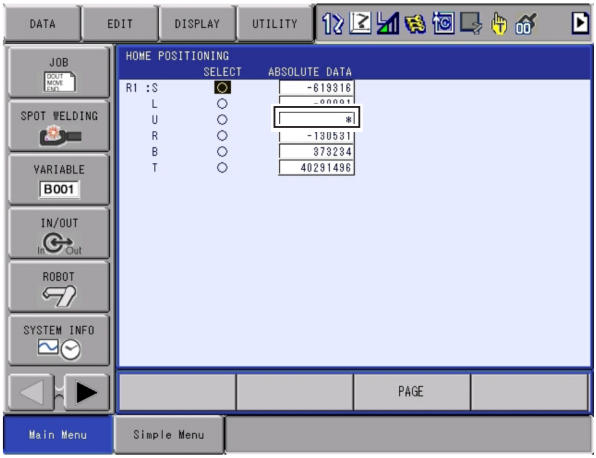
- If any of the encoder cables is unplugged then the encoder position will be lost.
- If you try to change the encoder batteries when the power to the robot is off then also the encoder position will be lost.
- When you connect the base to a different arm or vice versa.

Use the pendant to check if the axes zero properly (the Current Position of all axes should be less than 1000 pulse indicating they are close to zero.) To do this:

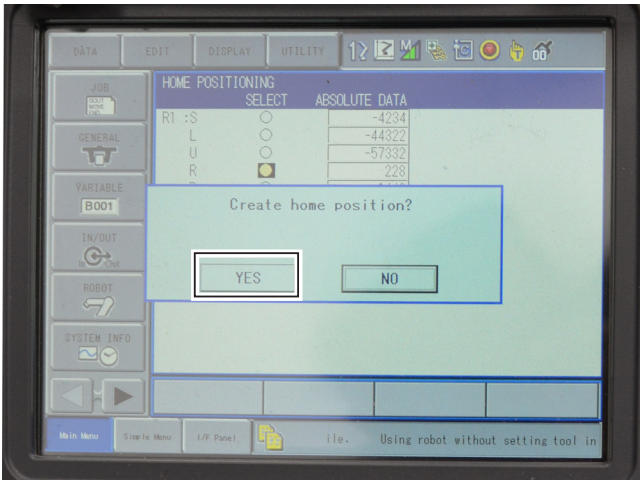
1. Align the arrows on the arm by eye to bring it to zero position as accurately as possible (this can be done either with the software or the pendant in Manual Mode).
2. Go to **MAIN MENU → ROBOT → CURRENT POSITION**. Check that the value is close to zero.
3. If one axis is not zero, change the User Profile to **Safety Mode**. Refer to *Changing User Profile* on page 44 for more information.
4. Select **MAIN MENU → ROBOT → HOME POSITION**.

5. Use the up and down arrows to navigate the joint you want to recalibrate and press the Select button to set it to 0. Sometimes '*'

appear instead of absolute encoder position indicating that there is a problem with the calibration. (In this example, we are using Pan.)

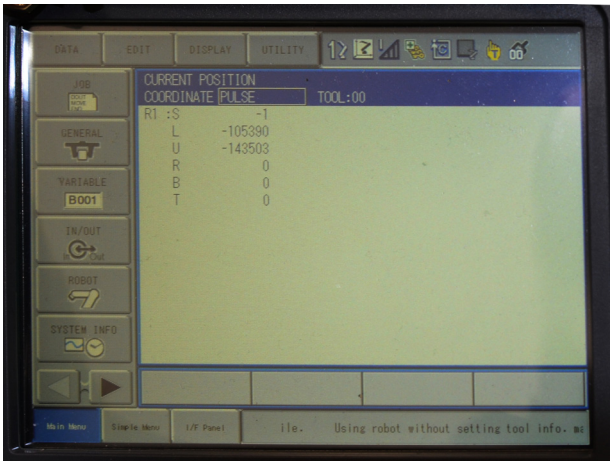


6. A message appears when you press **Select**. Select **Yes**.



The values in the ABSOLUTE DATA column will not change as they are absolute values. It is the current position values that will change.

7. Select **MAIN MENU → ROBOT → CURRENT POSITION**. The axis is changed to 0.



Changing User Profile

1. Select **MAIN MENU → SYSTEM INFO → SECURITY**.

2. You will be presented with a list of user profiles. Select the desired user profile.

3. Enter the password for the user:

   - Management Mode Password: 9999999999999999 (all 9s' - 16 digits)
   - Safety Mode Password: 5555555555555555 (all 5s' - 16 digits)

> Note
>
> When entering all the same digit, the numeric key can be held to automatically repeat to the maximum of 16 digits.

4. Press the **Enter** key on the keypad.

Second Home Position Check and Reset

When the robot is turned off, it stores the current position as the 'second home position'. An example scenario can be after a transport move the motors can move slightly and therefore the current axis position can change in the Second Home Position page. This might generate an error due to a mismatch between the memorised position and actual position.

For example, when Flair is started and the robot is engaged, the robot will engage successfully but all axes would become 'grey' in Flair again and you might not be able to move them. To resolve this issue:

1. Switch to **Manual (Teach) Mode**.

    1.1 Ensure that YRC1000 is powered up and booted.

    1.2 Switch the key on the pendant to 'Teach' position.

    1.3 If the E-stop cable as well as the rest of the system are still connected, switch the key on the safety PLC to horizontal position to bypass Flair (red LED will come on).

    1.4 Alternatively, if the safety PLC is not available, you can use Bypass Estop box [20529] and connect it directly to the umbilical.

    1.5 Ensure that the E-stop on the pendant is released and there are no error messages on the pendant.

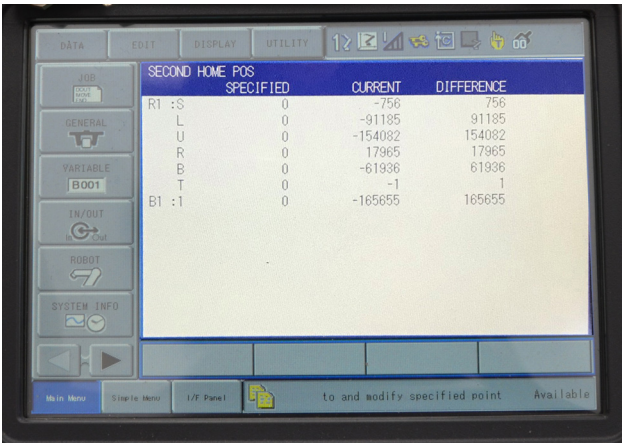
    1.6 Release the desk E-stop, or the Bypass Estop, by twisting the big red button engage the robot by pressing the small reset button.

2. Press the Dead Man's Handle at the rear of the pendant half way to turn the robot on. and release to turn it off.

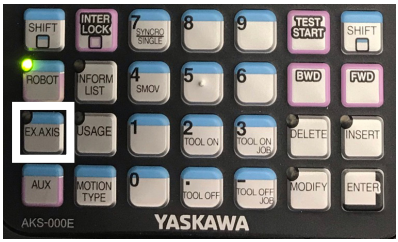
> Note
>
> If you release the deadman's handle, the robot will power off. Press the **Servo On Ready** button on the pendant and the deadman's handle half way again to power up the robot.

3. Select **Main Menu → Robot → Second Home Position**.

4. Move all axes to the SPECIFIED POSITION so that the values in the DIFFERENCE column are zero or close to zero. To do this enable the robot and press and hold **FWD**. Use the Fast/Slow buttons to alter the robot speed during this movement. The axes will all move to stored second home position so that the values in the Current position column are the same as those in the Specified position column and the Difference will be 0. Sometimes, you might need to move each axis individually.



If you want to move the Base, move from ROBOT to EX. AXIS.



5. Press **DATA**.
6. Click on Confirm Position. You might need to do this twice.

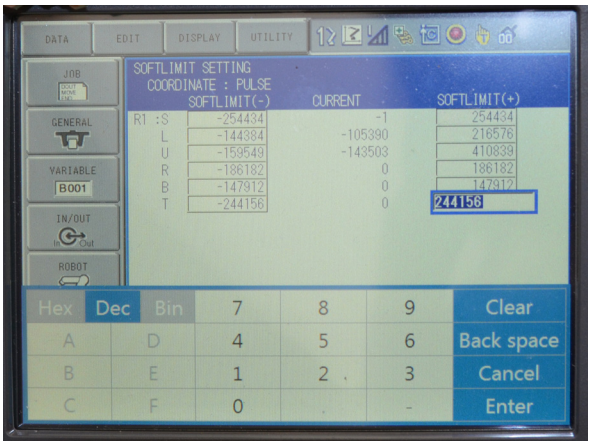
   The error should now clear.
7. Switch the key back to 'Remote' and engage Flair in the usual way.

Setting Joint Limits

1. Switch user profile to Safety Mode.
2. Select **MAIN MENU → ROBOT → SOFT LIMIT SETTING**.

3. Select the limit setting and enter a new setting. (Values are in pulses)

Joint T (Roll) is 100000, which is approximately 180°.



Moving the Bolt X Arm by Hand (Using Brake Release Function)

In certain situations, it might be pertinent to move the robot arm by hand. This can be in a situation, for example, when momentum or a programming error moves the arm against its internal hard limits or if the camera platform gets stuck against another part of the arm, the motors might not be able to move from this position without tripping out. To move the Bolt X arm by hand:

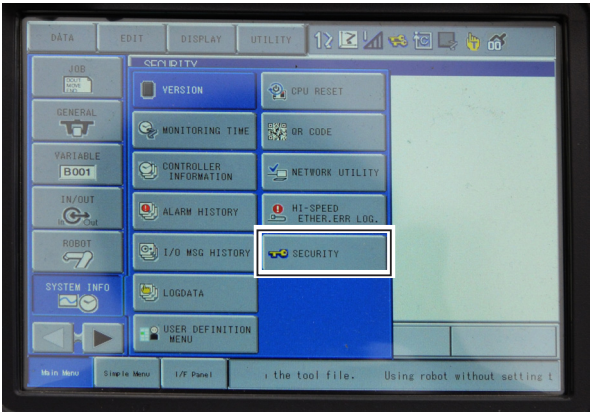
WARNING!

Brake release mode can lead to unforeseeable arm movements.

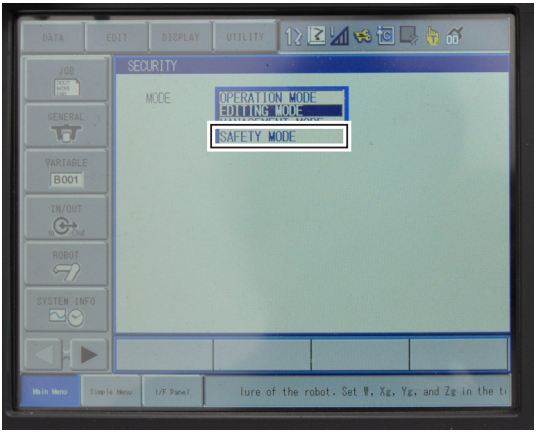
1. Ensure that YRC1000 is powered up and booted.
2. Switch the key on the pendant to 'Teach' position.
3. If the E-stop cable as well as the rest of the system are still connected, switch the key on the safety PLC to horizontal position to bypass Flair (red LED will come on).
4. Alternatively, if the safety PLC is not available, you can use Bypass Estop box [20529] and connect it directly to the umbilical.

5. Ensure that the E-stop on the pendant is released and there are no error messages on the pendant.
6. Release the desk E-stop by twisting the big red button engage the robot by pressing the small reset button.

7. Select **MAIN MENU → SYSTEM INFO → SECURITY**.



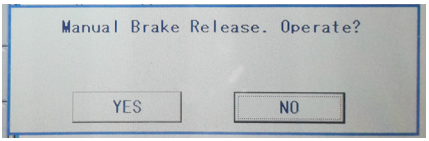
8. You will be presented with a list of user profiles. Scroll to **Safety Mode** and press **Enter**.



9. Enter the password for the Safety Mode user: 5555555555555555 (all 5s' - 16 digits)

10. Press the **Enter** key on the keypad.

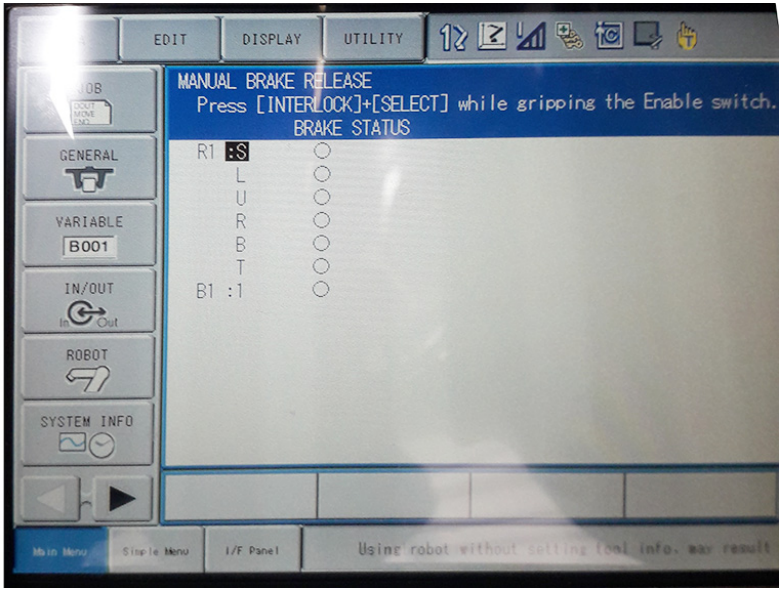
11. Navigate to **Robot → Manual Brake Release**. Scroll to find the option, if required. Select **Yes** for confirmation.



12. Scroll down to the axis for which the brake needs to be released.

WARNING!

It is important that the desired axis is highlighted and people are prohibited in the isolation area around the robot. Brake release mode can lead to unforeseeable arm movements.


EDIT
DISPLAY
UTILITY
JOB
GENERAL
VARIABLE
B001
IN/OUT
In
Out
ROBOT
SYSTEM INFO
MANUAL BRAKE RELEASE
Press [INTERLOCK]+[SELECT] while gripping the Enable switch.
BRAKE STATUS
R1 :S
L
U
R
B
T
B1 :1
Main Menu
Simple Menu
I/F Panel
Using robot without setting tool info. may result

13. Simultaneously press deadman's handle to half position and **Interlock** + **Select** buttons. The brake releases on the highlighted axis and is ready to be moved by hand.

WARNING!

Exercise extreme caution when using Brake Release function as unexpected movement of the robot can cause damage to both personnel and equipment.

Checking if Yaskawa YRC1000 Output File is set to Flair

The Yaskawa YRC1000 is set to communicate with Flair in the factory. If for some reason, this has changed then the robot will fail to communicate with Flair. The file names used for Flair is Flair2Motoman.out. To check this setting:

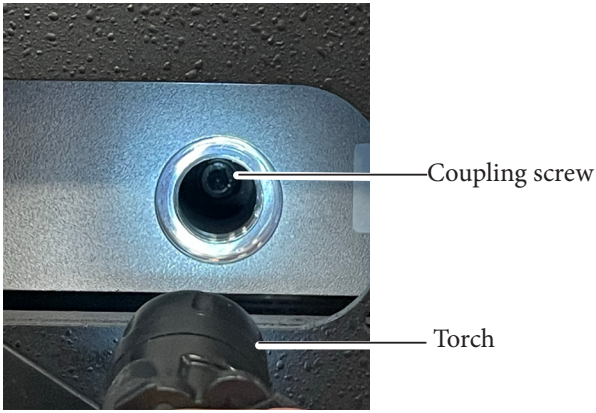
1. Turn on the robot (YRC1000).
2. In the Pendant, select **MAIN MENU** → **JOBS** → **JOB**.
3. The Job name should be FLAIR. If the Job name is RTOS then the system needs to configured for Flair. Contact MRMC if this is the case.

Resolving Position Error on Track

If after hard acceleration or deceleration, the robot doesn't go to accurate Home position. Or if after an emergency stop, the robot stopped too quickly and fails to Home position later, the coupling between the gearbox and track motor might be lose and should be tightened. To do so:

1. Ensure that the tack pinion is not in mesh.
2. Access the coupling by opening the hatch in the Bolt X base and removing the screw, as shown.

3. You might need to flash a torch in the cavity for a clear view. Once in the clamp is in view, move the track motor slowly from Flair until the screw is clearly in view.



4. Using an allen key, tighten the screw, ensuring not tightening excessively to prevent breaking it.

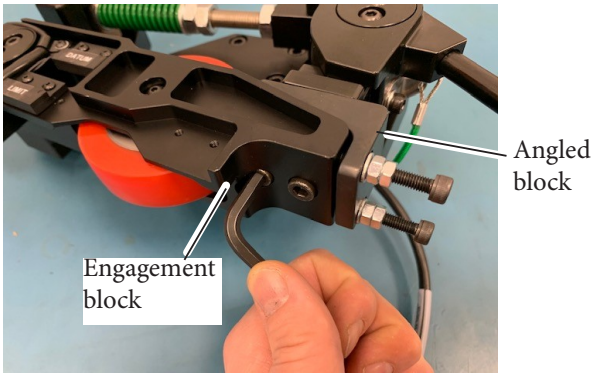
5. Replace the screw in the cavity and close the hatch.

Pinchwheel Setting

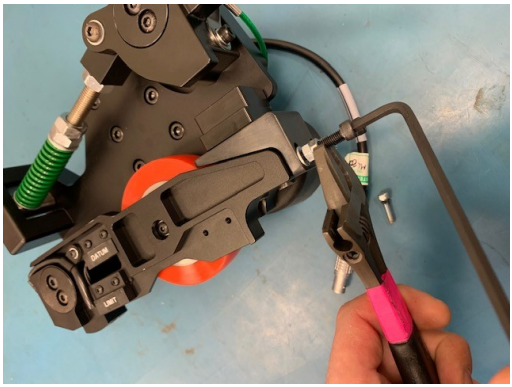
1. Pinch wheel mesh pressure setting:

The pinch wheel has an angled block, which is adjustable, which in turn raises or lowers the engagement block.

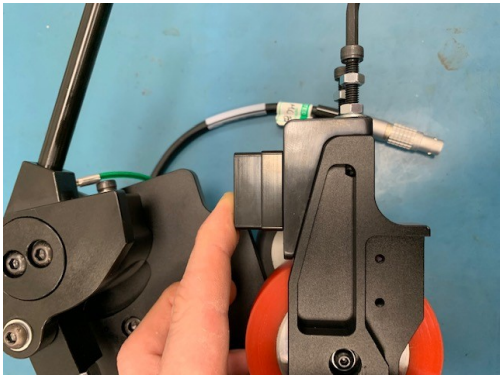
1.1 Firstly loosen the two cap head bolts that secure the block through the angled adjustment block:



1.2 Once these bolts are slackened, loosen the 4 nuts on the extruding bolts. We advise that when loosening these nuts, that an allen key is held in the bolt, as this bolt should not move, it is designed to stay tight:



1.3 Wind the locking nut out to the head of the bolt, so the secondary nut can be used to adjust the angled block to the necessary pressure, shown are the two extremes. 1st a loose mesh, 2nd a tight mesh:

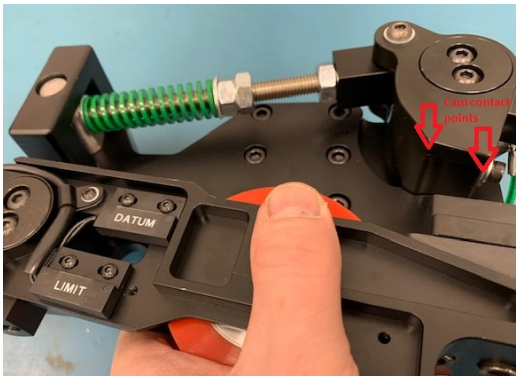


This can be done on the robot, with the pinch wheel assy. attached, locking pin in, close the engagement bar, check tightness of mesh (Too loose - the pinch wheel should not be able to be turned by hand. Too tight – the pinch wheel should not be bulging out), unengage, adjust nut, re-engage, check tightness of mesh. Continue until at the optimum pressure.

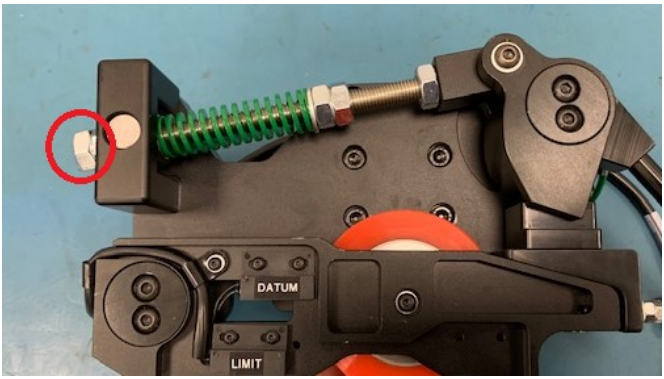
1.4 Once at the correct pressure, tighten down the locking nuts against the adjustment nuts and re-tighten the securing cap head bolts (reverse of points 1.1 and 1.2).

2. Adjusting the engagement bar and cam:

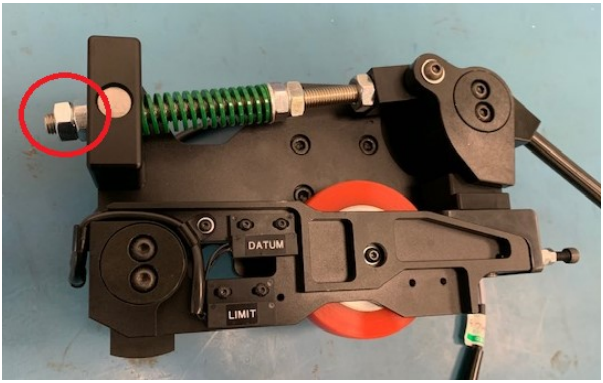
2.1 The adjustment bar and cam angle are adjusted by the nuts on the threaded bar that runs through to the outer edge of the assembly. The two raised edges of the cam should be in contact with the engagement block, when engaged.



2.2 Loosen the end nuts.



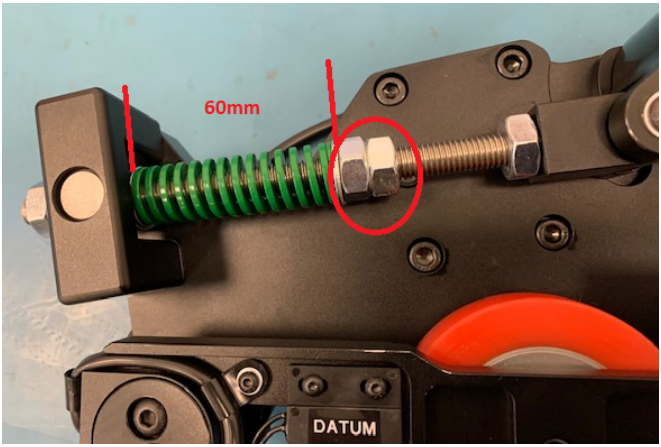
2.3 With the engagement bar closed, squeeze the cam to the engagement block. This will push the threaded bar out to the necessary adjustment point:



2.4 While squeezing the cam to the block, wind the adjustment nut down loosely finger tight, then lock the locking nut in place.

3. Adjustment cam bar pressure

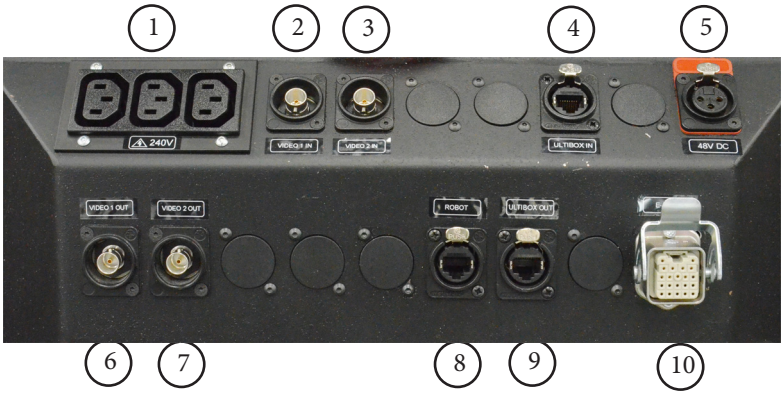
This adjusts the compression of the cam bar spring. A suitable compression, unengaged, the spring should be approx. 60mm.



It is adjusted and locked by the two nuts shown:

Appendix 3 **Bolt X panels**

Bolt X On Track base panel connector summary



1. **240V AC** output, for general use by additional devices that you want to mount on the base.

2. **VIDEO 1 IN** input connector for the video 1 signal from the camera. This has a straight-through internal connection to the **VIDEO 1 OUT** connector (6).

3. **VIDEO 2 IN** connector for the video 2 signal from the camera. This has a straight-through connection to the **VIDEO 2 OUT** connector (7).

4 and 9. **ULTI ETHERNET IN** and **ULTI ETHERNET OUT** connectors for communications between Ulti box on the arm and Ethernet hub via the umbilical cable.

5. **48V DC** power connector. You usually use this to power the Ulti-box (and its attachments) on the Bolt arm, by attaching a cable from this connector to the 48V connector on the arm.

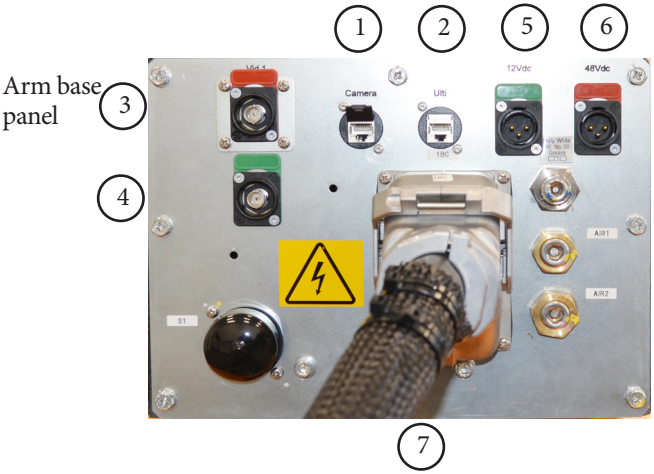
6. **VIDEO 1 OUT** connector for the video 1 signal from the camera. This has a straight-through connection to the **VIDEO 1 IN** connector (2).

7. **VIDEO 2 OUT** connector for the video 2 signal from the camera. This has a straight-through connection to the **VIDEO 2 IN** connector (3).

8. **ROBOT** connector. You use this to connect the robot Controller YRC1000 inside the Bolt X base, via the umbilical cable, to the hub in where the Flair PC is connected

10. **E-STOP** connector. You connect this to the PLC via the umbilical cable.

Bolt X arm panels connector summary



1. **Camera** connector is an Ethernet connector or communications between the camera and the rest of the system. The connection between these two connectors is a straight-through internal connection through arm.
2. **Ulti** connector is an Ethernet connector or communications between the Ulti box on the robot arm and the rest of the system. You ordinarily attach this to the Ethernet connector in Bolt X base (for Bolt X On Track).
3. **VID 1** output connector for the video 1 signal from the camera. This can be connected to the **VIDEO 1 IN** connector on the Bolt X base.
4. **VID 2** output connector for the video 1 signal from the camera. This can be connected to the **VIDEO 2 IN** connector on the Bolt X base.
5. **12 V DC** input power connector. You can use this to power the camera or other devices mounted on the camera platform.
6. **48V DC** input power connector supplies 48 Volts DC output to the Ulti box on the Bolt X arm. This has a straight-through internal connection to the **Ulti-box input** connector.

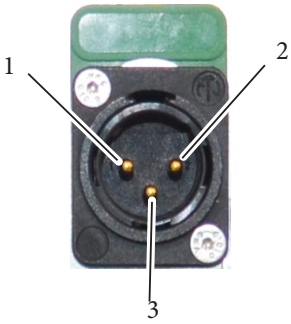
7. **YRC1000 power and controller** connector. This is for the encoder and power cable that runs between the Bolt X arm and the YRC1000 controller unit, which supplies control to the arm.

Bolt X arm connector pinout information

12VDC connector

This type of connector is used to power the camera through the robot arm.

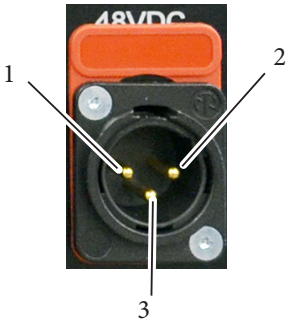
1. GND
2. +12-24V
3. Not used



48VDC connector

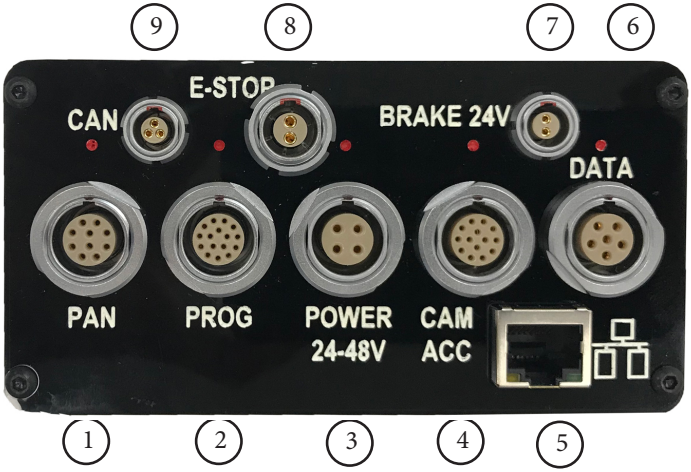
This type of connector is used to power the camera through the robot arm.

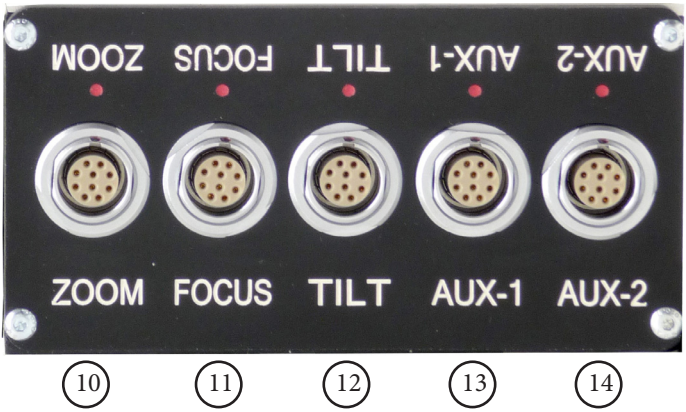
1. GND
2. Not used
3. +48V



Ulti-box connector summary

The Ulti-box that is mounted on the Bolt X arm is a multi-purpose interface box that is used to control servo motors on many MRMC heads and Lens Control Motor (LCM) units. The Ulti-box offers versatile connections for many camera and lens configurations although some of the axes connectors such as **PAN**, **TILT**, and **DATA** are not ordinarily used in the context of Bolt X, as Bolt X itself provides these features.





1. **PAN** connector for the Pan servo motor on a head. For pin-out information see *Servo motor connector* on page 68.

2. **PROG** serial connector for connection to a controller using a Serial RS232 connection (as an alternative to an Ethernet or DataLink connection), and for updating the firmware in the Ulti-box. For pin-out information see *Program serial connector* on page 68.

3. **POWER** DC input for the Ulti-box and its attached devices. The standard unit uses a power input of 24-36 Volts. The high-power variant (marked **HV**, for **H**igh **V**oltage) uses 24-48 Volts. For pin-out information see *Power connector* on page 69.

4. **CAM ACC** Camera Accessory input/output connector. It has pins for three stepper motors, two serial lens controls, two trigger in controls, and two trigger out controls. For pin-out information see *Camera Accessory connector* on page 69.

5. **ETHERNET** RJ45 connector for controlling the Ulti-box and its connected devices from a Flair PC. This Ethernet port is rated at 100 Mbits/sec but can operate at lower speeds of 10 Mbits/sec or less.

6. **DATA** DataLink In (Up Link) connector for controlling the Ulti-box and its attached devices using a DataLink connection, as an alternative to an Ethernet or Serial RS232 connection. You connect this to a device that is further up the DataLink daisy-chain, such as one of the following:

   - The **DATA OUT** (or **DOWN LINK**) connector on a controller such as the MSA-20 Handwheels or Large Format Panel (LFP).
   - The **RIG/HEAD** connector on an RT-12 or RT-14 interface box which is in turn connected to a PC running Flair Motion Control Software.

   Note that because there is no DataLink Out connector on the Ulti-box, the Ulti-box must be connected at the end of the DataLink daisy-chain rather than the middle. For pin-out information see *Data In connector* on page 70.

7. **BRAKE 24V** connector to connect the 24V brake power supply.

8. **E_STOP** connector can be used as an input for E-Stop. To enable the motors, Pins of this connector needs to be shorted, else all drivers are disabled and enable signal from Flair is ignored. It can be

connected to the external E-Stop box, but if no external E-Stop is needed, a bypass jumper may be used.

9. **CAN** connector is used to communicate with external CAN capable motor drives.

10,11. **ZOOM**, **FOCUS** connectors for external servo Lens Control Motors (LCMs) mounted on the camera platform. For pin-out information see *Servo motor connector* on page 68.

12. **TILT** connector for a Tilt servo motor on a head. For pin-out information see *Servo motor connector* on page 68.

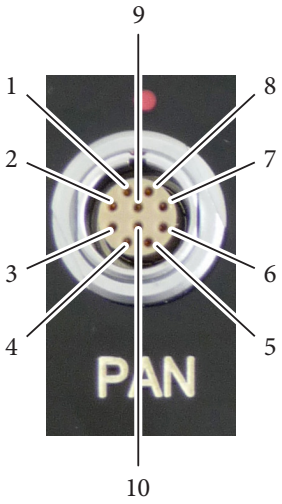
13,14. **AUX-1**, **AUX-2** connectors for control of auxiliary servo motors. For pin-out information see *Servo motor connector* on page 68.

Ulti-box connector pin-out information

Servo motor connector

This type of connector is used for six servo motor connectors on the Ulti-box: Pan, Zoom, Focus, Tilt, Aux-1, Aux-2.

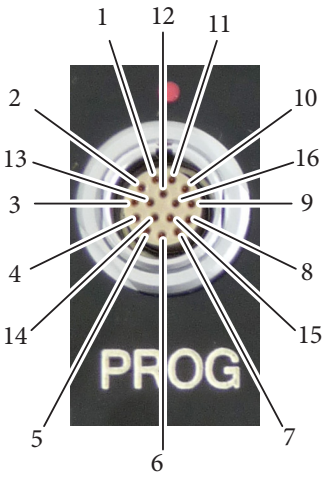
1. DATUM
2. A+
3. B+
4. Z+
5. Brake/Enable output
6. MOTOR_B
7. MOTOR_A
8. LIMIT
9. +5V
10. GND



Program serial connector

Serial connector for connection to a controller using a **Serial RS232** connection, and for updating the firmware in the Ulti-box.

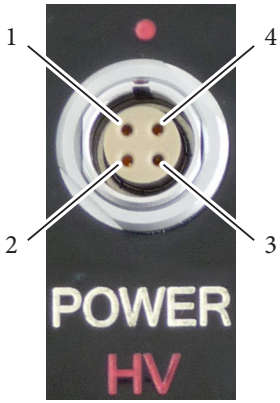
1. SerialTxA
2. SerialRxA
3. +5V
4. FGPIO
5. DSP_TRSTN
6. TCK
7. TMS
8. DSP_TDI
9. DSP_TDO
10. DSP_EMU0
11. DSP_EMU1
12. FPGA_TDI
13. FPGA_TDO
14. BOOT_SEL
15. +3.3V
16. GND



Power connector

The power input connector for the Ulti-box. For usage see page 66.

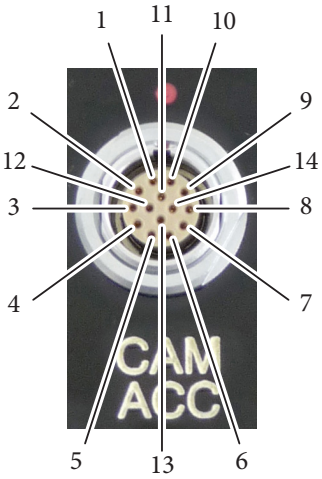
1. GND
2. GND
3. +35V
4. +35V



Camera Accessory connector

This is a multi-purpose camera accessory connector with connections for three stepper motors, two serial lens controls, two trigger in controls, and two trigger out controls.

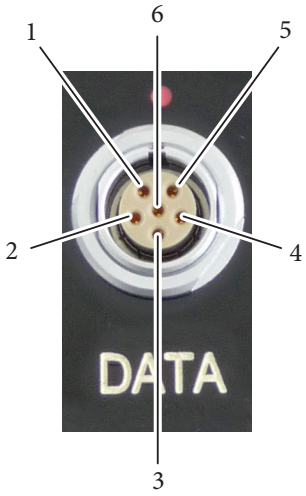
1. Step1
2. Gp2In (Trigger In 2)
3. Step2
4. SerialTxB serial lens control
5. Step3
6. SerialRxB serial lens control
7. Dir3
8. GND
9. +5V
10. Gp1In (Trigger In 1)
11. Dir1
12. Dir2
13. Gp2Out (Trigger Out 2)
14. Gp1Out (Trigger Out 1)



Data In connector

This is a DataLink In connector for connection to a controller using a DataLink connection. DataLink In (Up Link) connector for connection to a DataLink device higher up in the DataLink daisy-chain. For usage see. page 70.

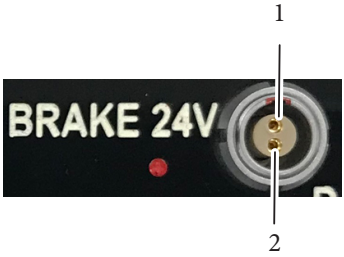
1. Watchdog–
2. Link1Out–
3. Link1Out+
4. Link1In–
5. Link1In+
6. Watchdog+



Brake 24V connector

This is a Lemo Size 0 2-way connector and is sourced from external PSU.

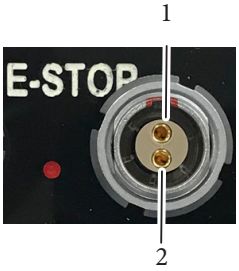
1. GND
2. +24V



Brake 24V connector

This is a Lemo Size 1 2-way connector; external circuitry should keep the pins closed.

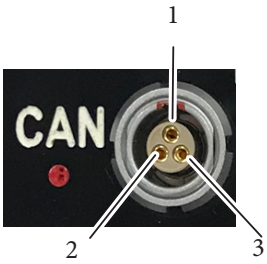
1. E-STOP-
2. E-STOP+



CAN connector

This is a Lemo Size 0 3-way connector; is used to communicate with external CAN capable motor drives.

1. CAN Hi
2. CAN Lo
3. GND



Appendix 4 **Specifications**

Physical Specification

Dimensions	Bolt X On Pedestal	Bolt X On Track
Weight - Arm [kg]	560	560
Weight - Base [kg]	200	430
Weight - YRC1000 controller unit [kg]	85	85 (included in the weight of the base)
Weight - anchor weights and wings [kg]	1600	1600 (if taken off the track)
Weight - floor plates (2 per section of track) [kg]	NA	80 x 2
Maximum payload [kg]	20	20
Height - maximum lens height [mm]	4300	4300
Lowest position [mm]	-1300	-1300
Maximum mechanical vertical clearance needed [mm]	4800	4800
Maximum lens reach from rotate centre [mm]	3212	3212
Maximum horizontal clearance needed [mm]	3800	3800
Height - arm in transport position [mm]	1719	1860
Length - arm in transport position [mm]	1991	1112
Width - without wheels [mm]	NA	
Width - with wheels [mm]	NA	1234
Width - with weights [mm]	2255	NA
Width - without weights [mm]	950	NA

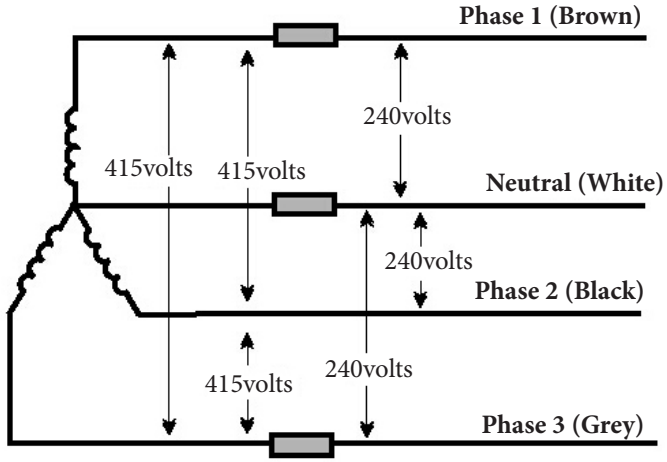
Temperature range: 0-45 °C (32-113 °F)
Humidity tolerance: 0% to 85% relative humidity, non-condensing

Range of Travel

Track: Unlimited range of travel @ 4 m/s
Rotate: +/- 180˚ range of travel @ 180˚/s
Lift: + 135˚ to - 90˚ range of travel @ 180˚/s
Arm: + 206˚ to - 80˚ range of travel @ 180˚/s
Pan: +/- 200˚ range of travel @ 400˚/s
Tilt: +/- 150˚ range of travel @ 430˚/s
Roll: +/- 455˚ range of travel @ 630˚/s

Power requirements

Bolt X on Track requires three-phase power line with Neutral in Wye connection plus Earth (Ground), 50-60 Hz.



Phase to phase voltage must be 380V at least, any lower voltage would reduce maximum track speed. Maximum applied voltage is 415V +10%.

Bolt X On Pedestal requires three phase but NO NEUTRAL.The power cable is wired directly to the robot's controller (YRC1000).

Allowed three phase input voltages:

3-Phase, 380-480VAC (+10%, -15%), 50/60 Hz (±2%)

Cable Colours

Brown	Phase 1
Black	Phase 2
Grey	Phase 3
Green/Yellow	Ground

General Electric Data

Earth

Earth must have good connection (less than 10 ohm) to the closest grounding point of the location.

Earth Leakage Protection

In industrial situations, where you are running large machinery, the earth leakage breaker (RCD/GFI) must be at least 100mA, preferably 300mA. Otherwise the machine will not power up and will sometimes trip when running.

Power for Flair and PC (500W)

The PC running FLAIR and associated components are delivered mounted in a flight case. The power requirement is 110/240VAC single phase 50/60Hz and consumes no more than 500 Watts. All PSUs adjust automatically to the supply voltage.

WARNING when using generators!

Bolt on Track versions MRMC-2080-00 to -02, the Regen Protection box must be used for regenerative current protection damage along with a generator of 20kW.

For MRMC-2080-03 and above, regenerative excess energy damage protection unit is integrated with the robot but it is recommended that a generator of 20kW or above is used with the unit.

Power Data by Country - USA

MAX POWER REQUIREMENTS (+/-10%)	POWER KVA (mean)	SUPPLY VOLTAGE	CURRENT AMPS	RIG CONFIG	WIRING CONFIG	SUPPLIED CONNECTOR	TRANS FORMER 208/415 DELTA/WYE	GFI	NOTE
BOLT X on PEDESTAL (380-480)	3.5	208	10	3+E	DELTA	L21-30P	8KVA	300mA	1, 2
BOLT X on TRACK (380-415)*	8	208	22	3+N+E	WYE	L21-30P	8KVA	300mA	3

*YRC1000 3-Phase, 380-480VAC (-10%, +15%), 50/60Hz, (±2%) (Regen Protection Unit requires 400/415V only)

Notes

1. Bolt X on Pedestal does not need a neutral.
2. If needed the Bolt X on Pedestal requires a transformer to bring the voltage into the operating range 380-480V 3-Phase.
3. Bolt X on Track will require a transformer to bring the voltage into the operating range of 400/415V for correct operation of the Regen Protection Unit and to provide a balanced neutral.

Notes

Appendix 5 **Cleaning and Maintenance**

General Care

After transport, the machine may exhibit an error on its Teach pendant that prevents enabling of the axes; this is due to slight shifting of the arms in transport, creating an out of position error. This can be corrected by going through the Second Home Position reset as explained in the *Second Home Position Check and Reset* on page 45.

Inspect carefully the cableways along the arms for damage or stretching of cables, and ensure any cable clamps and flexing corners are adjusted to suit.

Take great care with the large multi way connectors on the base, arm and umbilical. If they are unplugged for transport ensure they are wrapped or covered so the tiny pins cannot get damaged. Do not spry cleaning fluids into these plugs and sockets.

Cleaning

The Bolt X on tracks should be turned off and unplugged for cleaning.

Main Body and Arm

The Bolt X on Track requires little maintenance, but should be cleaned frequently depending upon where it is used. Clean the main body of the rig and arm with a proprietary cleaning liquid on a soft cloth, then go over the machine with a cloth with WD40, or similar. Gaffer Tape smears can be removed with sticky stuff remover. Fans in the body of the machine should be sucked with a vacuum cleaner.

Cables

Cables should be also cleaned in the same way, but avoid spraying liquids into any open sockets.

Pinchwheel

The Pinch wheel should be checked occasionally. Any signs of damage to the red rubber wheel should have it replaced. Limit sensors on the pinch wheel pivot should be replaced whenever they become broken or their cables damaged.

Track Gearbox

After approximately five years of use the track gearbox oil will need changing, this is just a gear oil available from motor factors, grade EP90.

Track and Track Bearings

The Track Bearings should be frequently greased using a good quality grease gun, again from a motor factor; the grease is Brown Low Melting grade. This should be done at least once per month if the machine is busy and especially in sandy or gritty environments. The bearings should be pumped with grease into one end grease nipple with the bearing on the rail moving slowly along; until the dirty grease stops coming out around the sides onto the rail.

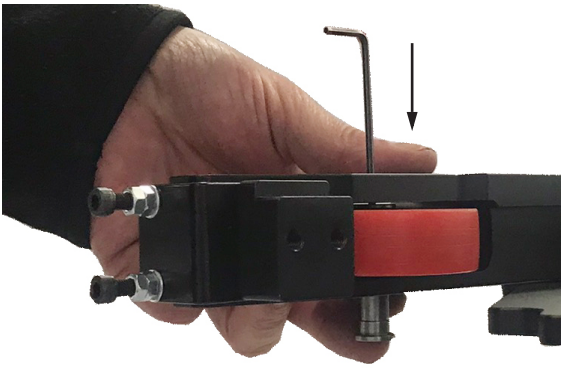
Running with dry bearings will be noisy and produce loose shaky shoots, and will considerably shorten the life of the bearings and the bearing rail. As soon as any track bearing becomes slightly loose on the rail or noisy, or has been damaged or has any balls missing from its four raceways, it should be replaced.

Replacing the Pinch Wheel

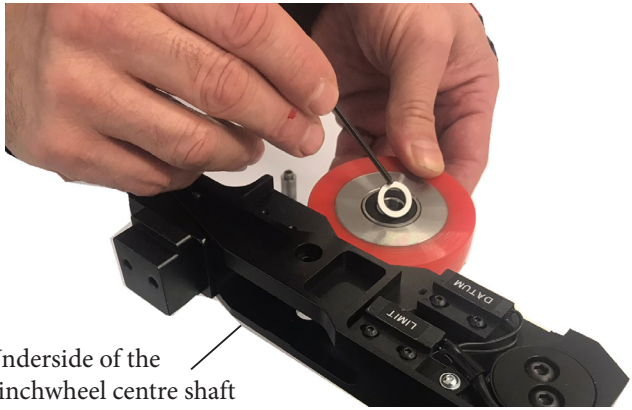
The worn out pinch wheel can be replaced in the pinch wheel assembly using the following procedure:

1. Unscrew the small screw on the pinch wheel on the underside of the pinch wheel assembly. The pinch wheel is not completely detached yet.

2. Using the same allen key push in the screw cavity to release the pin securing the pinch wheel.



3. Notice a washer above the pinch wheel; keep it aside. Discard the worn out pinch wheel.



Underside of the
Pinchwheel centre shaft

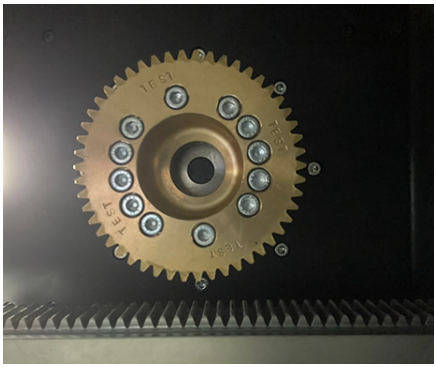
4. Replace the washer on the new pinch wheel carefully and inserting it lined with the screw cavities in the centre shaft of the pinch wheel assembly. Ensure that the washer is inserted towards the underside of the shaft and not on the top.
5. When the pinch wheel is centred on the cavities insert the pin. (Refer to step 2 for alignment and pin position). Push the pin enough so it is flush with shaft and is not protruding.
6. Replace the screw and washer to secure the pinch wheel to the assembly.

pinch wheel pin levelled
with centre shaft

Replacing the Track Pinion

This procedure can be performed either while the robot is on track or while the robot is on jacking wheels.

1. If the robot is mounted on the track, remove the pinchwheel assembly from the track motor and move the track motor away from the rail racking. Using bare fingers, observe the underside of the pinion to perceive the position of the pinion on the shaft.
2. Remove the 12 x screws from the track pinion.



3. You should now be able to release without applying pressure. If it is not released easily, use Flair to run the track motor at a slow speed, eg 20rpm. While the track pinion is rotating, use a heat gun to heat the pinion to allow it to expand.

Caution

- Take care when heating the pinion with the heat gun to only direct the gun downwards onto the sides and central when underneath. If the heat gun is directed at the gearbox seal above the pinion it can cause damage and create leaks.
- Do not hit the pinion or gearbox with any tools to detach it from the gearbox. Hammering can cause permanent damage to the pinion and gearbox.

4. Once the pinion is sufficiently expanded, using heat-proof gloves, try removing the pinion; again without using much pressure.
5. Replace the new track pinion by inserting and pushing it onto the shaft. Using the reflection of the pinion on a mirror or mobile phone, align the pinion on the shaft. If it doesn't fit easily, heat it using the heat gun and then slide it on to the track motor shaft. The position of the pinion should be the same as you had observed before removing the worn out pinion; approximately only 1-2mm of shaft projecting from the pinion centre.
6. Replace the 12 x screws to secure the pinion.

Notes

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