Main Control Box

Network Horner Controller

CAN Connector

M12 Port ( RS232)

PC

USB-A Port

DB9 Connectors

LCDT Plate

Load Cell

M12 4 Pin Bulkhead

Displacement Transducer

M8 4 Pin Bulkhead

M12 8 Pin Bulkhead

M12 8 Pin Female Bulkhead

Start Button

Stop Button

M8 4 Pin Female Bulkhead

Barcode Scanner

Ethernet Port

24 Pin Female Connector

24 Pin Male Connector

M12 8 Pin Female Bulkhead

M12 5 Pin Female Bulkhead

M12 5 Pin Male Connector

Slow Up Valve

Fast Up Valve

M12 4 Pin Female Bulkhead

DB9 Connectors (To Use The Fork Proof Load PC as a lab Network PC)

Slow Down Valve

Fast Down Valve

Clamp Valve

Air Pressure Sensor

HMI Control Box

HMI Horner Controller

CAN Connector

M12 5 Pin Female Bulkhead

M12 5 Pin Male Connector

HMI Control Box

HMI Horner Controller

CAN Connector

M12 5 Pin Female Bulkhead

M12 5 Pin Male Connector

HMI Control Box

HMI Horner Controller

CAN Connector

M12 5 Pin Female Bulkhead

M12 5 Pin Male Connector

HMI Control Box

HMI Horner Controller

CAN Connector

M12 5 Pin Male Connector

## HMI Control Box Wiring

### HMI Horner Controller

| J1 | J2 |
|---|---|
| I1 (Start) | 0V |
| I2 (Stop) | V+ (24 VDC) |
| I3 (AP Low) | NC |
| I4 (AP High) | Q12 |
| I5 | Q11 |
| I6 | Q10 |
| I7 | Q9 |
| I8 | Q8 |
| H1 | Q7 |
| H2 | Q6 |
| H3 | Q5 (Clamp) |
| H4 | Q4 (Fast Down) |
| NC | Q3 (Slow Down) |
| NC | Q2 (Fast Up) |
| 0V | Q1 (Slow Up) |

J3: T1+ (LC+) | T1- (LC-) | T2+ | T2- | AG1 (LC-10V) | AG2 | 0V (LC-0V) | MA1 | V1 | 0V | MA2 (OT Signal) | V2 | 0V

HMI Horner Controller furthest from the Main Control Cabinet (usually station A) should have 120 Ohm resistor placed across CN_L and CN_H and do not have shield connected to the CAN Connector on the controller

CAN Connector: V- | CN_L | SHLD | CN_H | V+

Screw Terminal Connector: V- | CN_L | SHLD | CN_H | V+

Female 5 Pin Connector: 1 | 2 | 3 | 4 | 5

Male 5 Pin Connector: 1 | 2 | 3 | 4 | 5

M1J2

| RJ45 Pins | T568B Wiring |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 (GND) | |
| 7 (RXD) | |
| 8 (TXD) | |

GND | DC- | DC+

### 24 Pin Male Connector Bulkhead

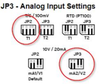
| |
|---|
| 1 (Start) |
| 2 (Stop) |
| 3 (Air Pressure Low) |
| 4 (Air Pressure High) |
| 5 (Slow Up) |
| 6 (Fast Up) |
| 7 (Slow Down) |
| 8 (Fast Down) |
| 9 (Clamp) |
| 10 |
| 11 |
| 12 (GND) |
| 13 (Load Cell 10 VDC) |
| 14 (Load Cell 0 VDC) |
| 15 (Load Cell Signal +) |
| 16 (Load Cell Signal -) |
| 17 (Displacement Transducer Signal) |
| 18 |
| 19 (Barcode Scanner TXD) |
| 20 (Barcode Scanner RXD) |
| 21 (Barcode Scanner GND) |
| 22 |
| 23 (24 VDC) |
| 24 (24 0 VDC) |

### Jumper Settings for Model 5

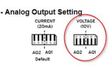
Location of I/O jumpers (JP1 - JP4) and wiring connectors (J1 -J3) with back cover removed


**JP1 - Digital DC Inputs**


**JP2 & JP3 - Analog Input Settings**




**JP4 - Analog Output Setting**




### HMI Box Wire Lengths

J1: 520mm (qty: 4)
J2: 470 mm (qty: 5)
J3: 495 mm (qty: 5)

GND: 250 mm, 150mm, 110mm

24 0VDC to 0V J1: 100 mm
0V J1 to 0V J3: 140 mm
0V to V2 J3: 50 mm
24 VDC to V+ J2: 200 mm

M1J1/2 RJ45 Cable: 600 mm

CAN Wires: 450 mm

## Main Control Cabinet

| Wire Layer Order in Main Cabinet | |
|---|---|
| 11 | Barcode Scanner Cable + Power |
| 10 | Horner->Lab PC RS232-USB |
| 9 | Network Ethernet Cable |
| 8 | CAN Cable |
| 7 | Station 24 Pin Wires |
| 6 | Bulkhead Wires |
| 5 | 24 Pin Power and Ground |
| 4 | Bulkhead Power and Ground |
| 3 | Aux Power and Ground |
| 2 | DB9 Connectors to PC |
| 1 | Non-Station Power and Ground (Including Cabinet Grounding) |

### Barcode Scanner Cable

DB9 Breakout

| Barcode Scanner DC Barrel Jack Wiring | |
|---|---|
| Dashed Line | 0V 5VDC |
| Blank | 5V |

Barcode Scanner Cable CBL-020-300-C00

DC Barrel Jack

Barcode Scanner Ethernet

5 VDC

DATA 0 V

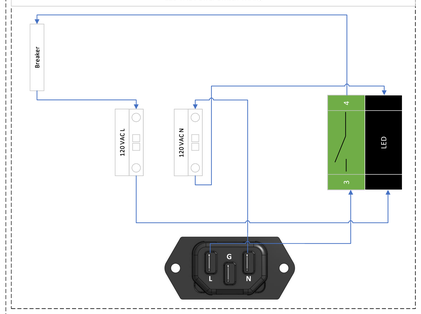
### Network Horner to Lab PC Connection

| DB9 RS232 | |
|---|---|
| Pin Number | Description |
| 1 | CD (Carrier Detect) |
| 2 | RxD (Receive Data) |
| 3 | TxD (Transmit Data) |
| 4 | DTR (Data Terminal Ready) |
| 5 | GND (Ground) |
| 6 | DSR (Data Set Ready) |
| 7 | RTS (Request to Send) |
| 8 | CTS (Clear to Send) |
| 9 | RI (Ring Indicator) |

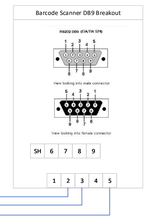
| Horner MJ2 | |
|---|---|
| Pin Number | Description |
| 1 | RX+/TX+ |
| 2 | RX-/TX- |
| 3 | CTS |
| 4 | RTS |
| 5 | TX @ 5V mA |
| 6 | 0V / GND |
| 7 | RXD |
| 8 | TXD |

Horner MJ2 Connector → RJ45 / Pigtail Ethernet Cable → DB9 Breakout (See Above Wiring) → USB-A to RS232 Converter → PC USB-A Port

### 120 VAC Power Switch Wiring




### Barcode Scanner DB9 Breakout




Wire order from back view of Horner ControTer. Reverse for Front View

CAN Connector: V- | CN_L | SHLD | CN_H | V+

120 Ohm resistor should be placed across CN_L and CN_H (included with Horner Controller)

All the confusing routing is to keep CN_L and CN_H in the same twisted pair.

1 (Black 1) | 2 (Cable Shield) | 3 (Black 2) | 4 (White 2)

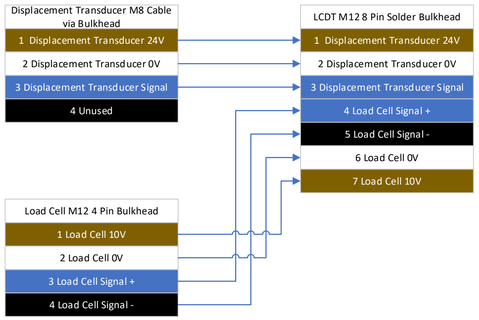
GND | 0V 24VDC | CV- | CN_L | SHIELD | CN_H

### 24 Pin Connector Female Bulkhead

12 (Start) | 11 (Stop) | 10 (Air Pressure Low) | 9 (Air Pressure High) | 8 (Slow Up) | 7 (Fast Up) | 6 (Slow Down) | 5 (Fast Down) | 4 (Clamp) | 3 (Unused) | 2 (Cable Shield Ground) | 1 (Mtl Ground) | 24 (Load Cell 10 VDC) | 23 (Load Cell 0 VDC) | 22 (Load Cell Signal +) | 21 (Load Cell Signal -) | 20 (Displacement Transducer Signal) | 19 (Unused) | 18 (Barcode Scanner TXD) | 17 (Barcode Scanner RXD) | 16 (Barcode Scanner GND) | 15 (Unused) | 14 (24 VDC) | 13 (24 0 VDC)

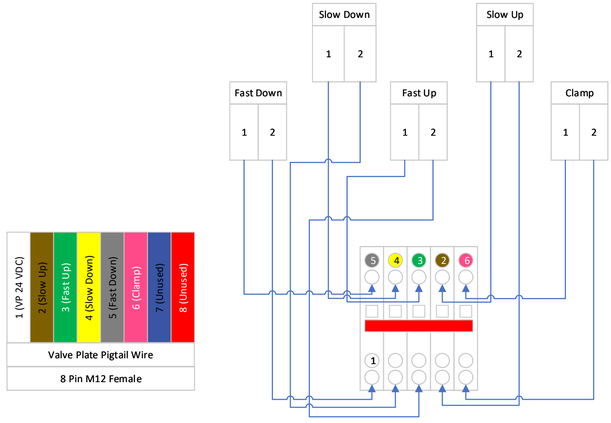
| Load Cell / Displacement Transducer | Start/Stop | Valve Plate | Plan B Power | Air Pressure | CAN |
|---|---|---|---|---|---|
| 1 (OT 24 VDC) | 1 (24 VDC) | 1 (24 VDC) | 1 (24 VDC) | 1 (24 VDC) | 1 (CV-) |
| 2 (OT Signal) | 2 (Unused) | 2 (Slow Up) | 2 (Unused) | 2 (5 VDC) | 2 (Cable Shield GND) |
| 3 (OT 0 VDC) | 3 (Start) | 3 (Fast Up) | 3 (0 VDC) | 3 (Air Pressure High) | 3 (CN_L) |
| 4 (Load Cell Signal +) | 4 (Stop) | 4 (Slow Down) | 4 (GND) | 4 (Air Pressure Low) | 4 (CN_H) |
| 5 (Load Cell Signal -) | | 5 (Fast Down) | | | 5 (Unused ) |
| 6 (Load Cell 10V) | | 6 (Clamp) | | | |
| 7 (Load Cell 0V) | | 7 (Unused) | | | |
| 8 (Unused) | | 8 (Unused) | | | |
| 8 Pin M12 Female | 4 Pin M8 Female | 8 Pin M12 Female | 3 Pin M8 Female | 4 Pin M12 Female | 5 Pin M12 Female |

## LCDT Plate Wiring




**Click Here for Dozuki Guide for Assembly Instructions**

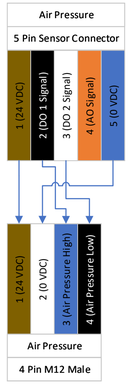
## Valve Plate Wiring




Make sure to use modified terminal blocks as described here:

**Dozuki Guide for Terminal Block Modification**

## Air Pressure Sensor Terminal Block Box



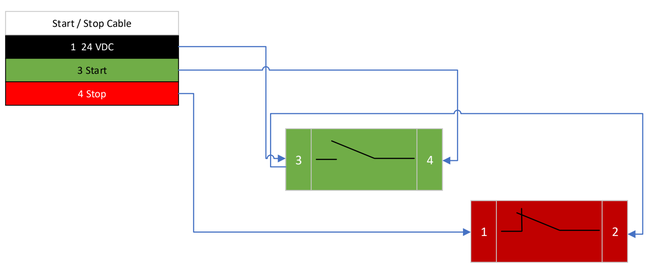

### Air Pressure Sensor Programming Guide:

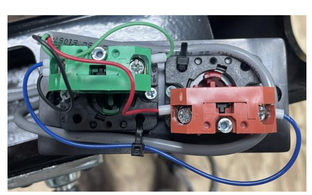
OUT1 is Air Pressure High
OUT2 is Air Pressure Low
Cut off the orange wire (analog out)

Everything about the default setup of the pressure sensor is OK except for the NO/NC settings of OUT1 and OUT2. Press and Hold SET until you see the screen change to Quick Setup mode. Press Set until you see "1o2o" on the screen. Press the up arrow until this is "1o2C" indicating that OUT1 is NO and OUT2 is NC.

After that press and hold SET to return to the Run screen. Pressing SET will now cycle through the trip point settings for OUT1 and OUT2. For OUT1 (1-P will display on the screen) you want to set it at 125 PSI. For OUT2 (2-P will display on the screen) you want to set it at 95 PSI. You set the trip point values with the up and down arrows. Read the documentation about the sensor for everything to be more clear.

## Start / Stop Plate



| 24 Pin Cable | | |
|---|---|---|
| **Male Connector Pins** | Cable Wires | **Female Connector Pins** |
| 12 | Black 1 | 1 |
| 11 | White 1 | 2 |
| 10 | Black 2 | 3 |
| 9 | White 2 | 4 |
| 8 | Black 3 | 5 |
| 7 | White 3 | 6 |
| 6 | Black 4 | 7 |
| 5 | White 4 | 8 |
| 4 | Black 5 | 9 |
| 3 | White 5 | 10 |
| 2 | Cable Shield Drain Wire (Male Side Only) | 11 |
| 1 | White 6 | 12 |
| 24 | Black 7 | 13 |
| 23 | White 7 | 14 |
| 22 | Black 8 | 15 |
| 21 | White 8 | 16 |
| 20 | Black 9 | 17 |
| 19 | White 9 | 18 |
| 18 | Black 10 | 19 |
| 17 | White 10 | 20 |
| 16 | Black 11 | 21 |
| 15 | White 11 | 22 |
| 14 | Black 12 | 23 |
| 13 | White 12 | 24 |

The cable performs the function of swapping pins so that when we're looking inside the cabinet the "Start" signal (for example) is always on the top left, whether you are in the main control cabinet or in the HMI control box, it will always be top left. And that is the same for all of the pins. The technician then doesn't have to think about if it is a male or female connector, a single pin-out diagram can be supplied.

| Male (Wire Termination Side) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |

| Female (Wire Termination Side) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 |

| Lengths | |
|---|---|
| Station A | 10.5 ft |
| Station B | 10.5 ft |
| Station C | 8.5 ft |
| Station D | 8.5 ft |

Strip main cable covering back 3 inches

**For cable and connector part numbers, CLICK HERE to see control box CAD in Onshape**

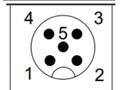
| CAN Cable |
|---|
| 1 [Black 1] (DT 24 VDC) |
| 2 (Cable Shield) |
| 3 [Black 2] () |
| 4 [White 2] () |

Twist three shield wires together to form one wire. Group together with one 18 AWG Ferrule

Twisted Pair

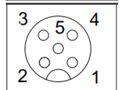
| Lengths | |
|---|---|
| Station A to B | 2 ft |
| Station B to C | 2 ft |
| Station C to D | 2 ft |
| Station D to Main Control Box | 8 ft |

Front View (Male)




**Male 5-Wire, 5-Pole (M12) A-Coded**

Front View (Female)



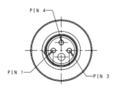

**Female 5-Wire, 5-Pole (M12) A-coded**

| Plan B (Separate) Power Cable |
|---|
| 1 (24 VDC) |
| 3 (0 VDC) |
| 4 (Ground) |

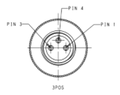
This backup plan was not needed and not implemented in the QST or Red Barn Refresh 2024 Fork Proof Load Builds. It was designed in case of any signal issues with the Load Cell and Displacement transducers caused by routing the signal wires in the 24 pin cable with the HMI control box power. No issues with the signal integrity have been observed as of 3/21/2024. If signal issues are found the 24V power for the HMI control box should not be sent through the 24 pin cable. The 24V wires should be disconnected from the 24 Pin bulkheads within the HMI and Main control boxes and this cable should be fabricated and installed. The requiredM8 3 pin bulkhead connectors are already installed in the main control box but not the HMI control boxes. Part numbers can be found in the CAD.

| Lengths | |
|---|---|
| Station A | 10 ft |
| Station B | 10 ft |
| Station C | 8 ft |
| Station D | 8 ft |

Front View (Male)



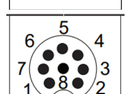

Front View (Female)




| Load Cell / Displacement Cable | |
|---|---|
| 1 (DT 24 VDC) | Twisted Pair |
| 2 (DT 0 VDC) | |
| 3 (DT Signal) | |
| 4 (Load Cell Signal +) | Twisted Pair |
| 5 (Load Cell Signal -) | |
| 6 (Load Cell 0 VDC) | Twisted Pair |
| 7 (Load Cell 10 VDC) | |
| 8 (Shield Drain Wire, Male Only) | |

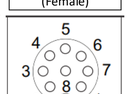
| Lengths | |
|---|---|
| Station A | 10 ft |
| Station B | 10 ft |
| Station C | 8 ft |
| Station D | 8 ft |

Front View (Male)




**Male 8-Wire, 8-Pole (M12) A-coded**

Front View (Female)

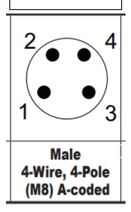



**Female 8-Wire, 8-Pole (M12) A-coded**

| Start / Stop Cable |
|---|
| 1 (24 VDC) |
| 2 (Unused) |
| 3 (Start) |
| 4 (Stop) |

| Lengths | |
|---|---|
| Station A | 10 ft |
| Station B | 9 ft |
| Station C | 7.875 ft |
| Station D | 6.8 ft |

Front View

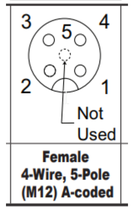



**Male 4-Wire, 4-Pole (M8) A-coded**

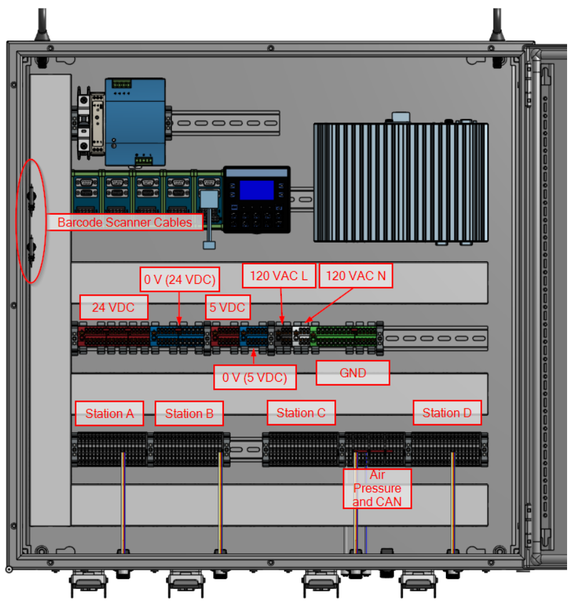
| Load Cell Cable |
|---|
| 1 (Load Cell 10 VDC) |
| 2 (Load Cell 0 VDC) |
| 3 (Load Cell Signal +) |
| 4 (Load Cell Signal -) |

| Lengths | |
|---|---|
| Station A | |
| Station B | |
| Station C | |
| Station D | |

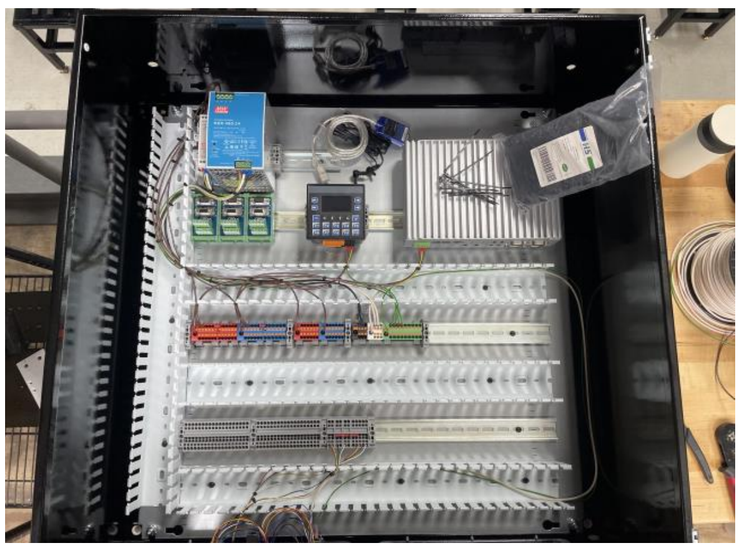
Front View

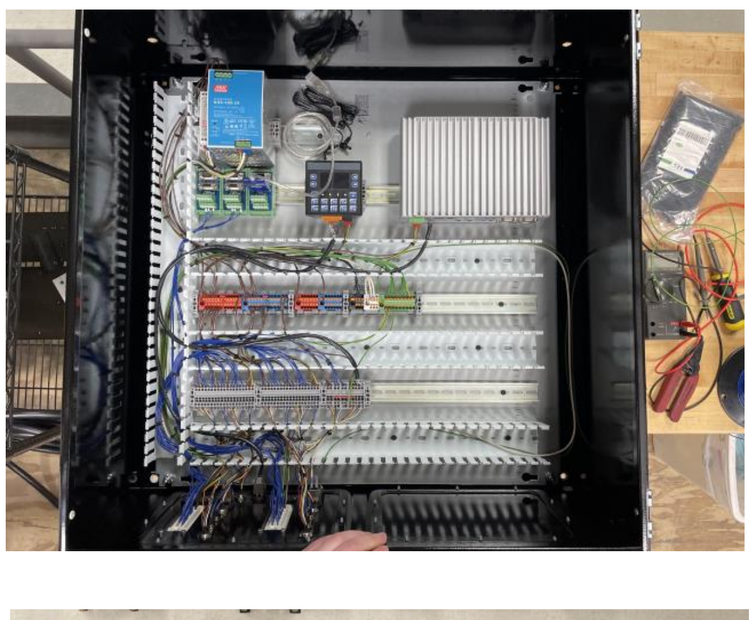



**Female 4-Wire, 5-Pole (M12) A-coded**



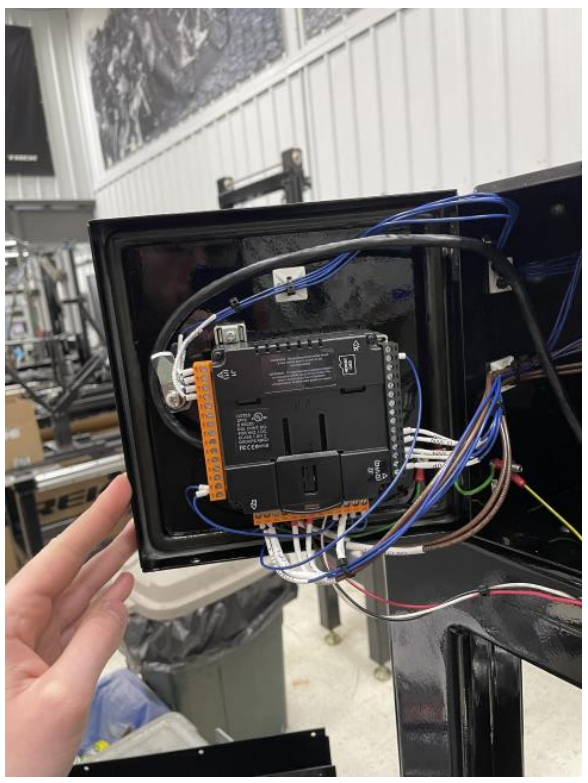

RBR Control Box Assembly

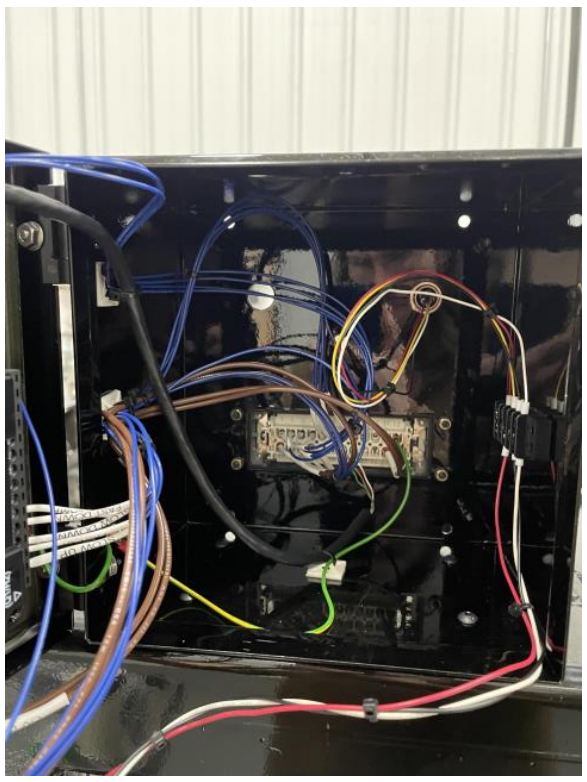




QST Completed Control Box

Station A (One CAN Connector)





Stations B, C and D (Two CAN Connectors)