Automation

ARNOLD AUTOMATION

ELSCO

Roller Guide Assembly Machine

User’s Manual

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INTRODUCTION

This machine is a robot assisted assembly unit designed to present pre-loaded wheels, bearings, and spacers in a pre-determined sequence to the press unit and provide press operations at the correct time to provide and discharge a completely finished wheel assembly.

PLC (programmable logic controller) programming monitors pre-loading conditions, including providing the operator with fixture positions for loading the wheels and assuring that bearings and spacers of the correct size are available for robotic transport. Additionally, measuring and transmitting the wheel position for robot selection, and initiating the press operation are controlled by the PLC.

Robot controller programming determines the exact positioning for each of the components, and operates end effectors to secure and place each of the necessary components on the press station. The robot controller programming is set up to respond to PLC communications and will operate only when the appropriate data has been provided to allow correct operation.

To correctly process the components, the operator must assure that necessary components are available, and must select the correct size of the wheel assembly to be processed (3-1/4", 6", 10") from the HMI (human machine interface) prior to beginning processing. Additionally, each wheel assembly will require specific end effectors to be installed on the robotic arm, and appropriate table fixture posts to be installed at correct locations on the indexer table. Details on these topics are provided later in this manual.

Common terminology

Certain terms, abbreviations are used throughout this manual:
PLC – programmable logic controller
HMI – human machine interface
LBS – large bearing station
SBS – small bearing station
LSS – large spacer station
SSS – small spacer station
WS – wheel station
PS – press station

Safety circuits:

The machine is equipped with several safety circuits. These circuits are monitored by the Keyence safety controller. Two e-stop buttons are located at: 1) the main panel and 2) at the bearing load area. A light curtain is provided at the wheel load station. Both access doors are equipped with locking safety switches.

All of these provide two channel monitoring of the safety inputs.

The e-stop pushbuttons will provide a stop category 0 to the table indexer by opening series safety contractors feeding the indexer VFD. These will also provide a stop category 0 to the Fanuc SCARA robot through a pair of force guided safety relays to the robot controller E-stop safety circuit.

The light curtain provides a stop category 1 to the indexer variable frequency drive by initiating an instant stop signal to the VFD control, followed by a timed interruption of the two channel STO (safe torque off) safety circuit of the VFD.

The locking door safety switches create a stop category 1 to the robot controller through a pair of force guided control relays, and a stop category 1 to the indexer by initiating an instant stop signal to the VFD control, followed by a timed interruption of the two channel STO (safe torque off) safety circuit of the VFD.

Bearing Stations

Bearing stations are equipped with a pneumatic actuator. A photoelectric sensor also forms part of the bearing station. When the sensor determines there are no bearings available for the robot to pick, the pneumatic actuator will retract to load four new bearings the into pick position. Once loaded, the actuator will return to the normal, extended position. The status of the actuator is monitored by two magnetic switches (one for retracted, one for extended) located on the actuator housing.

A fault condition will occur if the actuator is commanded to a position and does not achieve the position within several seconds. Additionally, if the actuator attempts to load bearings for three successive attempts and is not successful, a fault will be triggered indicating no bearings available. The operator will need to correct the condition and reset the fault to continue processing

Both the large and small bearing stations operate similarly.

Spacer Stations

Spacer stations are equipped with a pneumatic actuator. A photoelectric sensor also forms part of the spacer station. When the sensor determines there is no spacer available for the robot to pick, the pneumatic actuator will extend to reach a new spacer and then retract to load that spacer the into pick position. Once loaded, the actuator will remain retracted to prevent the spacer from moving due to vibration. It will then return to the normal, extended position shortly before the robot moves to pick the spacer. The status of the actuator is monitored by two magnetic switches (one for retracted, one for extended) located on the actuator housing.

A fault condition will occur if the actuator is commanded to a position and does not achieve the position in several seconds. Additionally, if the actuator attempts to load bearings for three successive attempts and is not successful, a fault will be triggered indicating no bearings available.

Both the large and small spacer stations operate similarly.

Indexing table

The indexing table supports 12 fixture positions. The 3.25” wheels and the 6” wheels will occupy 1 fixture position each, filling all 12 positions; the 10” wheels will occupy 2 fixture positions so that 6 actual fill positions will be occupied by 10” wheels.

The table will rotate a fixed amount each movement (index). Several different triggers can initiate an index: 1) when the robot has picked all of the wheels within a given fixture, an index will be triggered; 2) when the operator has filled a fixture to its full capacity - ((7) 3.25” wheels or (6) 6” wheels) and the fixture reaches position #1(left-most from the operator’s point of view), an index will be triggered so that the operator will always have access to as many minimally loaded fixtures as possible; finally, 3) the operator may manually request an index of the table from the manual operation screens.

Normal Operation:

Once the operator presses the “Start Processing” button, the system will cycle through the following operations:

The indexer will move, one position at time, until there is a stack of 1 or more wheels present at the robot pick position. If the cycle was started with 1 or more wheels in the pick position, the indexer will not move at that time.

The robot will travel to the bearing station and pick up a bearing using the smaller gripper. If the bearing station needs to cycle in order to make a bearing available, the robot will wait while the actuator is in motion

The robot will then return to a position near the wheel indexer. If the indexer is in motion, or the pick position is empty, the robot will wait until there is a wheel available.

Using the larger gripper, the robot will pick the top wheel from the stack in the pick position and transport that wheel to the press.

The robot will place the wheel on the press, retract from the press position, and place the bearing on the press.

As the robot retracts from the press area, the press will actuate and press the first bearing in to position.

While the press actuates, the robot will travel to the spacer station and pick up 1 spacer using the smaller gripper.

The robot will return to the press area and place the spacer on the press station.

The robot will travel to the bearing station and pick up a second bearing.

The robot will return to the press area and place the bearing on the press station.

As the robot retracts from the press area, the press will actuate and press the second bearing in to position, completing the wheel assembly.

While the robot travels to the bearing station to start the next cycle, the platform on the press station will lift the completed wheel up so that it is clear of the lower tooling.

The pusher mechanism will push the completed wheel away from the press so that the wheel slides down the roller ramp and out of the system enclosure.

The pusher mechanism and lift platform will retract to allow for the next wheel to be placed.

ROBOT Operation:

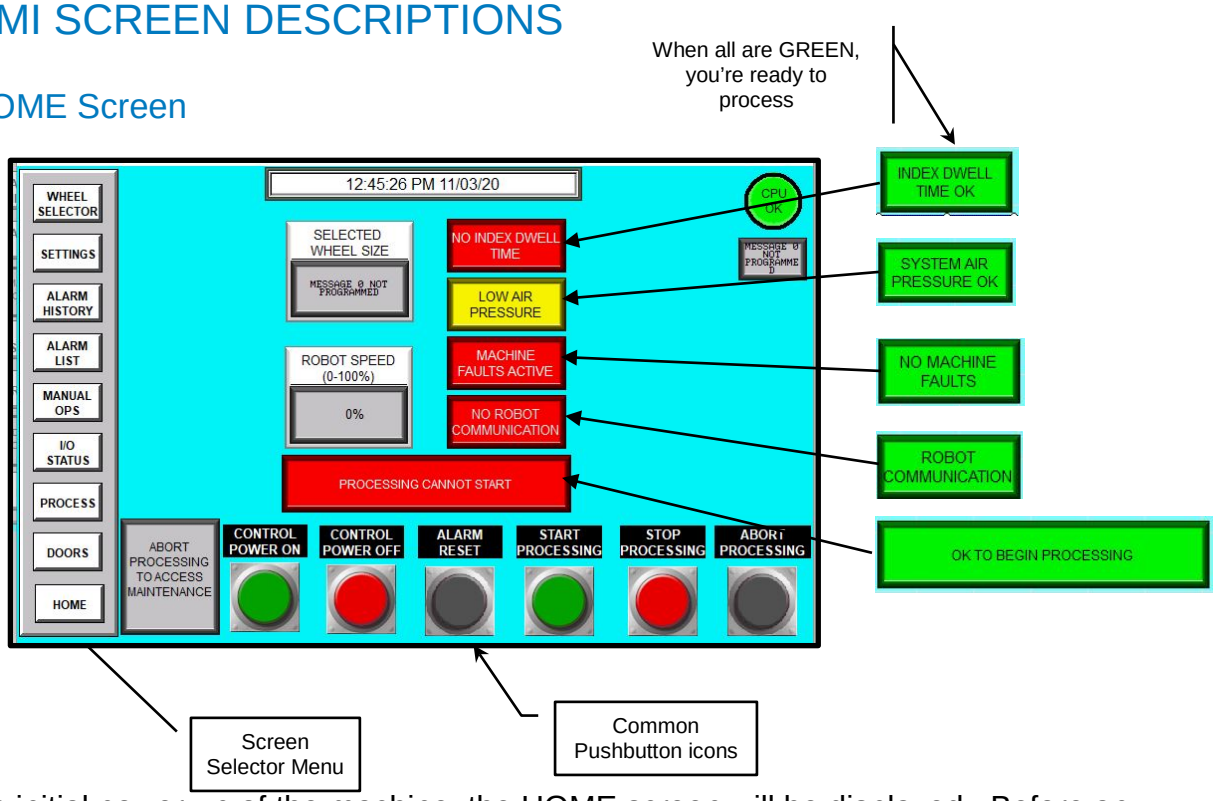
The ROBOT (robot controller) typically operates in three states: 1) RUNNING, 2) PAUSED, or 3)ABORTED.

When the robot is running, the controller is actively executing the program in the robot controller. When the robot is paused, the program execution has been temporarily halted, but can continue from the point in the program at which it was halted. When the robot is aborted, processing in the PLC is stopped, and the robot it is no longer running any program, and is not paused.

Once an ABORT command has been issued, the next time processing is started from the HMI, the robot will execute an abort routine, which is a different set of logic from the normal running condition: the robot will move to a predetermined unload position at which any product presently held by either end of arm tooling will be dropped. Then the robot will progress back to the HOME position, and be return to the paused state – ready to begin executing the normal logic steps.

HMI SCREEN DESCRIPTIONS

HOME Screen



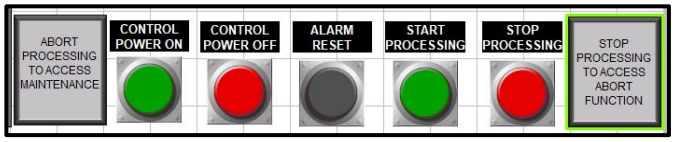
On initial power-up of the machine, the HOME screen will be displayed. Before any further operations of the machine may be undertaken, the operator should initiate control power. This is done by pressing the on-screen "Control Power On" pushbutton icon, or the Control Power On pushbutton located just below the HMI (Human Machine Interface) on the control panel.

Once control power has been established, the operator may use the screen control buttons at the left side of the screen to move to any other screen. In order to begin processing, however, it will be necessary to verify the conditions necessary to allow the machine to progress: 1) index dwell time has appropriate setting, 2) air supply has adequate pressure, 3) machine faults have been addressed and reset, and 4) robot communication has been established. Once all of these condition indicators are green, the large indicator at the bottom of the screen will also turn green and indicate "OK TO BEGIN PROCESSING". Before leaving this screen, the operator should also verify that the correct wheel size has been selected, and the ROBOT SPEED is at an appropriate setting (more about this later)

This is typically where the operator will begin to interface with the machine. It is the screen from which other operating screens are accessed and the screen to which the operator will frequently return.

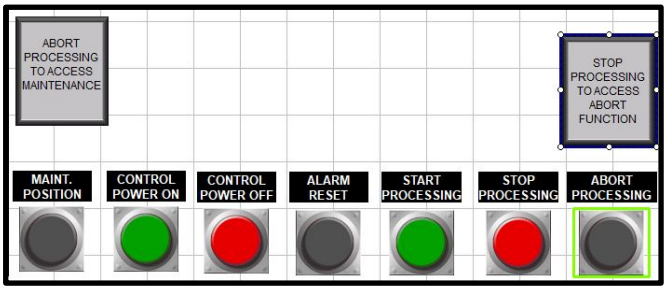
HOME Screen, cont'd

Several items to note:

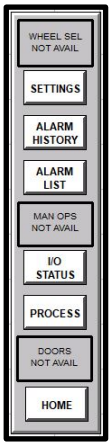


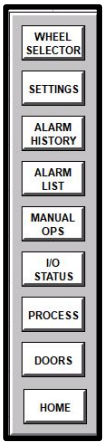
1) there is a common set of pushbutton icons located along the bottom edge of the screen. These same pushbutton icons typically appear along the bottom of several of the operating screens and operate in the same manner on each.

Several of the pushbutton icons may be blocked from operator access during various opeating conditions to prevent improper machine operating conditions. Instructions for the 'blocks' appear on the face of the appropriate block.



2) there is a common screen selector menu that appears at the left hand side of the screen. This same screen selector menu typically appears along the left side of several of the operating screens and operates in the same manner on each.



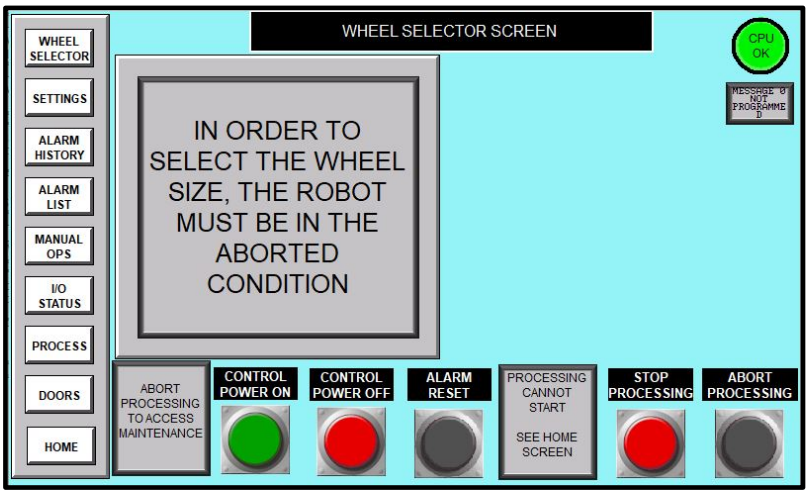


Once again, several of the screen selectors my be blocked at various operating conditions of the machine. This is to prevent inapprorpriate operator access during part procssing. Each of the blocked selectors may be accessed once processing has been ended.

As can be seen on the previous page, there is a variety of information perating to the overall condition of the machine. Each of these is an important paramter that the opeator must verify/correct before attempting to process parts: 1) Correct wheel size must be selected, 2) all machine fault conditions must be rectified and reset, 3) Robot speed must be set. Once the conditions have been met, the operator will see an "OK TO BEGIN PROCESSING" message at the bottom of the parameters. From here, the operator should move to the PROCESS Screen by selecting the PROCESS Screen selector in the Screen Selector menu at the left.

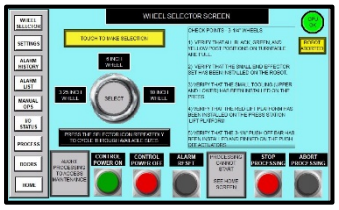
First, let's checkout some of the screens accessed prior to processing

WHEEL SELECTOR Screen

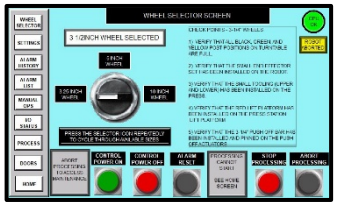


Prior to beginnng any processing operation, it will be necessary to assure that the correct wheel size (3-1/4”, 6”. Or 10”) has been selected. The operator will use the WHEEL SELECTOR screen to perform this operation.

As indicated by the large ‘blocking’ panel, before any wheel selection can be made, the robot must be in the aborted condition. To accomplish this, simply press the ABORT PROCESSING pushbutton icon at the lower right hand corner of the screen. Once this has been done, the ‘blocking panel’ will be removed, and the operator will be presetned with a selector switch icon, allowing selection of the appropriate wheel size.

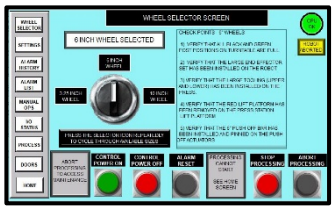


If no choice has been previously made, the screen will appear as shown to the left. It advises the operator to pick a wheel size to continue. This is done by pressing the SELECT object in the center of the slector switch icon

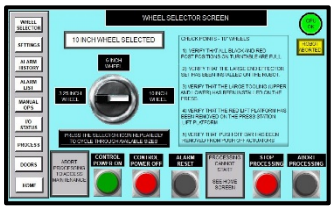


On the first press, the small wheel will be selected, as idicated at the left. Note that a set of ‘CHECKPOINTS’ for the 3-1/4inch wheel are now also displayed on the screen. This set of reminders will assist the operator in verifying the mechanical setup of the machine that must be accomplished for the 3-1/4 inch wheel

WHEEL SELECTOR Screen, cont'd

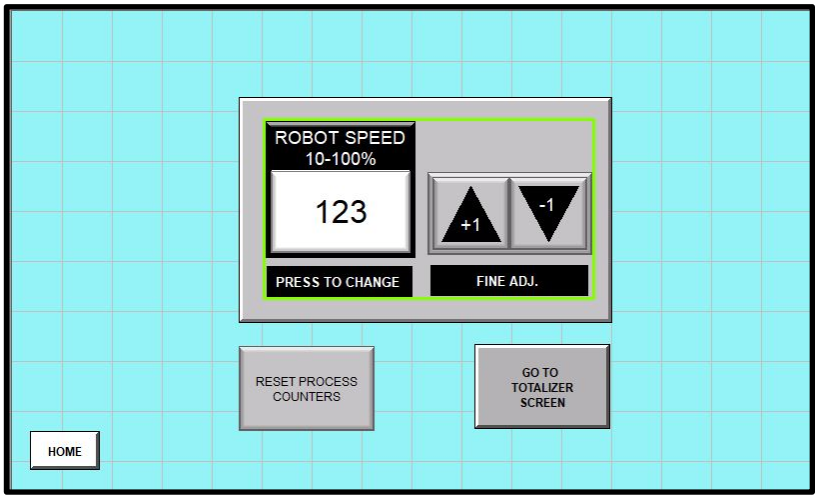


On the next press, the medium (6 inch) wheel will be selected. Note that it has it's own set of CHECKPOINTS particular to that wheel size.



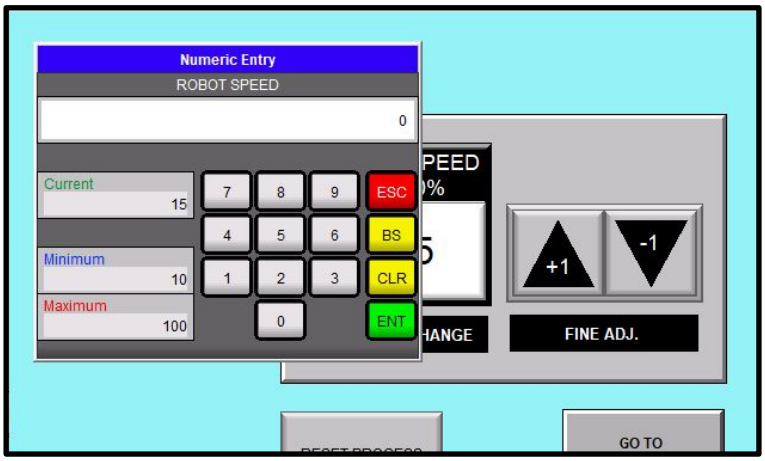
Finally, on the next press the large (10 inch) wheel will be selected for processing. Againit has it's own set fo CHECKPOINT items that should be verified.

SETTINGS Screen



The SETTINGS Screen will allow the operator to adjust the speed at which the robot is operating. Values of 10 - 100% are permissible. To adjust the current value, the operator may use the UP/DOWN arrow buttons to the right of the curent speed setting indicator to adjust the setting 1% at a time.

SETTINGS Screen, cont'd

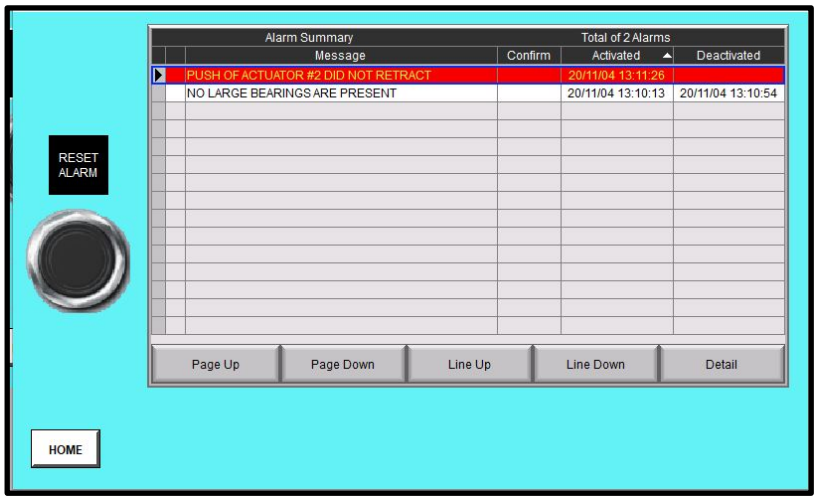


Should a larger change in the robot speed setting be desired, the operator may press the speed indicator directly; this will provide a numeric entry keypad where the operator may directly enter the desired speed. Once the desired speed shows in the top window of the keypad, the operator should press the green ENT button at the bottom of the keypad to make the setting change.

Additionally, on this screen is the button used to reset the Product Counters on the PROCESSING Screen (to be discussed later).

Also provided on this screen is a button, that will allow the user with PASSWORD security to acces the TOTALIZER Screen, which provides a running total of all of the different wheel sizes processed. These counts are maintained over time until a reset operation occurs.

ALARM LIST Screen



The ALARM LIST Screen will show the status of any ALARM conditions that exist on the machine. Active alarm conditions will automatically trigger display of the screen. Active alarms are shown with YELLOW Font on a RED Background (ACTIVE ALARM). Faults that have existed and been reset are shown as BLACK Font on a WHITE Background. (RESET ALARM). Any active alarms should be investigated and corrected before attempting to RESET the ALARM using the pushbutton icon provided on this screen. Navigation icons are provided on the bottom of the ALARM List – use these to navigate through the list as needed.

A list of ALARM conditions that may be indicated follows:

ALARM LIST Screen, cont'd

ALARM LIST DISPLAY

ALARM REFERENCE NUMBER

	Alarm Summary		Total of 15 Alarms	
	Message	Confirm	Activated	Deactivated
1	SBS ACTUATOR DID NOT EXTEND 15:16 10-DEC-20		20/12/10 15:16:24	
2	SBS ACTUATOR DID NOT RETRACT 03:16 PM 10/12/20		20/12/10 15:16:28	
3	LBS ACTUATOR DID NOT EXTEND 15:16 10-DEC-20		20/12/10 15:16:32	
4	LBS ACTUATOR DID NOT RETRACT 03:16 PM 10/12/20		20/12/10 15:16:51	
5	SSS ACTUATOR DID NOT EXTEND 15:18 10-DEC-20		20/12/10 15:18:03	
6	SSS ACTUATOR DID NOT RETRACT 03:18 PM 10/12/20		20/12/10 15:18:05	
7	LSS ACTUATOR DID NOT EXTEND 15:18 10-DEC-20		20/12/10 15:18:07	
8	LSS ACTUATOR DID NOT RETRACT 03:18 PM 10/12/20		20/12/10 15:18:08	
9	WHEEL PRESS ACTUATOR DID NOT EXTEND 03:18 PM 10/12/20		20/12/10 15:18:24	
10	WHEEL PRESS ACTUATOR DID NOT RETRACT03:18 PM10/12/20		20/12/10 15:18:27	
11	WHEEL LIFT ACTUATOR #1 DID NOT EXTEND 03:18 PM 10/12/20		20/12/10 15:18:44	
12	WHEEL LIFT ACTUATOR DID NOT RETRACT 03:18 PM 10/12/20		20/12/10 15:18:55	
13	WHEEL LIFT ACTUATOR #2 DID NOT EXTEND		20/12/10 15:18:59	
14	WHEEL LIFT ACTUATOR #2 DID NOT RETRACT		20/12/10 15:19:00	
15	PUSH OF ACTUATOR #1 DID NOT EXTEND		20/12/10 15:19:17	
16	PUSH OF ACTUATOR #1 DID NOT RETRACT		20/12/10 15:53:59	
17	PUSH OF ACTUATOR #2DID NOT EXTEND		20/12/10 15:54:10	
18	PUSH OF ACTUATOR #2 DID NOT RETRACT		20/12/10 15:54:23	
19	NO LARGE BEARINGS ARE PRESENT		20/12/10 15:54:50	
20	NO SMALL BEARINGS ARE PRESENT		20/12/10 15:54:58	
21	NO LARGE SPACERS ARE PRESENT		20/12/10 15:55:00	
22	NO SMALL SPACERS ARE PRESENT		20/12/10 15:55:02	
23	ROBOT ALARM- BEARING PICK ILLEGAL ROW NUMBER		20/12/10 15:59:08	20/12/10 15:59:12
24	ROBOT ALARM - ROBOT DROPPED BEARING MORE THAN 3 TIMES IN A ROW			20/12/10 15:59:15
25	ROBOT ALARM - ROBOT DROPPED PRODUCT WHILE MOVING		20/12/10 15:59:15	20/12/10 15:59:19
26	ROBOT-ALARM - ILLEGAL ROBOT HOMING POSITION		20/12/10 15:59:19	20/12/10 15:59:22
27	ROBOT ALARM - ILLEGAL PRODUCT NUMBER SELECTION		20/12/10 15:59:22	20/12/10 15:59:42
28	ROBOT ALARM - BEARING PICK ILLEGAL ROW NUMBER		20/12/10 15:59:42	20/12/10 15:59:54
29	ROBOT ALARM - WHEEL PICK ILLEGAL LAYER NUMBER		20/12/10 15:59:54	20/12/10 16:00:04
30	ROBOT ALARM - ILLEGAL BS POS REG APPROACH POSITION		20/12/10 16:00:04	20/12/10 16:00:23
43	KEYENCE SAFETY CONTROLLER FAULT		20/12/10 16:10:39	
48	PRESS STATION DID NOT ACTUATE 16:10 10-DEC-20		20/12/10 16:10:54	
50	TOO MANY IDEXES		20/12/10 16:11:43	
51	LOW INCOMING AIR PRESSURE		20/12/10 16:11:54	
52	ROBOT COLLISION FAULT		20/12/10 16:12:04	
53	INDEXER VFD FAULT		20/12/10 16:12:13	
54	PRESS EXTENDED TOO LONG		20/12/10 16:12:39	

ALARM LIST Screen, cont'd

ALARM CONDITIONS

Alarm Reference Number	Alarm Condition
1	SBS ACTUATOR DID NOT EXTEND <!<24H:MM>!> <!<dd-mmm-yy>!>
2	SBS ACTUATOR DID NOT RETRACT <!<12H:MM>!> <!<dd/mm/yy>!>
3	LBS ACTUATOR DID NOT EXTEND <!<24H:MM>!> <!<dd-mmm-yy>!>
4	LBS ACTUATOR DID NOT RETRACT <!<12H:MM>!> <!<dd/mm/yy>!>
5	SSS ACTUATOR DID NOT EXTEND <!<24H:MM>!> <!<dd-mmm-yy>!>
6	SSS ACTUATOR DID NOT RETRACT <!<12H:MM>!> <!<dd/mm/yy>!>
7	LSS ACTUATOR DID NOT EXTEND <!<24H:MM>!> <!<dd-mmm-yy>!>
8	LSS ACTUATOR DID NOT RETRACT <!<12H:MM>!> <!<dd/mm/yy>!>
9	WHEEL PRESS ACTUATOR DID NOT EXTEND <!<12H:MM>!> <!<dd/mm/yy>!>
10	WHEEL PRESS ACTUATOR DID NOT RETRACT<!<12H:MM>!><!<dd/mm/yy>!>
11	WHEEL LIFT ACTUATOR #1 DID NOT EXTEND <!<12H:MM>!> <!<dd/mm/yy>!>
12	WHEEL LIFT ACTUATOR DID NOT RETRACT <!<12H:MM>!> <!<dd/mm/yy>!>
13	WHEEL LIFT ACTUATOR #2 DID NOT EXTEND
14	WHEEL LIFT ACTUATOR #2 DID NOT RETRACT
15	PUSH OF ACTUATOR #1 DID NOT EXTEND
16	PUSH OF ACTUATOR #1 DID NOT RETRACT
17	PUSH OF ACTUATOR #2DID NOT EXTEND
18	PUSH OF ACTUATOR #2 DID NOT RETRACT
19	NO LARGE BEARINGS ARE PRESENT
20	NO SMALL BEARINGS ARE PRESENT
21	NO LARGE SPACERS ARE PRESENT
22	NO SMALL SPACERS ARE PRESENT
23	ROBOT ALARM- BEARING PICK ILLEGAL ROW NUMBER
24	ROBOT ALARM - ROBOT DROPPED BEARING MORE THAN 3 TIMES IN A ROW
25	ROBOT ALARM - ROBOT DROPPED PRODUCT WHILE MOVING
26	ROBOT-ALARM - ILLEGAL ROBOT HOMING POSITI0N
27	ROBOT ALARM - ILLEGAL PRODUCT NUMBER SELECTION
28	ROBOT ALARM - BEARING PICK ILLEGAL ROW NUMBER
29	ROBOT ALARM - WHEEL PICK ILLEGAL LAYER NUMBER
30	ROBOT ALARM - ILLEGAL BS POS REG APPROACH POSITION
31	ROBOT WAITING FOR PLC TO PICK AT BEARING STATION
32	RROBOT WAITING FOR BEARING GRIPPER CLOSED EOT SENSOR SIGNAL

ALARM LIST Screen, cont'd

33	ROBOT WAITNG FOR BEARING GRIPPER OPEN EOT SENSOR SIGNAL
34	ROBOT WAITNG FOR WHEEL GRIPPER CLOSED EOT SENSOR SIGNAL
35	ROBOT WAITNG FOR WHEEL GRIPPER EOT SENSOR SIGNAL
36	ROBOT WAITING FOR PLC OK TO PLACE BEARING SIGNAL
37	ROBOT WAITING FOR PLC OK TO PLACE SPACER SIGNAL
38	ROBOT WAITNG FOR PLC OK TO PLACE WHEEL SIGNAL
39	ROBOT WAITING FOR PLC OK TO PICK SPACER
40	ROBOT WAITING FOR PLC STACK HEIGHT IS READY AT WS
41	ROBOT WAITING FOR PLCE STACK HEIGHT CONFIRMATION AT WS
42	ROBOT WAITING FOR PLC OK TO PICK AT WS
43	KEYENCE SAFETY CONTROLLER FAULT
44	CAN'T RETRACT - LARGE BEARING(S) IN POSITION
45	LSS_FULL
46	CAN'T RETRACT - SMALL SPACER IN POSITION
47	SSS_FULL
48	PRESS STATION DID NOT ACTUATE
49	ROBOT FAULT
50	TOO MANY IDEXES
51	LOW INCOMING AIR PRESSURE
52	ROBOT COLLISION FAULT
53	INDEXER VFD FAULT
54	PRESS EXTENDED TOO LONG
55	TOO MANY SMALL WHEELS IN FIXTURE
56	TOO MANY 6 INCH WHEELS IN FIXTURE
57	TOO MANY 10 INCH WHEELS IN FIXTURE

In order for these ALARMS to be meaningful, it is necessary to know what corrective actions to take when an ALARM is annunicated. Typical ALARM corrective actions will be discussed by ALARM NUMBER since the corrective actions will be similar.

Alarms 1-8 – Bearing andSpacer Station Alarms

Alarms 1 to 8 in the above table all deal with the operation of the four actuators associated with the large bearing station (LBS), the small bearing station (SBS), the large spacer station (LSS), and the small spacer station (SSS). Each acutator has two status indicating switches (1– extended, 1- retracted), Each of these stations have alarms that indicate a failure to achieve an actuator position after a command has been issued by the PLC program – so, for instance, if the large bearing actuator is commanded to go to the retracted position, and it does not make that position in a pre-defined time frame, and ALARM will be annunciated (see Alarm Number 4 in the list above).

ALARM LIST Screen, cont'd

POSSIBLE CAUSES:

1)insufficient air pressure,
2)incorrect position of status indicating switch on the actuator,
3) failed status indicator switch on the actuator,
4)loose air connection at the actuator,
5) jammed production part,
6) actuator seal failure.

CORRECTIVE ACTIONS:

1) check/correct air pressure regulator;
2) Attempt to operate the actuator with the MANUAL OPERATOR (see MANUAL OPS Screens) to verify that it moves correctly. With the actuator in the 'alarmed' position, attempt to move the assoociated status indicating switch to achieve an indication (red LED illumines). Resecure status indicating switch on actuator in corrected position.
3) Replaced failed status indicating switch,
4) Identify leaking air line connection. Secure compressed air at manifold; remove leaking air line from connector and re-insert into connector. Restore compressed air at manifold.
5) Secure compressed air at manifold. Remove jammed part. Restore compressed air at manifold.
6) Replace actuator

Alarms 9-10 – Press Actuator Alarms

Alarms 9 and 10 in the above table deal with the operation of the PRESS Station actuator. The press station actuator, due to the volume of compressed air required for proper operation, is controlled by a stand-alone solenoid valve. The actuator is equipped with three status indicating position switches (1- retracted, 1- 6" and 10" wheel fully extended, 1- 3-1/4"wheel fully extended). As with the ALARMS 1-8, above, the press actuator has alarms that indicate a failure to achieve an actuator position after a command has been issued by the PLC program. The 'choice' of the extended positon swtch is made by the wheel size for processing selection.

POSSIBLE CAUSES:

1)insufficient air pressure,
2)incorrect position of status indicating switch on the actuator,
3) failed status indicator switch on the actuator,
4) loose air connection at the actuator,
5) jammed production part,
6) actuator seal failure.
7) FU327 blown

ALARM LIST Screen, cont'd

CORRECTIVE ACTIONS:

1) check/correct air pressure regulator;
2) Attempt to operate the actuator with the MANUAL OPERATOR (see MANUAL OPS Screens) to verify that it moves correctly. With the actuator in the 'alarmed' position (if one of the 'extended alarms is annunciated,this will require a second person to operate the actuator to keep it in the extended condition), attempt to move the assoociated status indicating switch to achieve an indication (red LED illumines). Resecure status indicating switch on actuator in corrected position.
3) Replaced failed status indicating switch,
4) Identify leaking air line connection. Secure compressed air at manifold; remove leaking air line from connector and re-insert into connector. Restore compressed air at manifold.
5) Using MANUAL Operator, remove jammed part form press.
6) see manufacturers' bulletin for corrective procedures
7) Check solenoid coil; replace FU327.

Alarms 11-18 – Press Station Alarms

Alarms 11 to 18 in the above table deal with the operation of the two lift table actuators and the two pushoff actuatros associated with press station. Each acutator has two status indicating switches (1– extended, 1- retracted), Each of these actuators have alarms that indicate a failure to achieve an actuator position after a command has been issued by the PLC program. These four actuators (unlike the press actuator) are controlled through the compressed air manifold).

POSSIBLE CAUSES:

1) insufficient air pressure,
2) incorrect position of status indicating switch on the actuator,
3) failed status indicator switch on the actuator,
4) loose air connection at the actuator,
5) jammed production part,
6) actuator seal failure.

CORRECTIVE ACTIONS:

1) check/correct air pressure regulator;
2) Attempt to operate the actuator with the MANUAL OPERATOR (see MANUAL OPS Screens) to verify that it moves correctly. With the actuator in the 'alarmed' position, attempt to move the assoociated status indicating switch to achieve an indication (red LED illuminates). Resecure status indicating switch on actuator in corrected position.
3) Replaced failed status indicating switch.

ALARM LIST Screen, cont'd

4) Identify leaking air line connection. Secure compressed air at manifold; remove leaking air line from connector and re-insert into connector. Restore compressed air at manifold.
5) Secure compressed air at manifold. Remove jammed part. Restore compressed air at manifold.
6) Replace actuator

Alarms 19-22 – No Parts Available Alarms

Alarms 19-22 alert the operator to a lack of production parts (bearings and spacers). Each of the 4 part stations are equipped with photosensors that detect the presence of parts. These sensors are the same sensors that trigger the loading of new production parts for robot pick. When an acutator attempts to load parts 3 times, without a part being sensed, an out of part alarm will be annunciated.

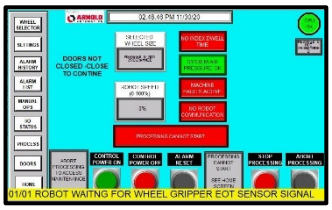
POSSIBLE CAUSES:

1) Part supply has been exhausted
2) Part sensor failure
3) Part jammed in stack

CORRECTIVE ACTIONS:

1) Load part into station receiver
2) Replace sensor
3) Carefully remove jammed part from stack and reload with spacers or bearings as appropriate.

Alarms 23-42 – Robot Alarms



Alarms 23-42 are all associated with the robot operation. These ALARMs are NOT included in the ALARM LIST Screen. Instead, they are annunciated in an ALARM BANNER which appears along the bottom of the screens. Since these alarms can be based on certain machine conditions outside of the actual robot mechanism, the message displayed will provide a machine functional area for investigation. Although a large number of causes for these alarms are possible, if the acutal cause cannot be identified, it is often most efficient to simply abort the robot, reset any other alarms (after correcting the cause), and begin processing once more.

Alarm 43 Keyence Safety Monitor Fault

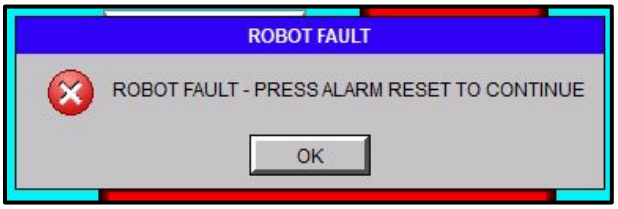
Refer to the Keyence GC1000 manual for information on Safety Monitor fault conditions and corrective actions.

ALARM LIST Screen, cont'd

Alarms 43-47 – Bearing and Spacer Actuators Can't Retract Alarms

Alarms 43-47 are associated again with the bearing and spacer stations, but are active only while the operator is attempting manual operations of any of those stations. These alarms will annunciate the inability of an actuator to achieve a retracted state due to the presence of a part in the 'loaded' position. While on the MANUAL OPS screen, physically remove the part from the loaded position, reset the alarm, an retry the manual operator.

Alarm 48 – Robot Fault Alarm



This alarm will display a message box advising of the corrective action, It is a general indication that the robot has stopped processing the program.

Alarm 49 – Too Many Indexes Alarm

The indexer table can have 12 fixture posititons. The table will index whenever the photosensor determines tha there are not wheels in position for the robot to pick. If this occurs 15 times consecutively, an alarm will be annunciated. This alarm indicates that no wheels are present on the indexer table. Supply necessary wheels and reset the alarm to continue operation.

Alarm 50 – Low Air Pressure Alarm

An Air Pressure switch is used to monitor the air pressure available to the machine. If this alarm is annunciated, check and correct the air supply to the machine.

Alarm 51 -Robot collision Fault Alarm

This is an alarm generated by the robot whenever the end effector recieves too much force upon it (like colliding with a fixture or wheel) Abort the robot and check the indexer table to assure it is in correct position. Reset Alarm and continue processing.

Alarm 52 -Indexer VFD Fault Alarm

If this Alarm is annunciated, open the main electrical panel (power on) and note the ERROR CODE displayed on the the AllenBradley PowerFlex 525 VFD LED display. Refer to the manufaturer's manual for corrective actions to be taken.

Alarm 53 -Press Extended Too Long Alarm

This Alarm indicates the press actuator has extended further than the normal expected position – typically due to misplacement of a spacer and second bearing. Abort the robot and manually clear the wheel from the press station. Re-commence processing.

ALARM LIST Screen, cont'd

Alarm 55-57 -Too Many Wheels in Fixture

POSSIBLE CAUSES:

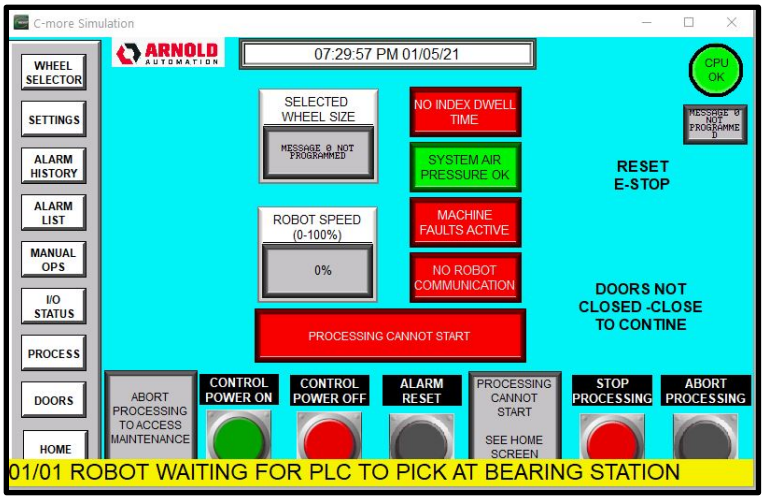
Too many parts hve been loaded into a fixture

CORRECTIVE ACTIONS:

Remove extra wheel(s) from fixture – reset alarm & continue processing

ROBOT MESSAGES

Robot messages will appear across the bottom of all of the screens in a yellow banner with black text. The messages are to alert the operator to a particular robot action (or lack of action).



Message #1:

(shown just above) alerts the operator that the robot is waiting for a signal from the PLC that it is OK to pick a bearing at one of the bearing stations (LBS, SBS)

Message #2:

indicates that the robot has commanded the bearing gripper end of arm tooloing to go to the closed position, but has not received confirmation of the closure. Check the sensor on the bearing gripper (smaller of the two end of arm tooling assemblies)

Message #3:

indicates that the robot has commanded the bearing gripper end of arm tooloing to go to the opened position, but has not received confirmation of opening. Check the sensor on the bearing gripper (smaller of the two end of arm tooling assemblies)

Robot Messages, cont'd

Message #4:

indicates that the robot has commanded the wheel gripper end of arm tooloing to go to the closed position, but has not received confirmation of closure. Check the sensor on the bearing gripper (smaller of the two end of arm tooling assemblies)

Message #5:

indicates that the robot has commanded the bearing gripper end of arm tooloing to go to the opened position, but has not received confirmation of opening. Check the sensor on the bearing gripper (smaller of the two end of arm tooling assemblies)

Message #6:

Indicates that the robot is waitng for an OK to Place the bearing at the Press Station. Verify that the wheel presence sensor at the Press table is functioning correctly.

Message #7:

Indicates that the robot is waitng for an OK to Place the spacer at the Press Station. Verify that the wheel presence sensor at the Press table is functioning correctly.

Message #8:

Indicates that the robot is waiting for an OK to Place the wheel at the Press Station. Verify that the wheel presence sensor at the Press table is functioning correctly.

Message #9:

Indicates that the robot is waitng for an OK to Pick the spacer at the Spacer Station (SSS, LSS). Verify that the spacer presence sensor at the spacer station is functioning correctly.

Robot Messages, cont'd

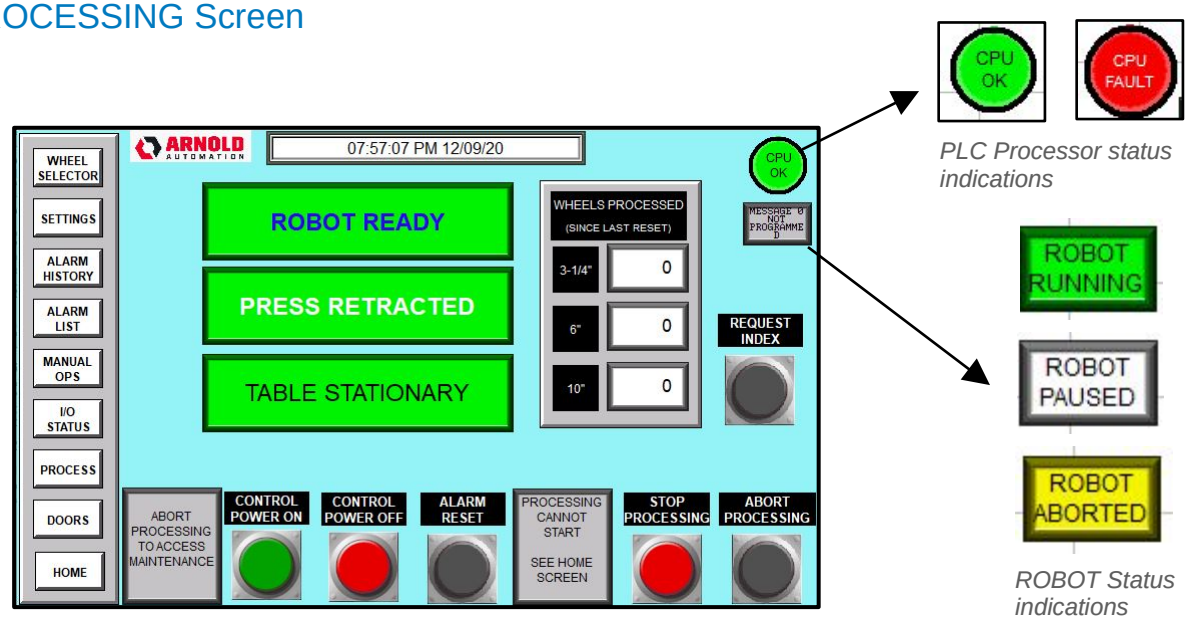
Message #10:

Indicates that the robot is waiting for a proper stack height to be transmitted for the PLC. Verify that the Keyence analog sensor above the indexer table is functioning correctly

Message #11:

Indicates that the robot is waitng for an OK to Pick the wheel at the Wheel Station (WS), of the indexer table Verify that the Keyence analog sensor above the indexer table is functioning correctly and that the indexer table has correctly indexed, and that the wheels in the pick position stack are all sitting flat.

PROCESSING Screen



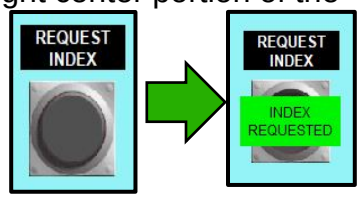
The PROCCESSING Screen will be used by the operator to commence and monitor the wheel assembly process. As shown above, since processing has not yet been started, a full menu of screen selectors is still availble to the operator.

The common pushbutton icons can be seen at the lower edge of the screen. In the central portion of the sceen are three main status indicators: 1) the robot status; 2) the press station status, and, 3) the indexer table status. Additionally, to the right of the status indicators is a table showing the number wheels that have been processed (by size) since the last time the counters were reset.

At the upper right corner, the PLC processor status and the ROBOT Status indicators can be seen (various indications shown).

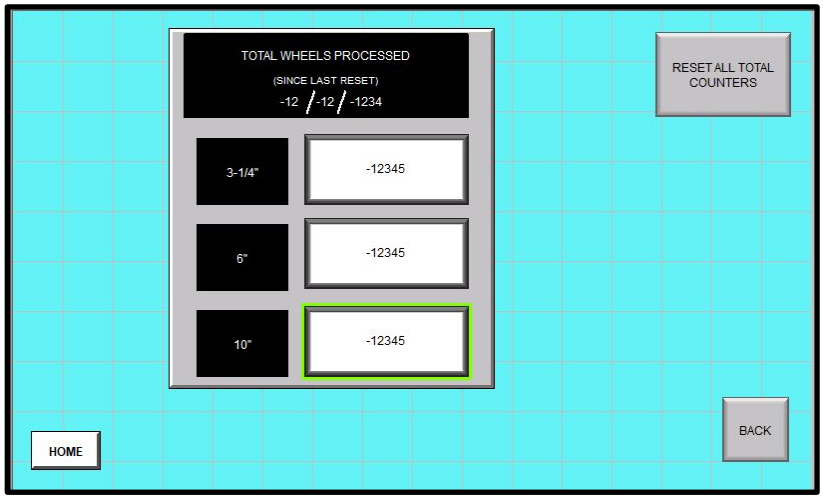
The Wheels Processed Counters are displayed just to the right of the three main status indicators. This portion of the display shows how many wheels of each size have been processed since the counters were last reset. Reset may be accomplished by accessing the Settings Screen – as discussed previously.

There is an REQUEST INDEX pushbutton icon located in the right center portion of the screen. This can be used by the operator to request a table index at the next opportunity to assist loading wheels. When pressed, the “INDEX REQUESTED” text will display on top of the button to let the operator know that the request is being processed, and an index will occur at the next opportunity in the process cycle.



Other Screens

Totalizer Screen

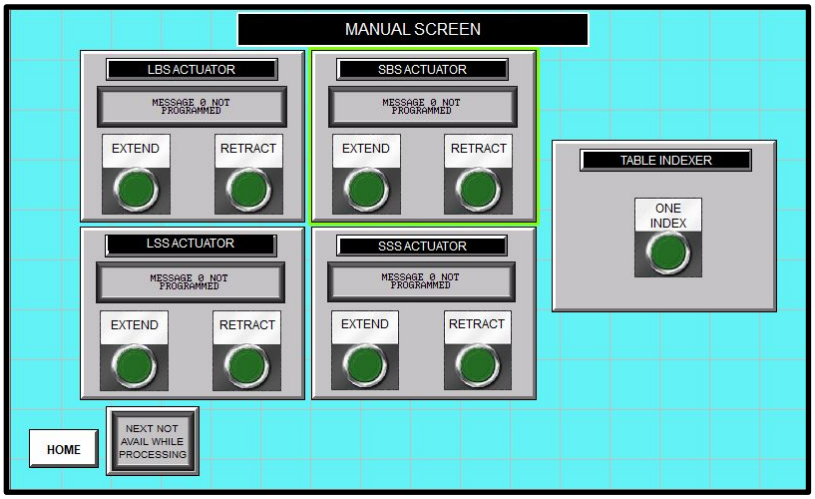


As mentioned previously, the Totalizer Screen is only accessible with the correct 'security credentials'. This screen will maintain a long term accumulation of all the wheel sizes that have been processed. As shown in the nameplate, the totals are valid for operations since the last reset. This screen also contains the button for resetting the counters at the upper right portion of the screen.

Manual Ops Screens

There are two Manual Operation Screens that can be used to individually operate the various machine components. These screens may only be accessed when processing is stopped (thus the screen menu to the left side of a screen has the MANUAL OPS item blocked until processing has been stopped). The INDEXER One Index Operator also requires that the Robot be in the ABORTED condition to prevent any robot movement due to other machine component operations.

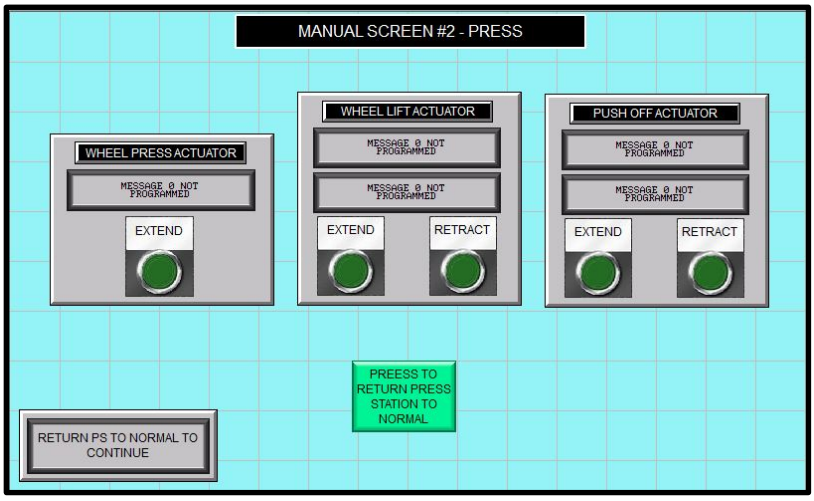
ManualOps



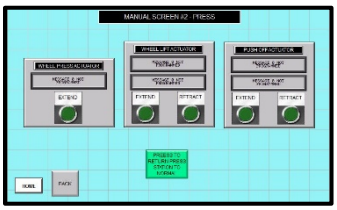
The first screen provides manual operators for the bearing and spacer stations actuators. These are momentary operators and can position the actuator at extremes or in between. The Table Indexer operator will provide 1/12 of a table rotation when it is pressed (equivalent to one fixture position for the 3-1/4 inch and 6 inch wheels). This will typically be used to properly align a fixture position for robot picking of the wheel when the 10 inch wheels are about to be processed (since there is a 50% chance that the fixture position will be in the correct position).

Other Screens, cont'd

Manual Ops2

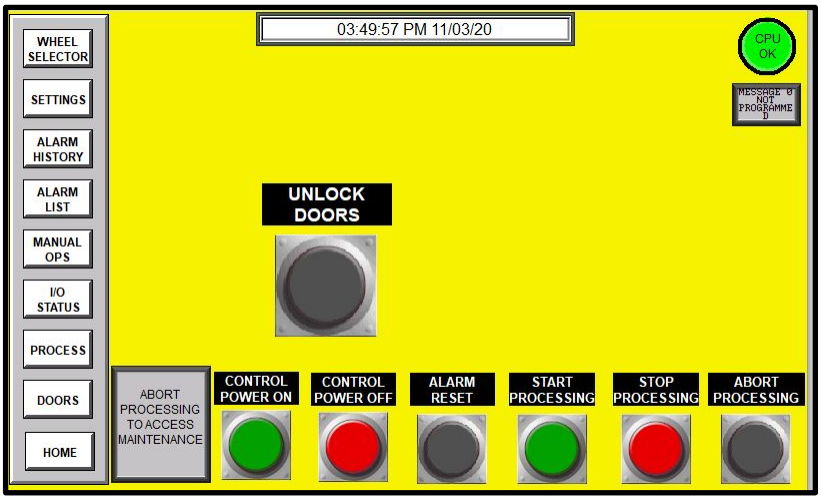


This screen is selectable from the first Manual Ops screen described above. It contains manual operators for the press station equipment. Again, these are momentary operators that can position the devices at extremes or in between. Note: there is no way to return to any other screen from this screen UNTIL the green "PRESS TO RETURN PRESS STATION TO NOMAL" button at the lower center of the screen has been pressed. This will assure that all components of the press station have been returned to the normal operating positions, ready for processing. Once this button has been pressed, the 'blocking panel' at the bottom left of the screen will be removed, and the



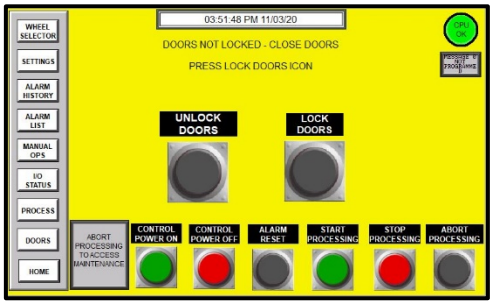
"BACK" and the "HOME" screen navigation buttons will be available for the operator use.

DOORS Screens



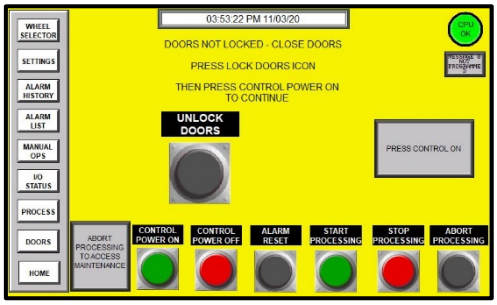
This machine is equipped with locking door safety switches. Locks are active anytime the machine power is on. In order to access the processing chamber, the doors must be unlocked. The screen menu to the left of screens will only allow the DOORS screen to be accessed while processing is not occurring. By pressing the DOORS screen navigation button, the screen shown at the right is displayed. In order to unclock the access doors, press the UNLOCK DOORS pushbutton icon. The doors will be unlocked, and the screen will change as shown on the next page:

DOORS Screen, cont'd



Note the changes: LOCK DOORS pushbutton icon provided as well as notes indicating condition of doors and next step to proceed.

Once the doors are properly closed and the LOCK DOORS pushbutton icon has been pressed, the next step required to return to normal operation is to press the CONTROL POWER ON pushbutton icon (or the actual CONTROL POWER ON pushbutton)



E-STOP Screens

If one of the two E-STOP buttons are depressed, the following screen will automatically display on the HMI. To return to processing, follow the TEXT message and reset the E-STOP button that was depressed by twisting it clockwise until it pops back out.

Once the E-Stop pushbutton has been reset, press the RESTORE CONTROL pushbutton icon that has appeared on the screen. This will reset all of the control power, and automatically display the HOME Screen

Accessing the MAINTENANCE POSITION

In order to perform changeover activities, or other tasks that may involve working with the robot end effectors, the operator may find it advantageous to move the robot to the MAINTENANCE position. From the HOME Screen, the operator will need to put the robot in the ABORT condition. This will remove the blocking panel and display the MAINT POSITION pushbutton icon. Initially, the pushbutton will be displayed with a BLACK color. The operator should press the button, and it will turn GREEN. This indicates that the robot has received the request for a MAINtENANCE postion move, and is ready to make the move.

Next, press the START PROCESSING pushbutton icon. The robot will slowly move to the MAINTENANCE position. Once it reaches that position, the robot will return to the ABORT condition. The operator will also need to reset several robot alarms that will be annunciated on the HMI. Use the ALARM RESET pushbutton icon to perform the resets. <u>REMEMBER- you need to press the OK button on the ROBOT FAULT message box before any other screen activity can occur.</u>

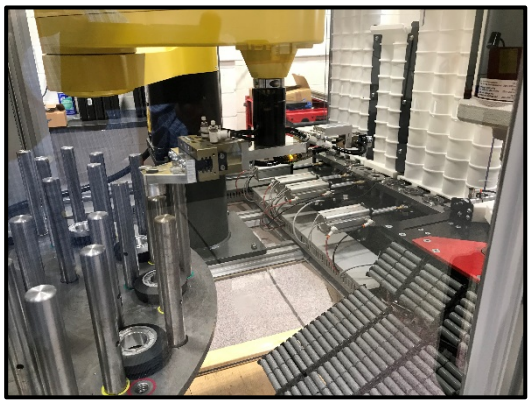


PHOTO 1 - Robot in Maintenance position

Once all of the robot faults have been cleared, the operator should move to the DOORS screen by selecting it from the SCREEN MENU at the left of the HOME Screen (see DOORS Screen, previous). As. Previously discussed, the operator should unlock the doors by pressing the UNLOCK DOORS pushbutton icon located on the DOORS screen. Two text messages will appear top center on the screen. Open the door(s) and perform the necessary task(s).

Following the text messages that have appeared on the DOORS Screen, next, close the door(s). Now press the LOCK DOORS pushbuton icon. Next, press the CONTROL ON pushbutton; the robot status will still be indicating ABORTED. Reset any ROBOT alarms that may have appeared by pressing the OK button on the message box follwed by pressing the ALARM RESET pushbutton icon.

Accessing the MAINTENANCE POSITION, cont'd

One all of the alarms have been reset, press the START PROCESSING pushbutton icon. The robot status indicator will change to ROBOT RUNNING, and the robot will slowly return to the HOME position. Once there, the robot satus indicator will change to ROBOT PAUSED.

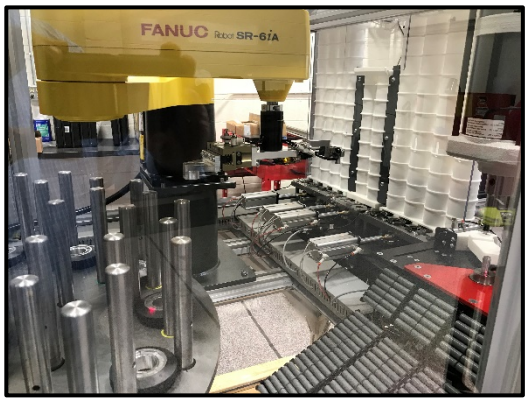


PHOTO 2 - Robot in HOME position

The system is now ready to begin processing.
Remember to go back to the HOME SCREEN and set all of the necessary parameters if a WHEEL SIZE change has occurred.

CHANGE-OVER PROCESS

When changing between different size wheels, there are three aspects of the system that will require changes; the indexing table, the robot End-of-Arm Tooling, and the press station.

Indexing table

The indexing table uses an array of steel posts to define the wheel positions. These posts are all identical, and include a 5/8-11 male thread on the bottom end. The table surface has a pattern of mating threaded holes. Each hole is marked with a color coded circle. These are used determine where to place the posts when changing over.

10” Wheels	All BLACK and RED locations
6” Wheels	All BLACK and GREEN locations
3.25” Wheels	All BLACK, GREEN, and YELLOW locations.

Make sure all posts are firmly tightened to the table.
NOTE: For the 10” wheels, the operator is responsible for properly orienting the indexer table before processing begins. CORRECT and INCORRECT positions are shown in the following photos:

PHOTO 3 - CORRECT Orientation

PHOTO 4 - INCORRECT Orientation

Robot End-of-Arm Tooling (EOAT)

The robot EOAT consists of two grippers; a larger gripper that is used for wheels, and a smaller gripper that is used for bearings and spacers. Each gripper has two fingers which are used to grip components (wheels, bearings, or spacers) from the inside diameter. For each pair of fingers, there is a small version and a large version, for a total of eight fingers, four of which are in use at any given time.

The 6” and 10” wheels use the larger fingers on both grippers.

The 3.25” wheels use the smaller fingers on both grippers.

To change gripper fingers, it is recommended to first place the robot in to the Maintenance Position.

The fingers on the larger gripper are attached using two M4 button head machine screws each, for a total of four. Remove these machine screws, replace the fingers with the desired size, and re-tighten the machine screws. Make sure that the two fingers are aligned with each other. The horizontal surfaces just above the screws should be even and parallel.

The fingers on the smaller gripper are attached using one M4 button head machine screw each, and oriented using two 1.5mm dowel pins for each finger. Remove the machine screws, replace the fingers with the desired size, taking care to ensure the dowel pins line up with the appropriate holes, and re-tighten the machine screws.

Press station

The press station includes tooling used in the press operation, as well as features used for lifting and ejecting finished wheels. Each of these needs to be addressed when changing the system for a new wheel size.

There are 2 sets of press tooling, each of which consists of 2 parts; the lower assembly that holds the wheels, bearings, and spcers in position, and the upper ram that presses bearings downward.

The larger tooling set is used for the 6” and 10” wheels.

The smaller tooling set is used for the 3.25” wheels.

The lower portion of the tooling can be changed by simply lifting it up out of its location in the press, and lowering the other tooling in its place. Note that this is a close fit, and the tooling will need to be lifted and lowered straight up and down.

The ram is changed by loosening the set screw on the press rod using a 3/16” allen key. Once this is loosened, the ram can be pulled straight down and removed. To replace the ram, insert it in to the bore of the press rod until it stops. Holding it in this position, tighten the set screw until it is snug.

The wheel lift platform requires the addition of a spacer plate in order to handle the 3.25” wheels. This spacer plate is attached using (5) ¼-20 flat head screws. Note that when this spacer plate is in place, it effectively traps the lower portion of the press tooling. Thus, when setting up for 3.25” wheels, the tooling needs to be changed before the spacer plate is installed. When changing from 3.25” wheels to either the 6” or 10” wheels, the spacer plate needs to be removed before the tooling can be changed. When changing between 6” and 10” wheels, the lift plate does not need to be altered.

The wheel ejection mechanism will need to be addressed anytime the system is changing from one wheel size to another. This system consists of 2 pneumatic cylinders mounted to the lift plate, and plastic pushers that are specific to the wheel sizes.

The 10” wheels are pushed by the 2 plastic blocks that are permanently attached to the cylinders. No other components are needed for the 10” wheels, and these blocks do not need to be removed for any size wheel. In each of these blocks is a quick-release pin which can be used to attach the plastic blocks for the other wheel sizes.

The 3.25” and 6” wheels each have their own plastic pusher block that bridges between the two permanent blocks, and attaches to them using the quick-release pins. The two size-specific pusher blocks can be differentiated by paying attention to the curvature of the pushing surface, which closely matches the radius of the appropriate wheel size. To install these pusher blocks, remove the quick-release pins from the permanent blocks, place the pusher block so that its mounting holes line up with the holes in the permanent blocks, and re-insert the quick-release pins.

DEVICE STATUS SENSORS

There are a number of devices that rely on status switches to properly communicate with the PLC in order to maintain proper processing. The following photos identify ‘system’ and the status sensors associated with them.

Bearing and Spacer Actuators

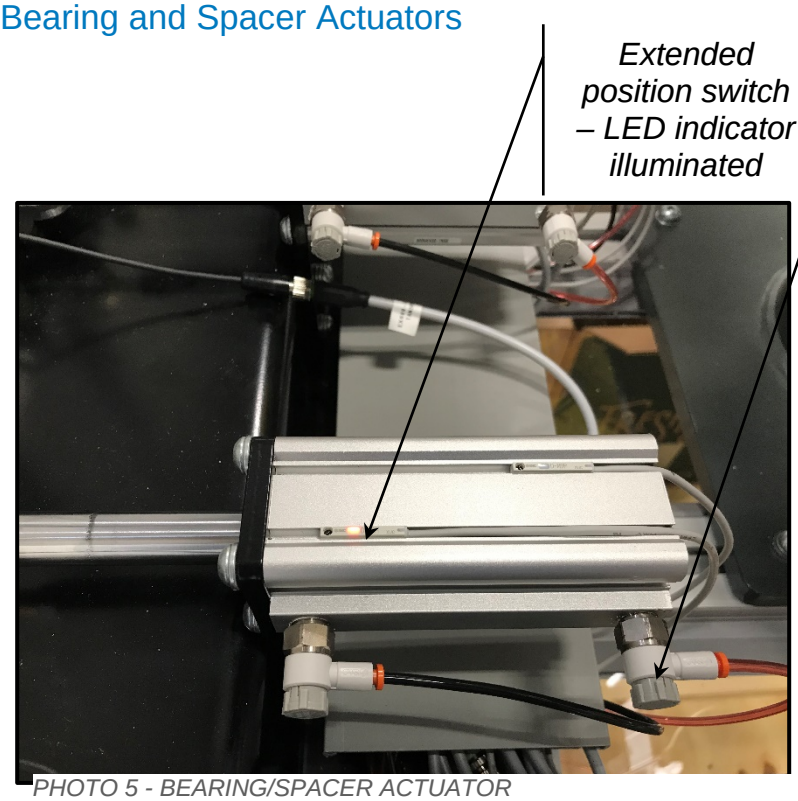


PHOTO 5 - BEARING/SPACER ACTUATOR

The pneumatic actuator for each of the bearing and spacer stations are shown at the left. Each position (extended, retracted) is monitored by a magnetically coupled switch. The switches are locked in place with a small screwdriver adjusted lock. Each switch has an LED indicator that shows when the switch is activated. Each port has a speed control air fitting that is used to adjust the speed at which the actuator moves to a position.

Device Status Sensors, cont'd

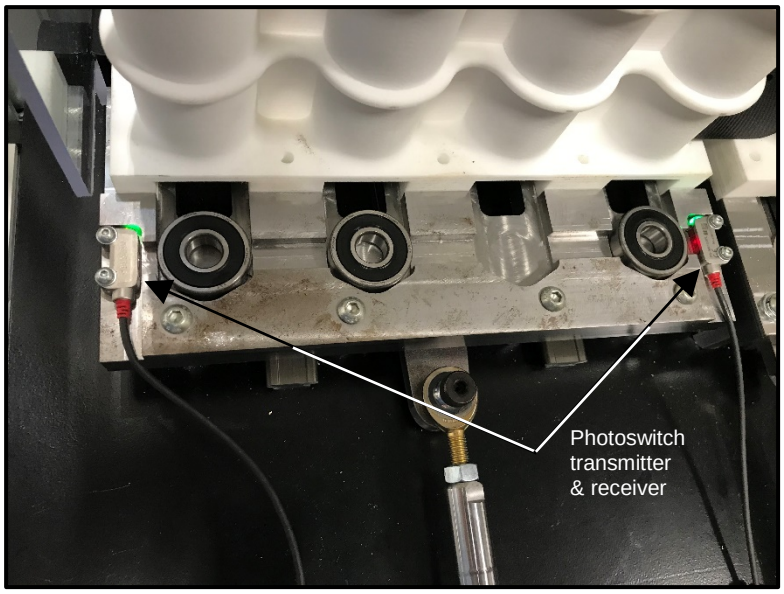


PHOTO 6 – BEARING STATION – BEARING PRESENT SENSOR

Each of the stations is also equipped with a photoswitch that: 1) determines if a component is available for robot pick; 2) initiates re-loading of components to the robot pick position when the station is empty. The bearing stations use a thru beam type of photoswitch; the spacer stations use a reflective type photoswitch.

The through beam arrangement of a bearing station is shown at left.

Lift Table Actuators

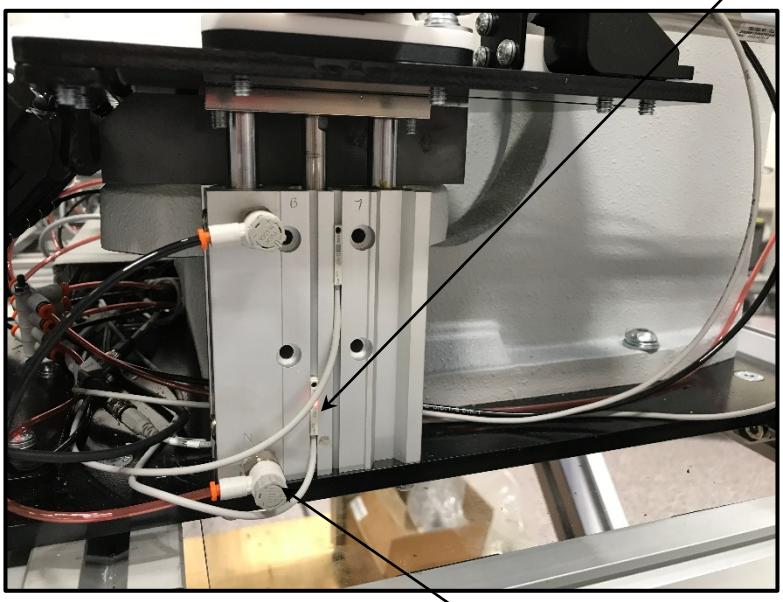


PHOTO 7 - LIFT TABLE ACTUATOR

Similar to the pneumatic actuators on the bearing and spacer stations. There are two pneumatic actuators (like the one shwon at left) on opposite sides of the lift table. Each position (extended, retracted) is monitored by a magnetically coupled switch. The switches are locked in place with a small screwdriver adjusted lock. Each switch has an LED indicator that shows when the switch is activated. Each port has a speed control air fitting that is used to adjust the speed at which the actuator moves to a position.

Push-off Actuators

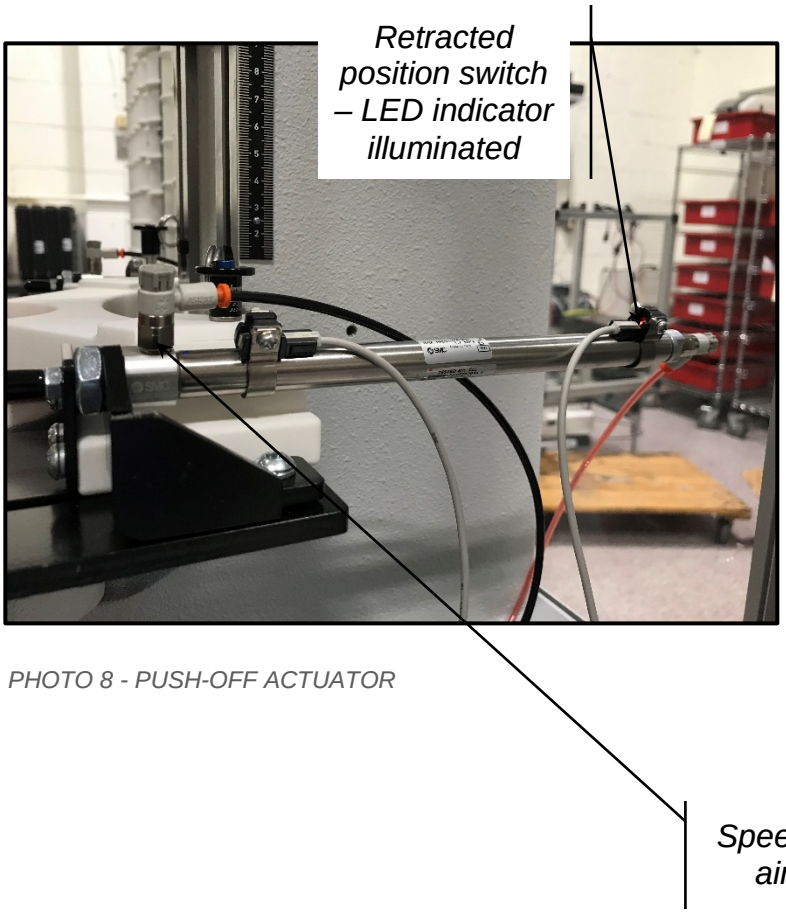


PHOTO 8 - PUSH-OFF ACTUATOR

The pneumatic push-off actuators (1 shown at the left, 2 total) are also equipped with magnetically coupled position status switches that monitor the extended and retracted positions. These switches are provided with a clamp type mounting arrngement – to adjust, simply loosen the clamp and slide the entire assembly along the body of the actuator. A RED LED will light when the switch is alagned with the internal magnet of the actuator piston Each port has a speed control air fitting that is used to adjust the speed at which the actuator moves to a position.

PRESS Actuator

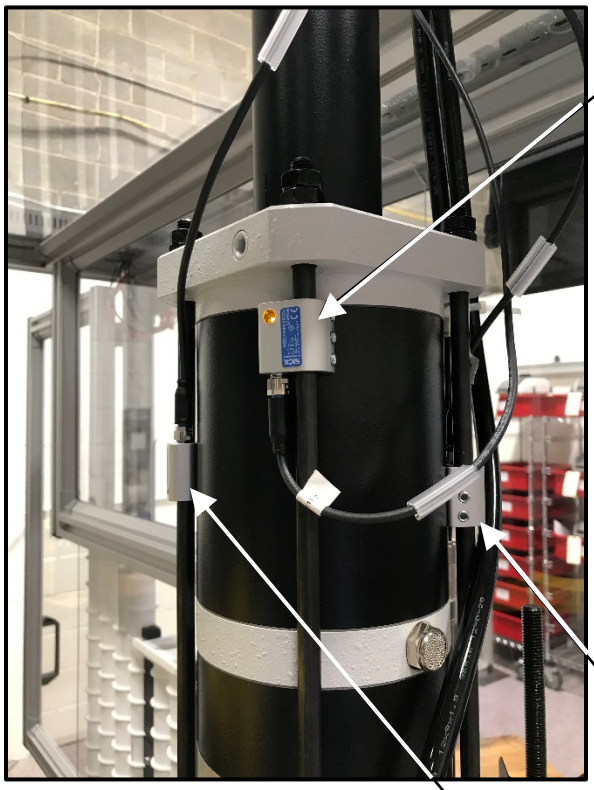


PHOTO 9 - PRESS ACTUATOR

RETRACTED POSITION

the PRESS actuator is a multi-stage pneumatic actuator. It is equipped with three (3) magnetically coupled postion status switches. Each has a YELLOW LED that lights up when the magent on the internal piston is aligned with the switch. This actuator needs to use three switches: 1) actuator retracted, 2) actuator extended for the 6 inch and 10 inch wheels, and 3) actuator extended for the 3-1/4” wheel.

The switches are adjusted by loosening the three set screws in the switch body.

6 & 10 INCH WHEEL – EXTENDED POSITION

3-1/4 INCH WHEEL – EXTENDED POSITION

Other sensors

Other sensing devices incorporated into the machine are shown below.

Keyence LZ-R Laser sensor

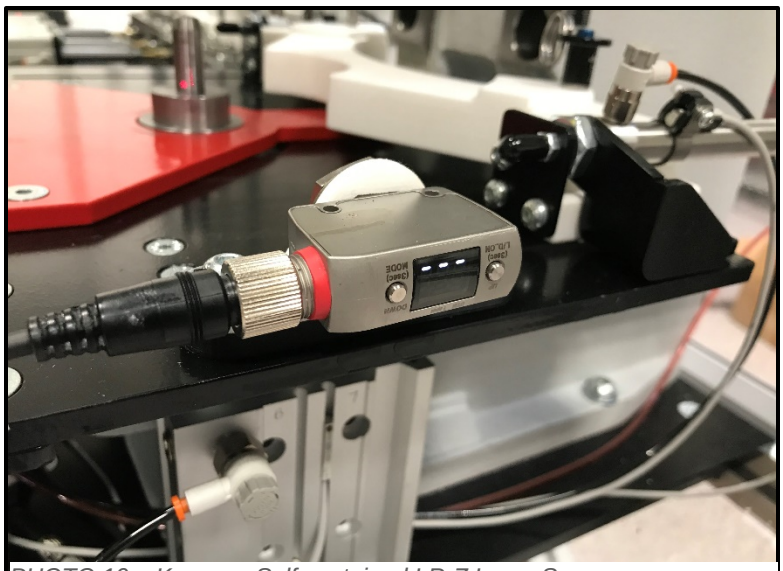


PHOTO 10 – Keyence Self contained LR-Z Laser Sensor

The Keyence Laser sensor is used to: 1) sense 'wheel presence' (shown at left), and, 2) to sense a full fixture at the load station (not shown). The user is referred to the manufacturer's manual (see Appendices for a copy of this manual) for making any adjustments that may be required on these devices. Both of these have been factory set for optimal performance and should not require adjustment.

Keyence LR-TB5000 Analog Laser sensor

PHOTO 11 - Keyence LR-TB5000 Analog Laser Sensor

The Keyence Analog Laser sensor is used to determine the wheel position within a fixture. It determines when a fixture is empty, and let's the robot know how far down into the fixture to go in order to successfully engage the next wheel for processing. The user is referred to the manufacturer's manual (see Appendices for a copy of this manual) for making any adjustments that may be required on these devices. This has been factory set for optimal performance and should not require adjustment.

Keyence Locking Door Switch

PHOTO 12 - Door locking limit switch

Each of the acccess door entries into the processing area is equipped with a locking limit switch. Shown at the left in the open condition, a RED indicator light will be displayed. Iif properly closed (but not yet locked) a blinking green indicator light will be visible. When properly closed and locked, a solid green light will display. These switches are monitored and controlled through the Keyence GC 1000 Safety controller

Pneumatic supply components

The pneumatic supply components prepare, regulate, monitor, and distribute the compressed air utility to all of the machine components.

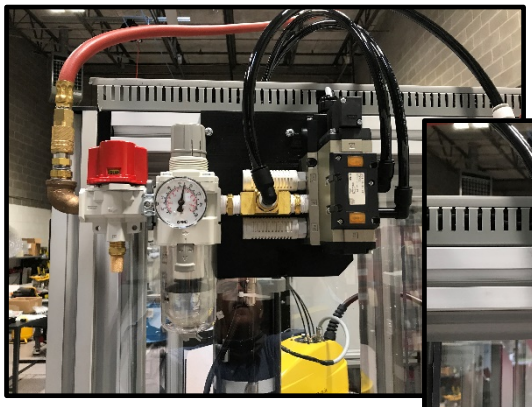


PHOTO 13- Primary Air Prep

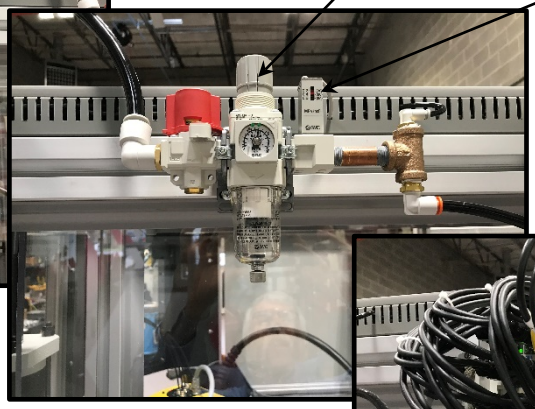


PHOTO 14 - Air Supply pressure switch

Additionally, status signals from most of the actuators are communicated through the EthernetI/P modules.

PHOTO 15 - SMC Pneumatic manifold and Ethernet IO modules

INDEXER CAM Switch

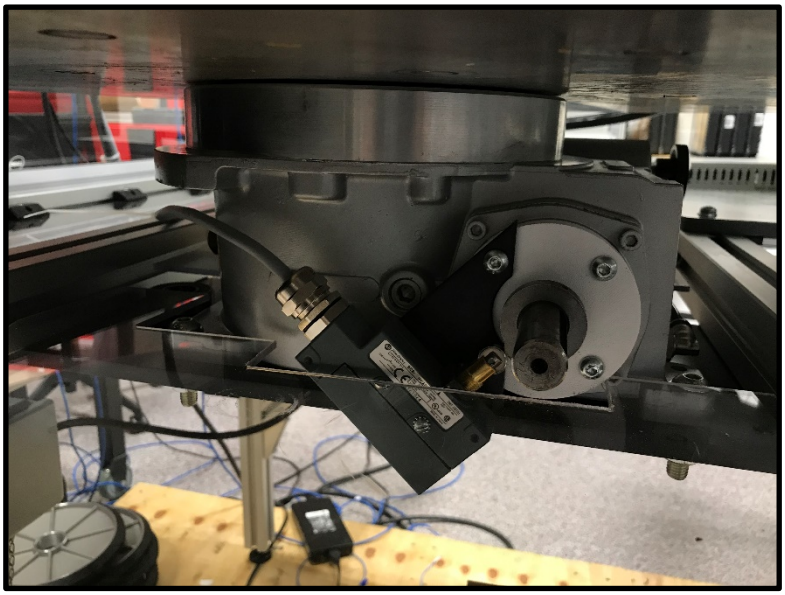
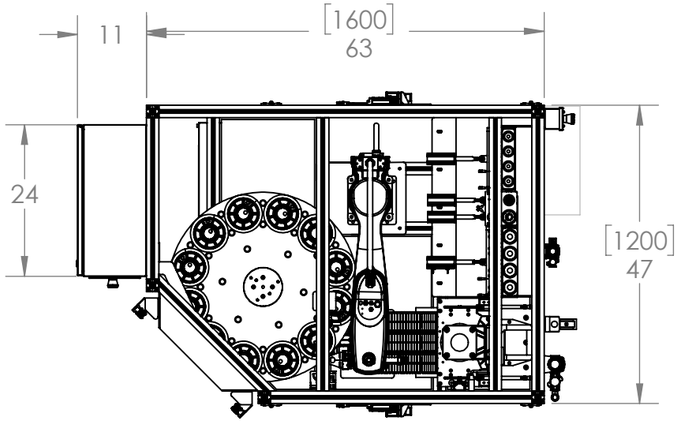
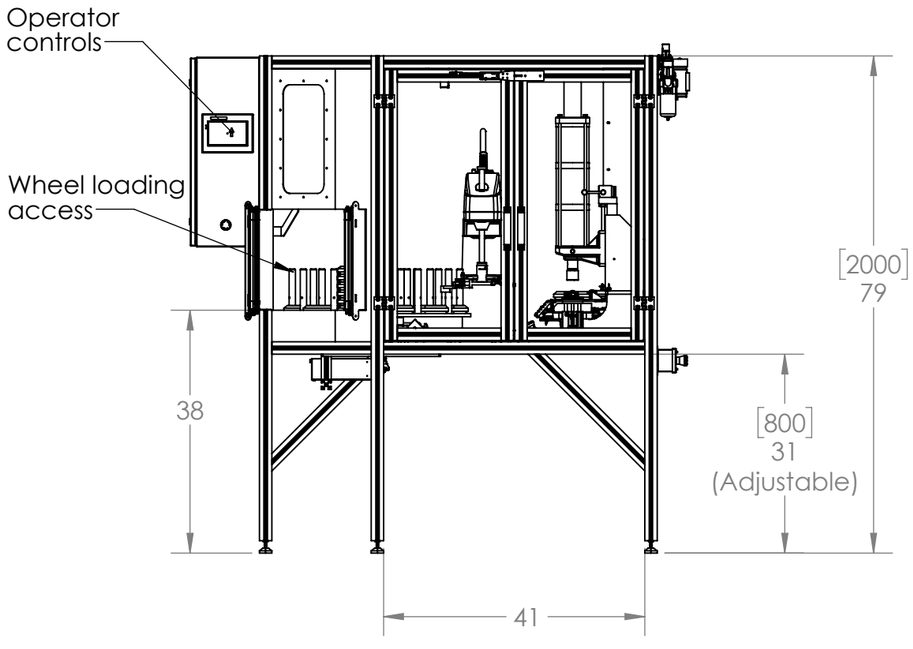


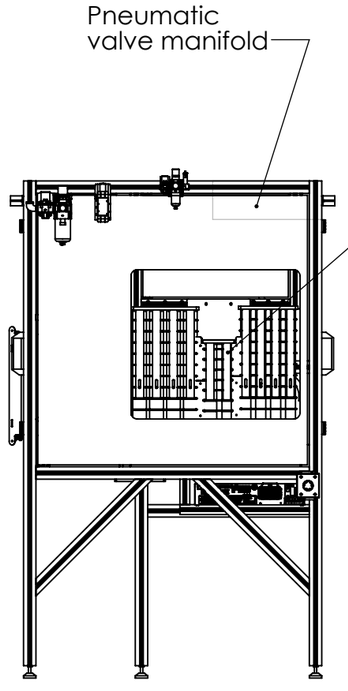
PHOTO 16 - INDEXER CAM Switch

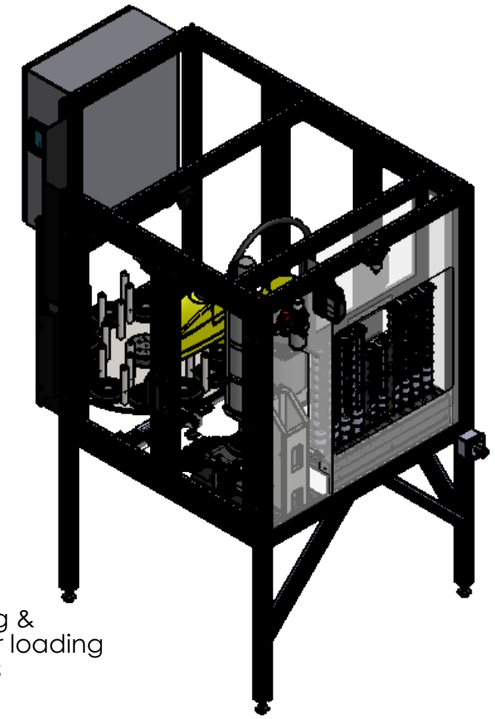
Located just under the indexer table, the indexer cam switch controls the operation of the indexer drive system. No adjustment of this device is possible or required.

MECHANICAL DRAWINGS









NOTES:
1. System can process 3.25", 6" or 10" wheels (6" shown)
2. Wheel infeed carousel can hold (12) stacks of 3.25" wheels, (12) stacks of 6" wheels, or (6) stacks of 10" wheels.
3. Required utilities:
   - 230/3/60
   - Compressed air, 80-100 psi

ARNOLD AUTOMATION

UNLESS OTHERWISE SPECIFIED:		
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± 1° BEND ± 3° TWO PLACE DECIMAL ±0.030 THREE PLACE DECIMAL ±0.005		
INTERPRET GEOMETRIC TOLERANCING PER:		
MATERIAL Material <not specified>		
FINISH	NEXT ASSY	USED ON
DO NOT SCALE DRAWING	APPLICATION	

	NAME	DATE
DRAWN	K. McHenry	5/8/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

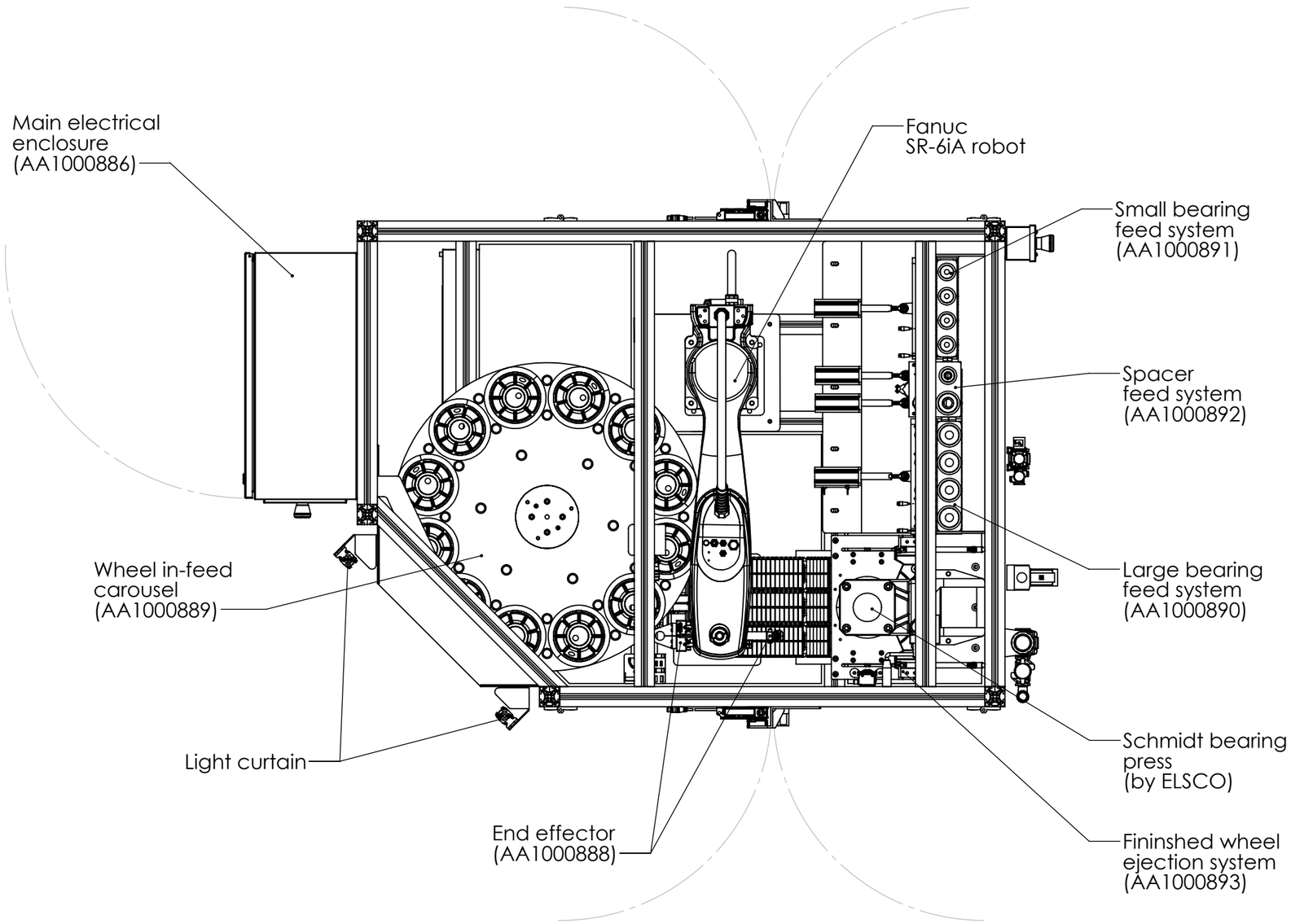
COMMENTS:

TITLE:

System, Robotic wheel assembly

SIZE	DWG. NO.	REV
B	AA1006	A

SCALE: 1:24 | WEIGHT: 0.00 | SHEET 1 OF 3



NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
Material <not specified>

FINISH

DO NOT SCALE DRAWING

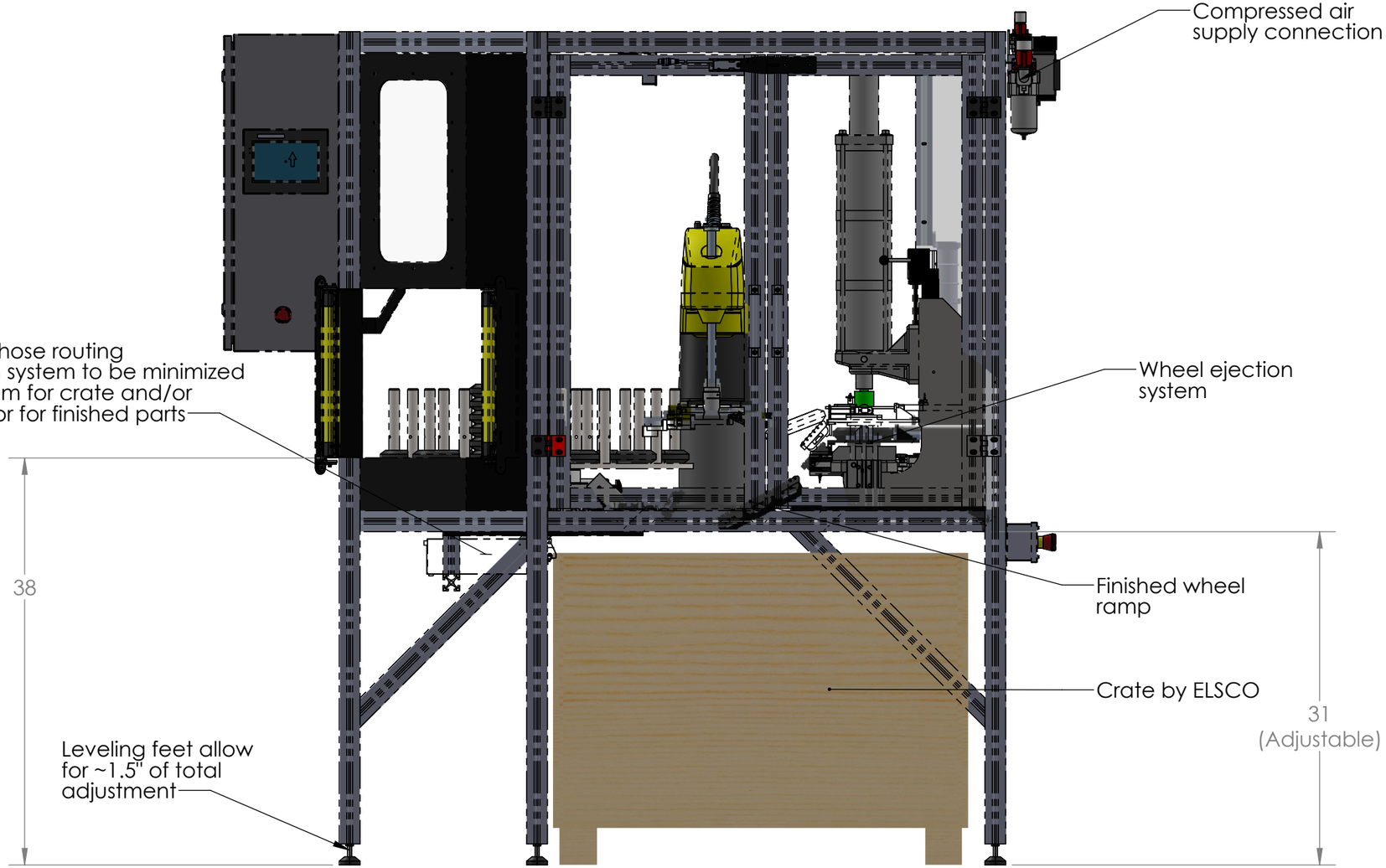
	NAME	DATE
DRAWN	K. McHenry	5/8/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

TITLE:
System, Robotic wheel assembly

SIZE	DWG. NO.	REV
B	AA1006	A

SCALE: 1:12 | WEIGHT: 0.00 | SHEET 2 OF 3



ARNOLD AUTOMATION

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
Material <not specified>

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	5/8/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

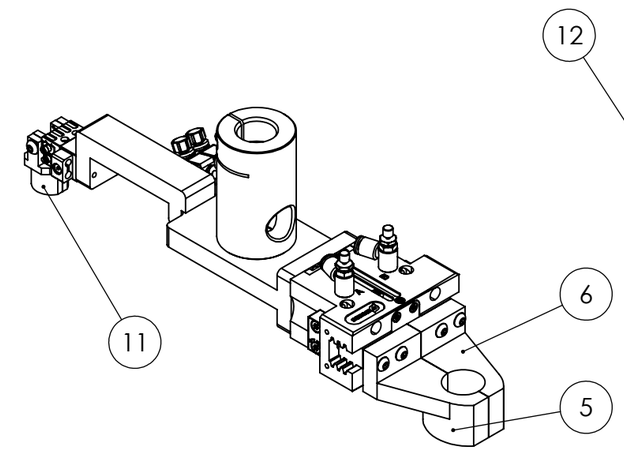
TITLE:

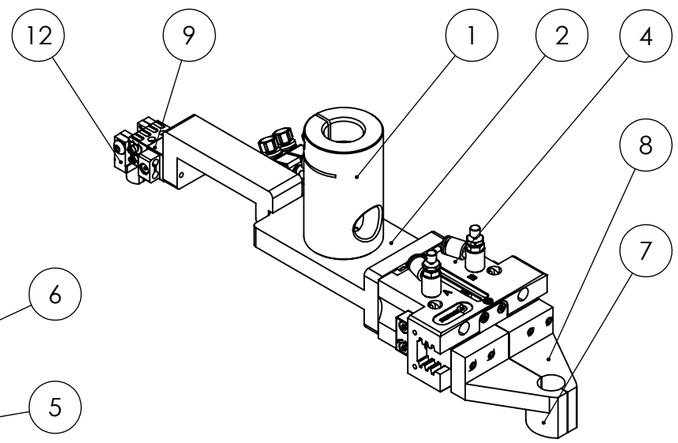
System, Robotic wheel assembly

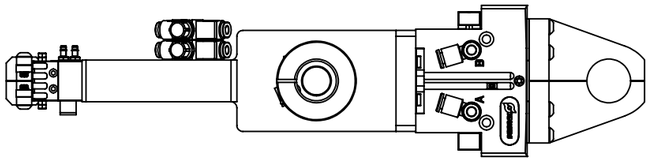
SIZE	DWG. NO.	REV
B	AA1006	A

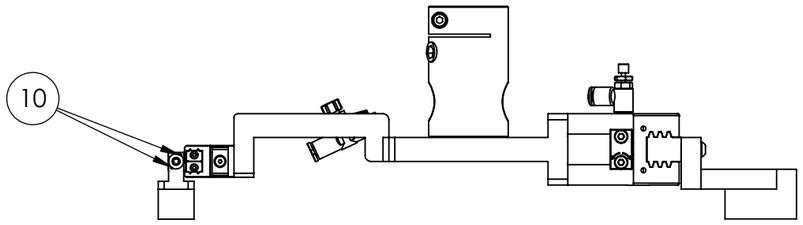
SCALE: 1:12 | WEIGHT: 0.00 | SHEET 3 OF 3

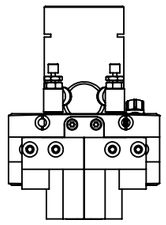
ITEM NO.	Number	DESCRIPTION	QTY.	QTY.	Source
1	A05B-1116-K113	Flange, SCARA tool	1	1	Fanuc
2	AA1000896	Block, gripper mounting	1	1	Arnold
3	91595A348	Dowel Pin, 5mm x 14mm	1	1	McMaster
4	0318500	Gripper, PGN-plus-P 2-finger parallel	1	1	Schunk
5	AA1000897	Fingers, Large wheel gripper	1	-	Arnold
6	AA1000898	Fingers, Large wheel gripper	1	-	Arnold
7	AA1000899	Fingers, small wheel gripper	-	1	Arnold
8	AA1000900	Fingers, small wheel gripper	-	1	Arnold
9	0305491	Gripper, MPG-plus 2-finger parallel	1	1	Schunk
10	91595005	Dowel Pin, 1.5mm x 6mm	4	4	McMaster
11	AA1000901	Finger, large bearing gripper	2	-	Arnold
12	AA1000902	Finger, small bearing gripper	-	2	Arnold
13	AS1002F-04A	Valve, 4mm flow control	2	2	SMC
14	EB25-M3	Fitting, M3 x 3/32 barb	2	2	Pneumadyne
15	AS1201F-M5-04	Elbow, M5 x 4mm flow control	2	2	SMC
16	0301370	Switch, gripper position	1	1	Schunk
17	0301474	Switch, gripper position	2	2	Schunk
18	92095A196	Button head hex drive screw, M4 x 20	4	2	McMaster
19	92095A190	Button head hex drive screw, M4 x 10	2	2	McMaster











NOTES:
1. Item 3 is a press fit in to both items 1 and 2.
2. Switches for gripper positions not shown.
3. Flat washers and lock washers for finger attachment not shown.

ARNOLD AUTOMATION

		UNLESS OTHERWISE SPECIFIED:
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± 1° BEND ± 3° TWO PLACE DECIMAL ±0.030 THREE PLACE DECIMAL ±0.005
		INTERPRET GEOMETRIC TOLERANCING PER:
		MATERIAL -
NEXT ASSY	USED ON	FINISH N/A
APPLICATION		DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

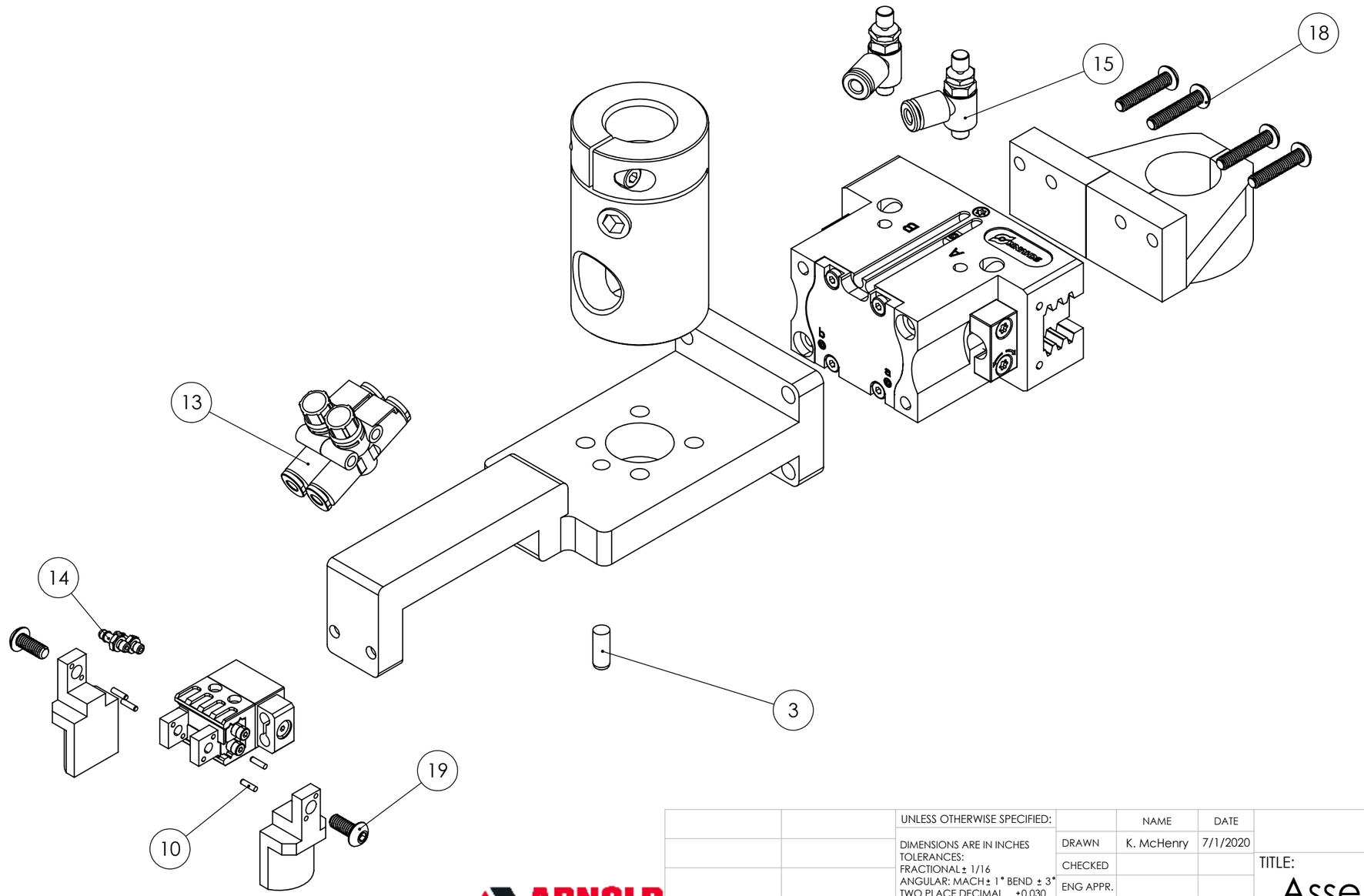
COMMENTS:

TITLE:

Assembly, Dual gripper EOAT

SIZE	DWG. NO.	REV
B	AA1000888	A

SCALE: 1:3 | WEIGHT: - | SHEET 1 OF 2



NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
-

FINISH
N/A

DO NOT SCALE DRAWING

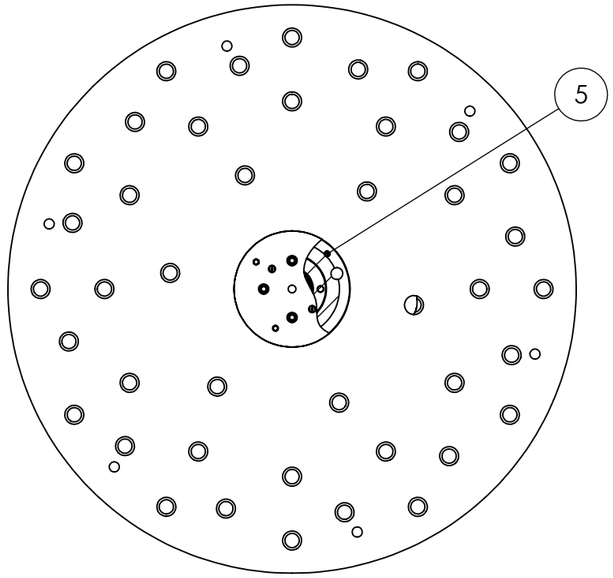
	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

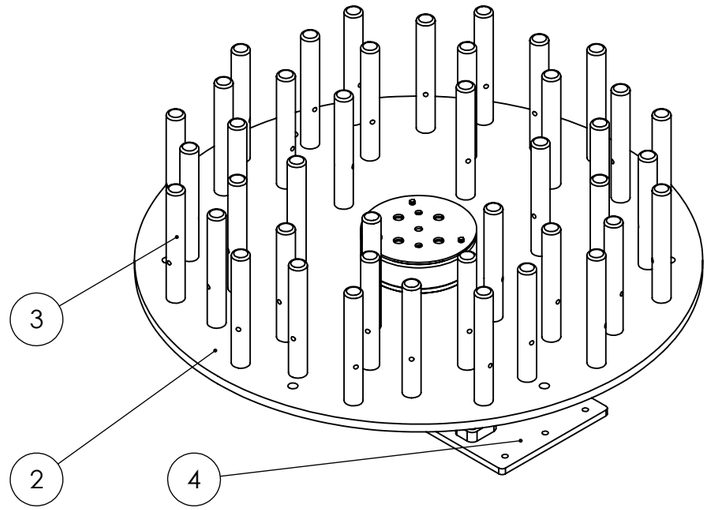
COMMENTS:

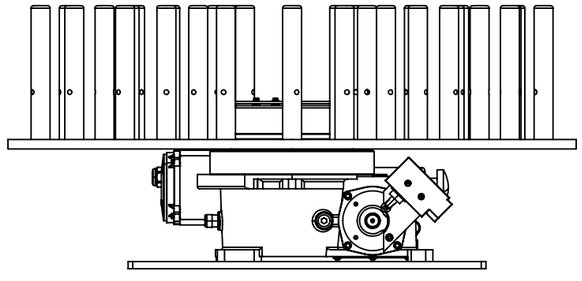
TITLE:
Assembly, Dual gripper EOAT

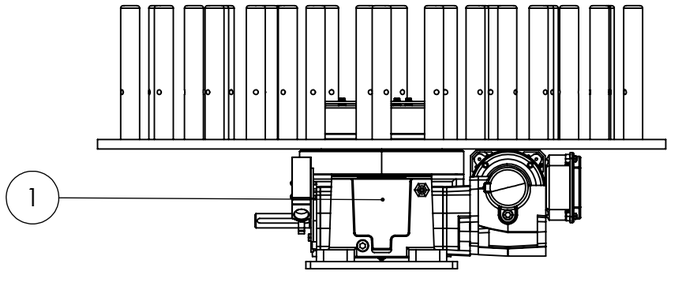
SIZE	DWG. NO.	REV
B	AA1000888	A

SCALE: 3:4 | WEIGHT: - | SHEET 2 OF 2









ITEM NO.	Number	DESCRIPTION	QTY.	Source
1	601RDM-12H24-270	Index drive, 30 degree	1	Camco
2	AA1000904	Dial plate, Wheel accumulator	1	Arnold
3	AA1000903	Post, Wheel accumulator	42	Arnold
4	AA1000905	Plate, Indexer mounting	1	Arnold
5	93831A581	Dowel Pin, 5/16 x 3/4"	2	McMaster

ARNOLD AUTOMATION

NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
Material

FINISH
N/A

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

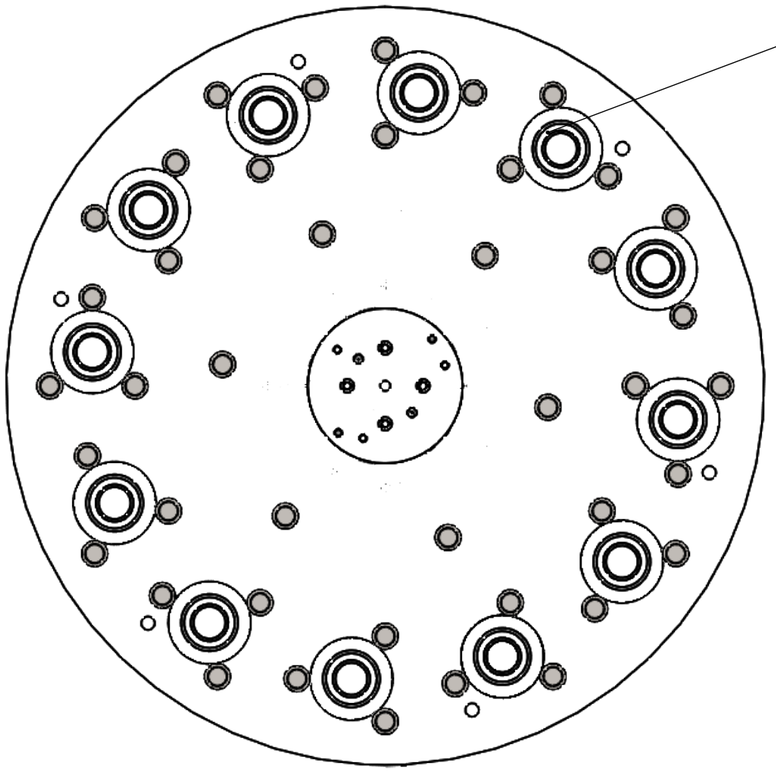
COMMENTS:

TITLE:

SA - Wheel accumulator

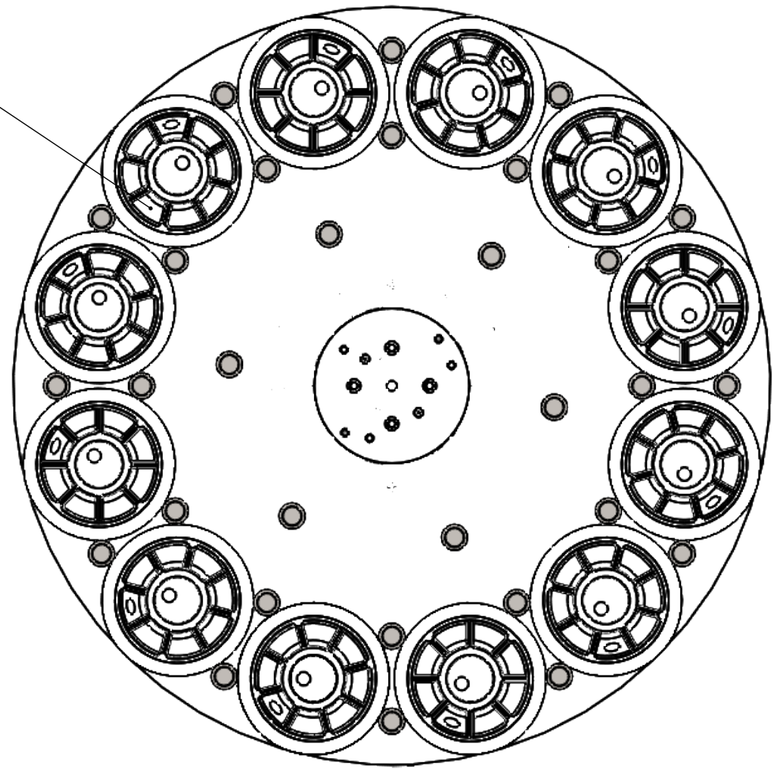
SIZE	DWG. NO.	REV
B	AA100089	A

SCALE: 1:8 | WEIGHT: - | SHEET 1 OF 3



3.25" Wheel configuration
(42) Posts used

Wheels shown
for reference



6" Wheel configuration
(30) Posts used

NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL: Material

FINISH: N/A

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

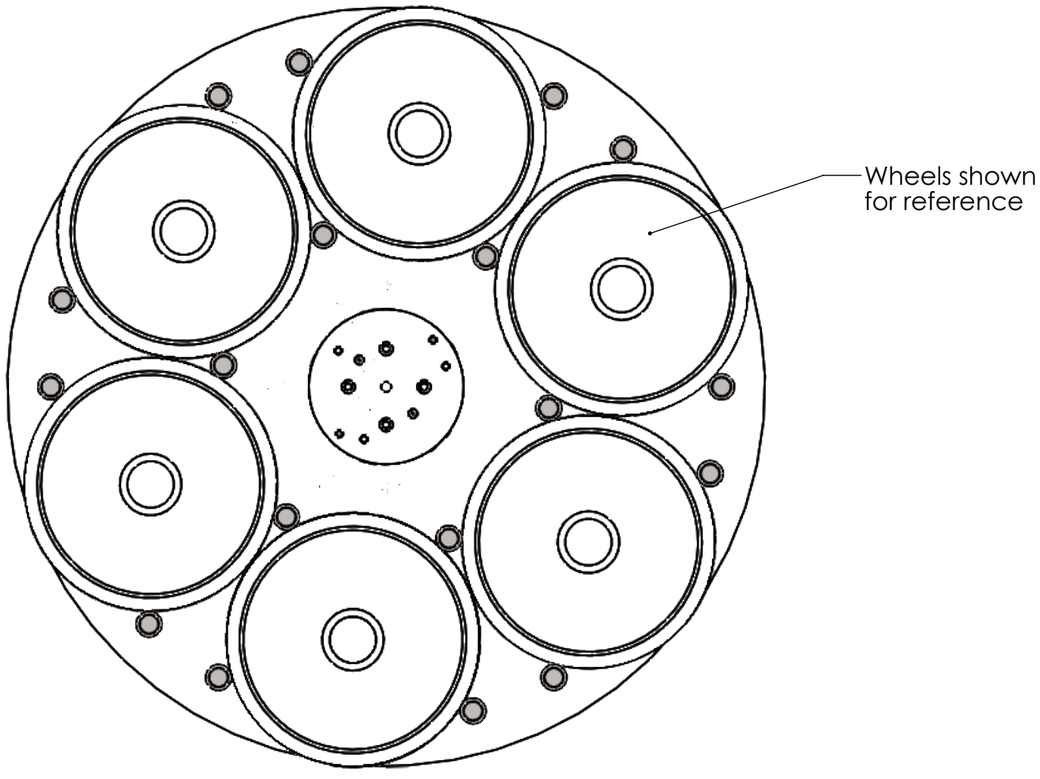
COMMENTS:

TITLE:

SA - Wheel accumulator

SIZE	DWG. NO.	REV
B	AA100089	A

SCALE: 1:6 | WEIGHT: - | SHEET 2 OF 3



10" Wheel configuration
(18) Posts used

ARNOLD AUTOMATION

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
Material

FINISH
N/A

DO NOT SCALE DRAWING

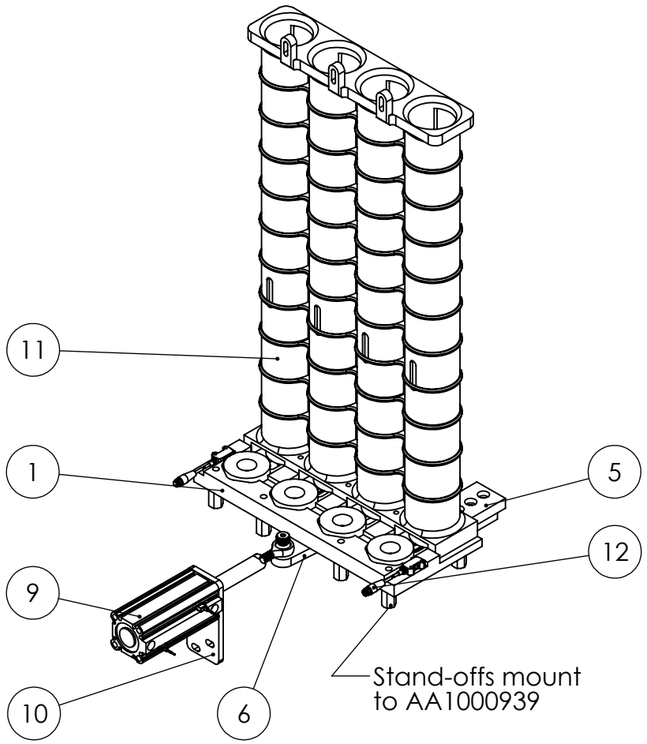
	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

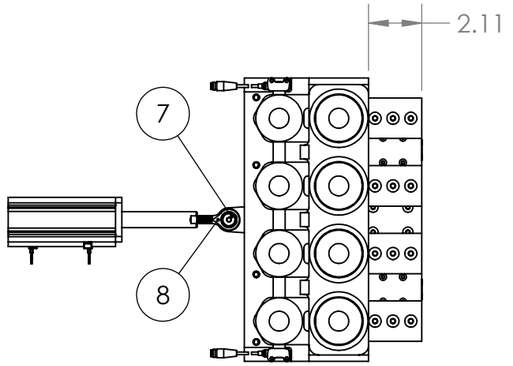
COMMENTS:

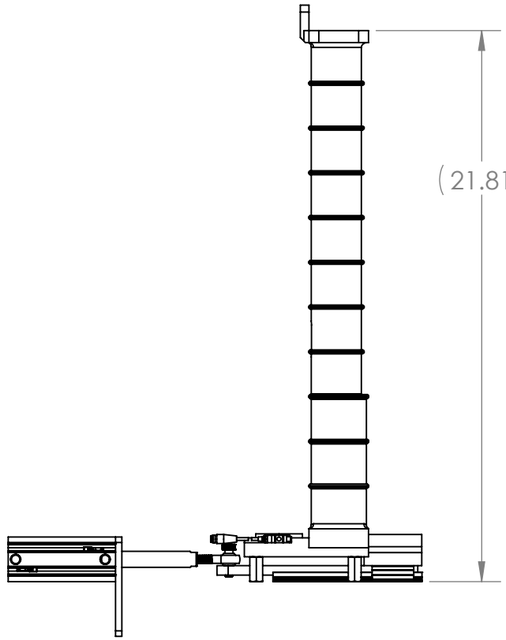
TITLE:
SA - Wheel accumulator

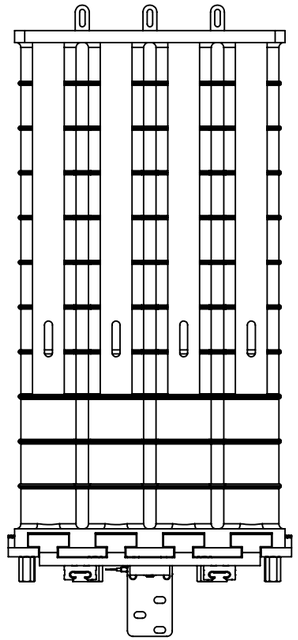
SIZE	DWG. NO.	REV
B	AA100089	A

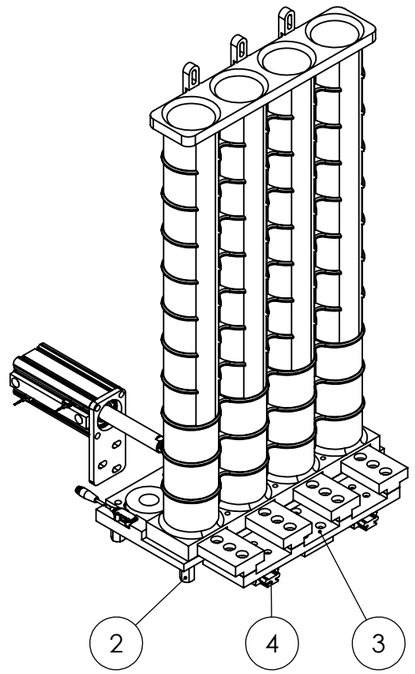
SCALE: 1:6 | WEIGHT: - | SHEET 3 OF 3











ITEM NO.	Number	DESCRIPTION	QTY.	Source
1	AA1000908	Plate, Large bearing pick-up	1	Arnold
2	95947A561	Stand-off, 6mm x 25mm hex	6	McMaster
3	AA1000909	Plate, Large bearing pusher	1	Arnold
4	MR15-0150-1	Linear guide	2	PBC Linear
5	AA1000910	Pusher, large bearing	4	Arnold
6	AA1000911	Plate, actuator connection	1	Arnold
7	90782A122	Shoulder Screw, 8 X 16mm	1	McMaster
8	59935K830	Ball Joint Rod End	1	McMaster
9	NCDQ2A32-75DZ	Cylinder, Double Acting, Single Rod, w/Auto Switch Mounting Groove	1	SMC
10	AA1000912	Plate, cylinder mounting	1	Arnold
11	AA1000913	Guide, vertical bearing feed stack	1	Arnold
12	PR-M51CN	Sensor, Thru-beam	1	Keyence

ARNOLD AUTOMATION

		UNLESS OTHERWISE SPECIFIED:
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± 1° BEND ± 3° TWO PLACE DECIMAL ±0.030 THREE PLACE DECIMAL ±0.005
		INTERPRET GEOMETRIC TOLERANCING PER:
		MATERIAL -
NEXT ASSY	USED ON	FINISH N/A
APPLICATION		DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

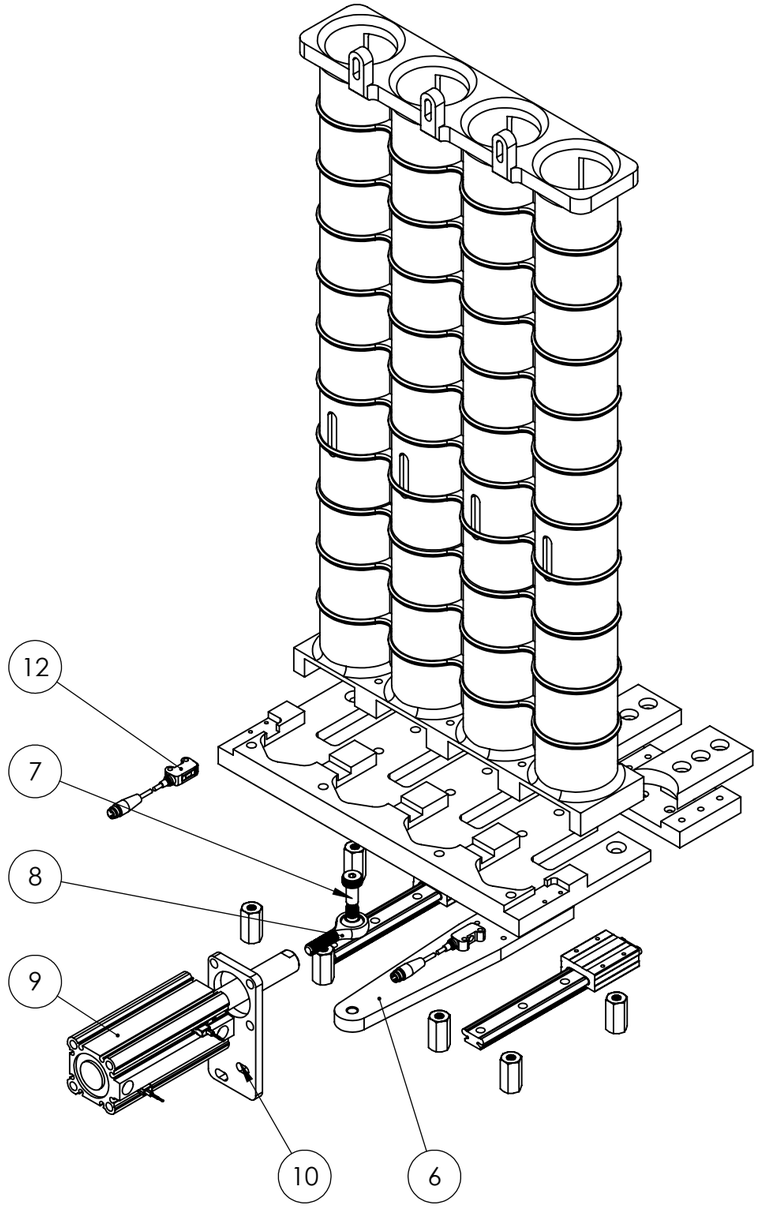
COMMENTS:

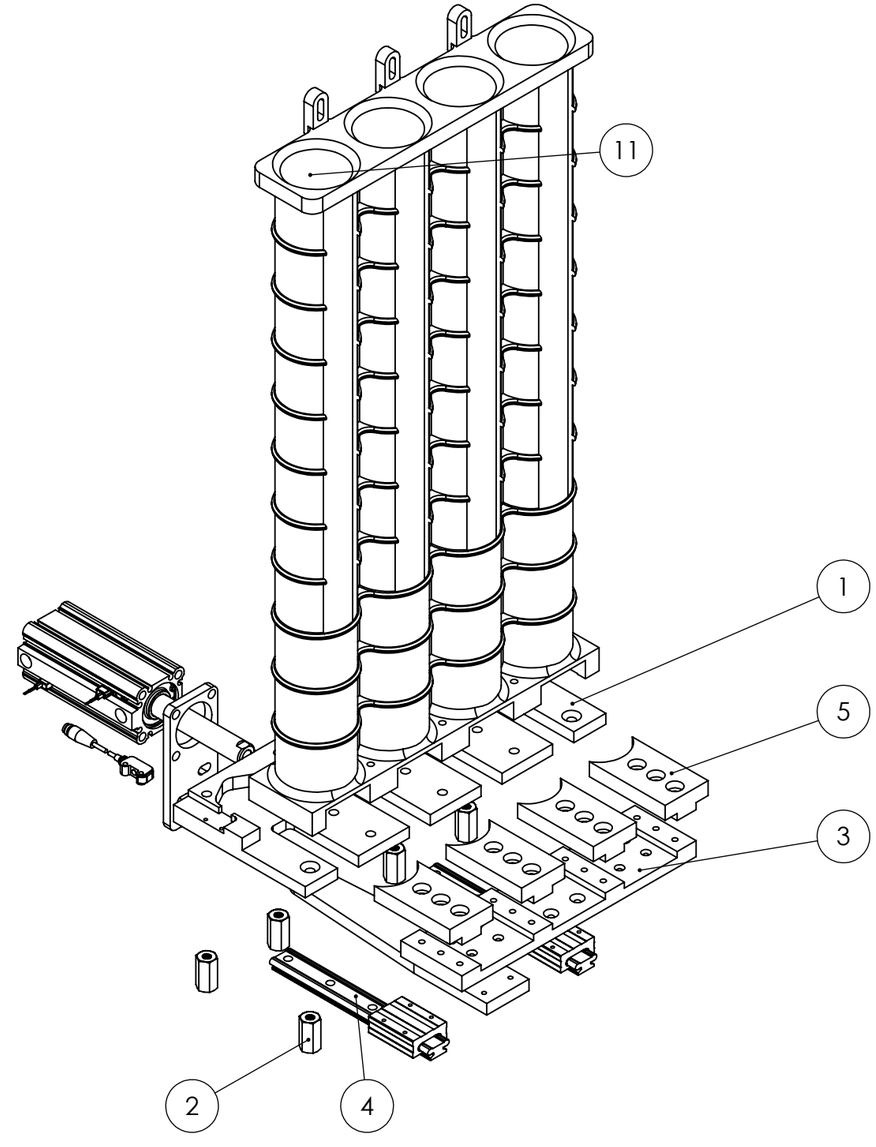
TITLE:

SA Large bearing feeder

SIZE	DWG. NO.	REV
B	AA1000890	A

SCALE: 1:6 | WEIGHT: - | SHEET 1 OF 2





ARNOLD AUTOMATION

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
-

FINISH
N/A

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

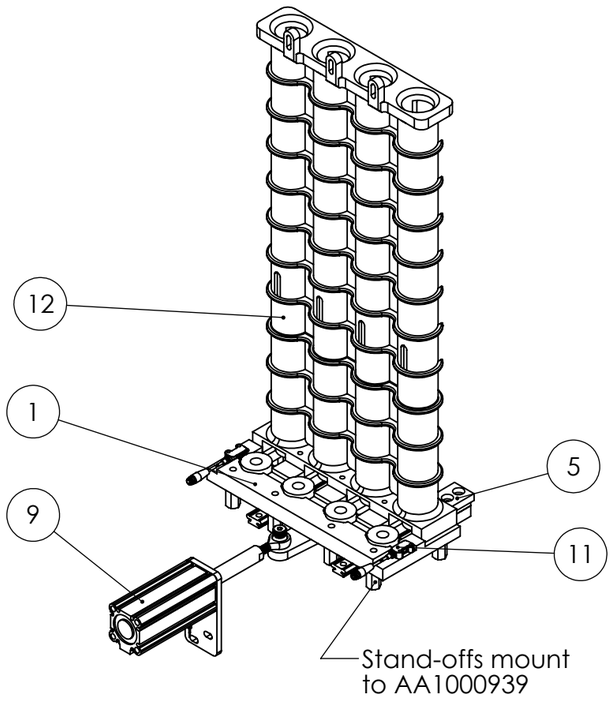
COMMENTS:

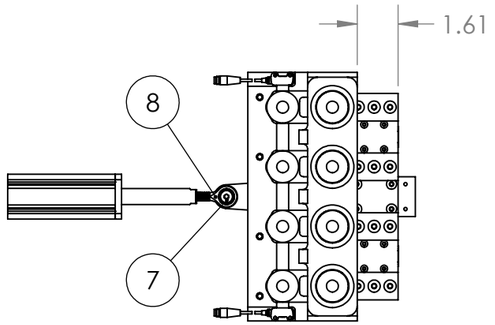
TITLE:

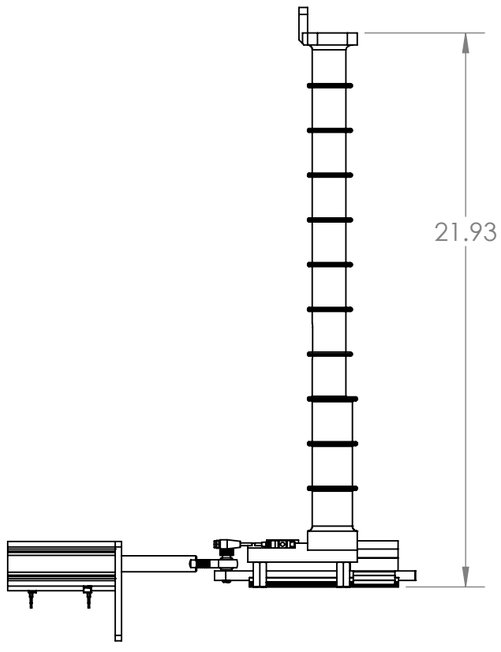
SA Large bearing feeder

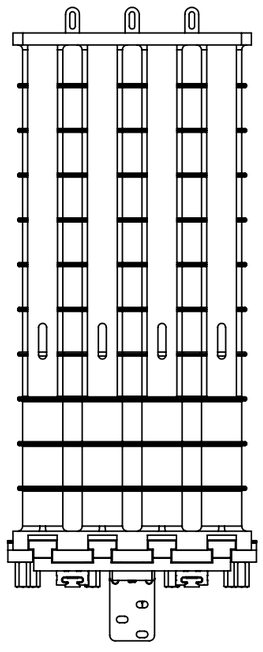
SIZE	DWG. NO.	REV
B	AA1000890	A

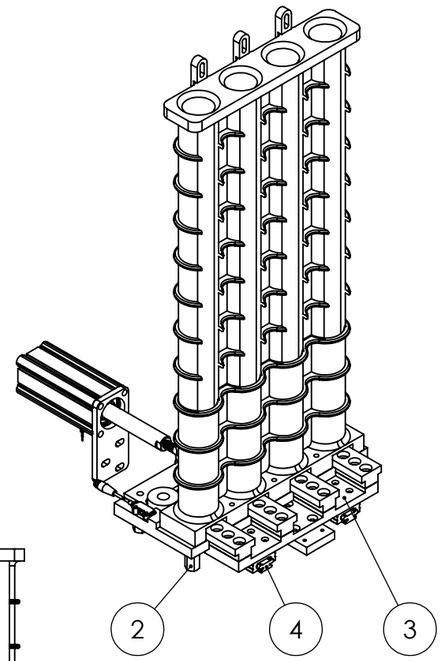
SCALE: 1:4 | WEIGHT: - | SHEET 2 OF 2











ITEM NO.	Number	DESCRIPTION	QTY.	Source
1	AA1000914	Plate, small bearing pick-up	1	Arnold
2	95947A561	Stand-off, 6mm x 25mm hex	6	McMaster
3	AA1000915	Plate, small bearing pusher	1	Arnold
4	MR15-0150-1	Linear guide	2	PBC Linear
5	AA1000916	Pusher, small bearing	4	Arnold
6	AA1000911	Plate, actuator connection	1	Arnold
7	90782A122	Shoulder Screw, 8 X 16mm	1	McMaster
8	59935K830	Ball Joint Rod End	1	McMaster
9	NCDQ2A32-75DZ	Cylinder, Double Acting, Single Rod, w/Auto Switch Mounting Groove	1	SMC
10	AA1000912	Plate, cylinder mounting	1	Arnold
11	PR-M51CN	Sensor, Thru-beam	1	Keyence
12	AA1000917	Guide, vertical bearing feed stack	1	Arnold

ARNOLD AUTOMATION

		UNLESS OTHERWISE SPECIFIED:
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± 1° BEND ± 3° TWO PLACE DECIMAL ±0.030 THREE PLACE DECIMAL ±0.005
		INTERPRET GEOMETRIC TOLERANCING PER:
		MATERIAL -
NEXT ASSY	USED ON	FINISH N/A
APPLICATION		DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

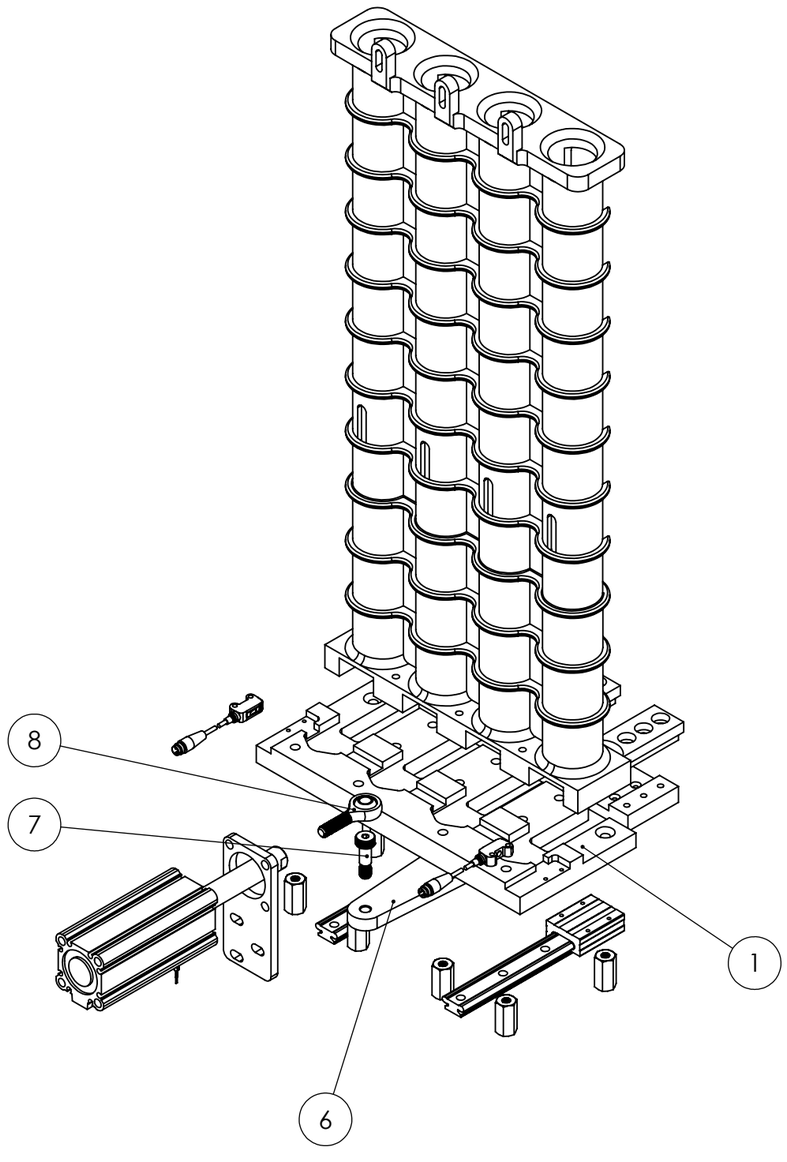
COMMENTS:

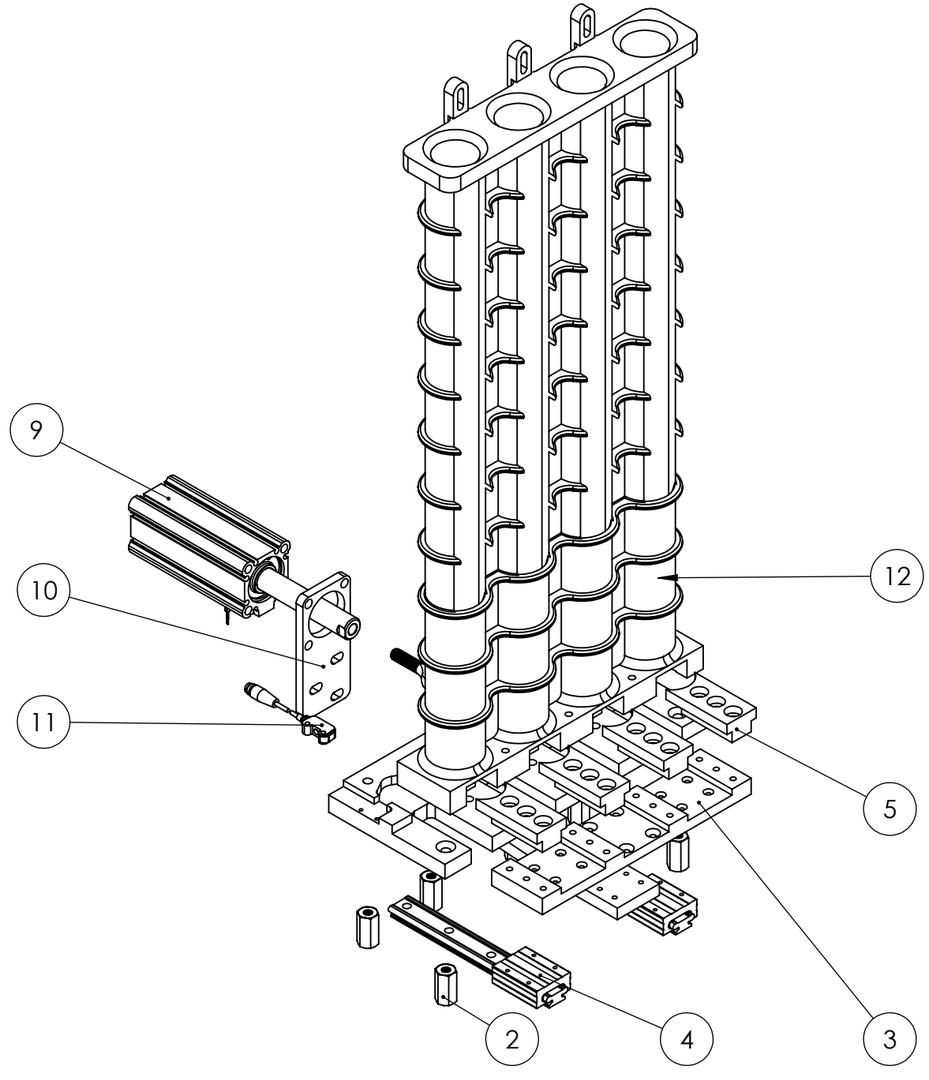
TITLE:

SA - Small bearing feeder

SIZE	DWG. NO.	REV
B	AA1000891	A

SCALE: 1:6 | WEIGHT: - | SHEET 1 OF 2





ARNOLD AUTOMATION

		UNLESS OTHERWISE SPECIFIED:
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± 1° BEND ± 3° TWO PLACE DECIMAL ±0.030 THREE PLACE DECIMAL ±0.005
		INTERPRET GEOMETRIC TOLERANCING PER:
		MATERIAL -
NEXT ASSY	USED ON	FINISH N/A
APPLICATION		DO NOT SCALE DRAWING

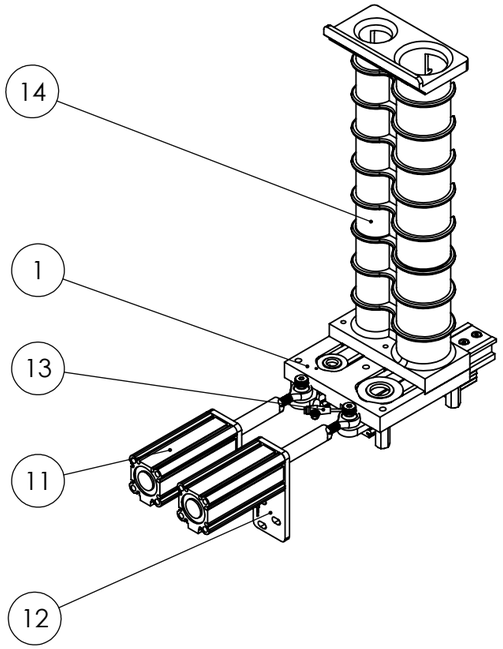
	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

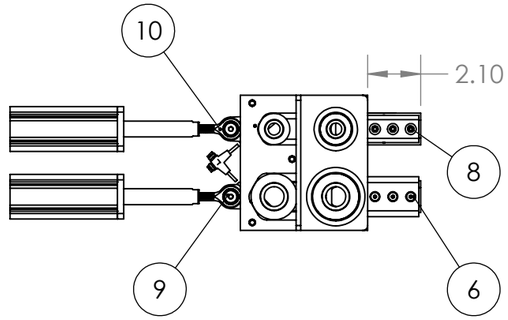
TITLE:

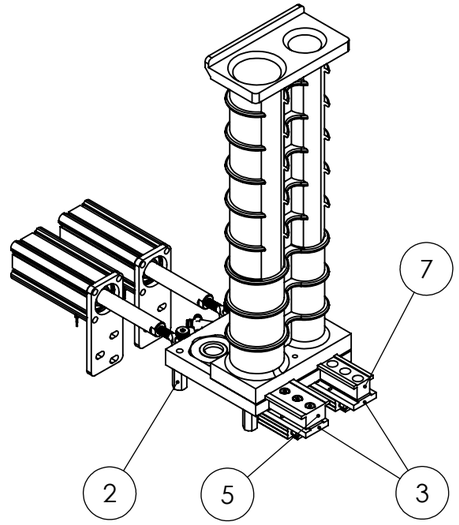
SA - Small bearing feeder

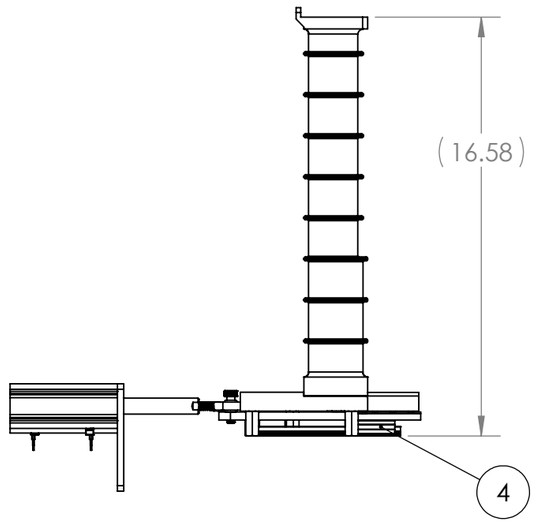
SIZE	DWG. NO.	REV
B	AA1000891	A

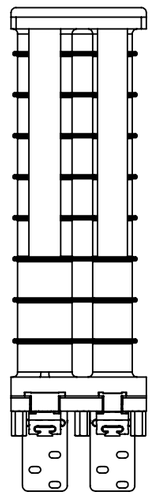
SCALE: 1:4	WEIGHT: -	SHEET 2 OF 2











ITEM NO.	Number	DESCRIPTION	QTY.	Source
1	AA1000918	Plate, spacer pick-up	1	Arnold
2	95947A561	Stand-off, 6mm x 25mm hex	5	McMaster
3	AA1000919	Plate, spacer pusher	2	Arnold
4	MR15-0150-1	Linear guide	2	PBC Linear
5	AA1000944	Pusher, large spacer	1	Arnold
6	92981A777	Shoulder screw, 5mm x 15mm	3	McMaster
7	AA1000921	Pusher, small bearing	1	Arnold
8	94669A014	Spacer, 6mm OD x 10mm long round	3	McMaster
9	90782A122	Shoulder Screw, 8 X 16mm	2	McMaster
10	59935K830	Ball Joint Rod End	2	McMaster
11	NCDQ2A32-75DZ	Cylinder, Double Acting, Single Rod, w/Auto Switch Mounting Groove	2	SMC
12	AA1000922	Plate, cylinder mounting	2	Arnold
13	PR-FB15CP	Photo switch, 15mm self reflective	2	Keyence
14	AA1000923	Guide, vertical spacer feed stack	1	Arnold

ARNOLD AUTOMATION

NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
-

FINISH
N/A

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

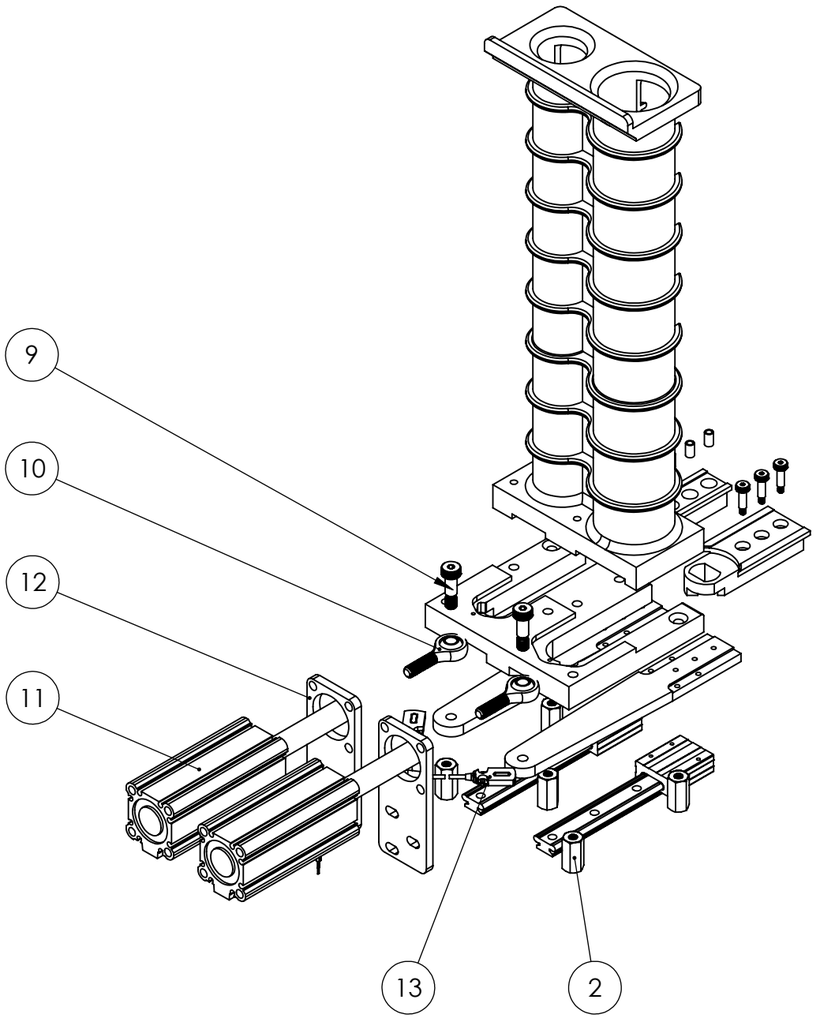
COMMENTS:

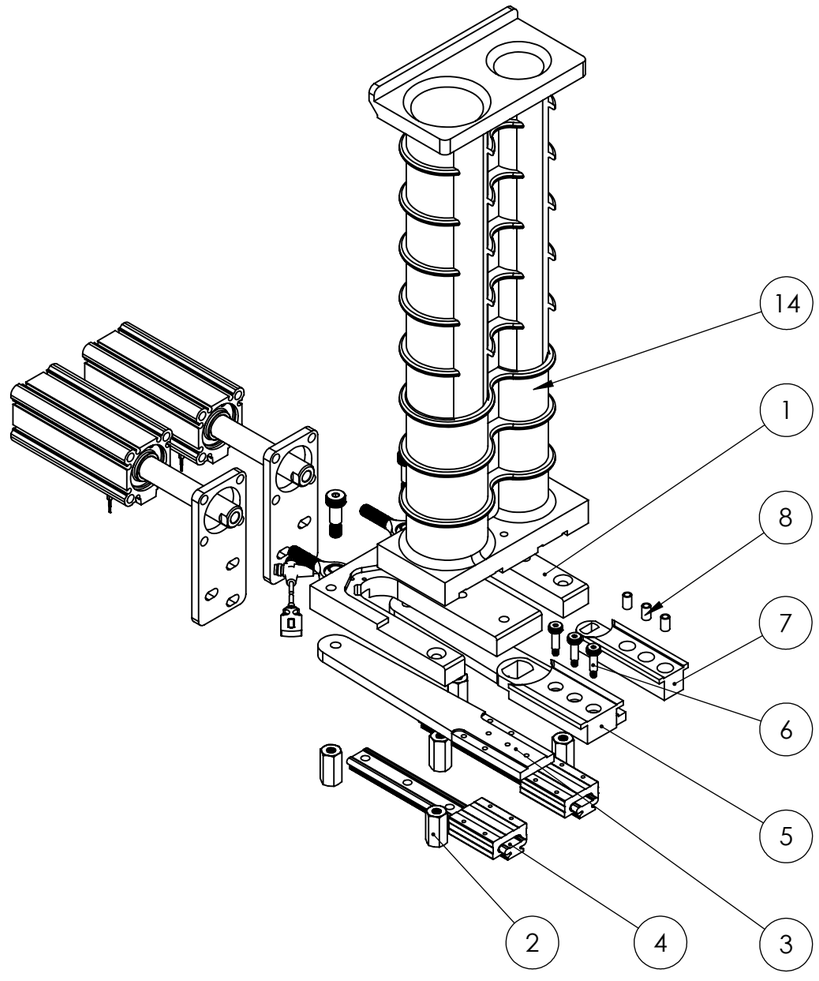
TITLE:

SA Spacer feeder

SIZE	DWG. NO.	REV
B	AA1000892	A

SCALE: 1:6 | WEIGHT: - | SHEET 1 OF 2





		UNLESS OTHERWISE SPECIFIED:
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± 1° BEND ± 3° TWO PLACE DECIMAL ±0.030 THREE PLACE DECIMAL ±0.005
		INTERPRET GEOMETRIC TOLERANCING PER:
		MATERIAL -
NEXT ASSY	USED ON	FINISH N/A
APPLICATION		DO NOT SCALE DRAWING

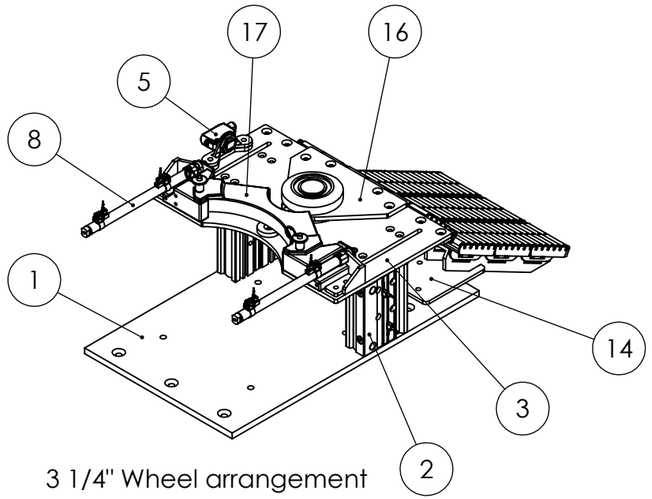
	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

TITLE:

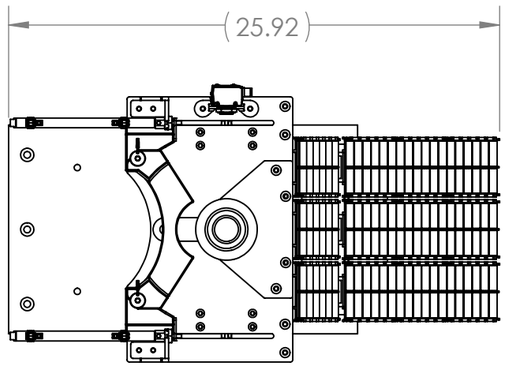
SA Spacer feeder

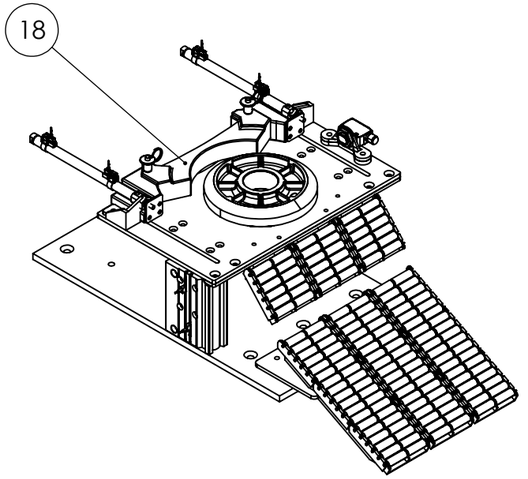
SIZE	DWG. NO.	REV
B	AA1000892	A

SCALE: 1:4 | WEIGHT: - | SHEET 2 OF 2



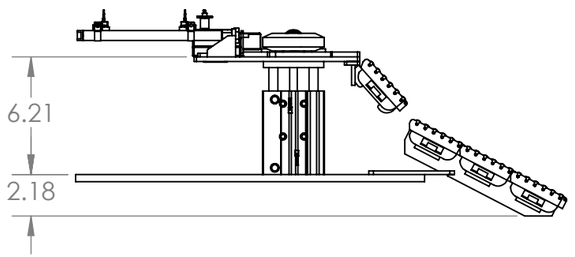
3 1/4" Wheel arrangement

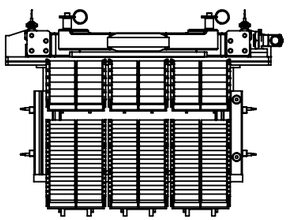




6" Wheel arrangement

ITEM NO.	Number	DESCRIPTION	QTY.	QTY.
1	AA1000924	Plate, press & ejection system mounting	1	1
2	MGPM20TN-75Z	Cylinder, 20mm bore x 75mm stroke guided	2	2
3	AA1000925	Plate, wheel lifting	1	1
4	AA1000927	Bracket, wheel presence sensor	1	1
5	LR-ZH490CB	Sensor, distance based laser	1	1
6	AA1000928	Bracket, Right hand cylinder mounting	1	1
7	AA1000929	Bracket, Left hand cylinder mounting	1	1
8	NCDMB044-0600C	Cylinder, 7/16 bore x 6" stroke pneumatic	2	2
9	AA1000930	Plate, pusher connection	2	2
10	AA1000931	Block, Right hand wheel pusher	1	1
11	AA1000932	Block, Left hand wheel pusher	1	1
12	90985A112	Quick-Release Pin, 1/4 x 1"	2	2
13	AA1000935	Bracket, Upper part removal ramp	1	1
14	AA1000936	Frame, Part removal ramp	1	1
15	P422	Segment, two-row roller guide	12	12
16	AA1000926	Plate, small wheel lift spacer	1	-
17	AA1000933	Block, 3.25" wheel pusher	1	-
18	AA1000934	Block, 6" wheel pusher	-	1
19	AA100xxxx	Wheel sensor spacer	1	1





ARNOLD AUTOMATION

NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
-

FINISH
N/A

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	7/1/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

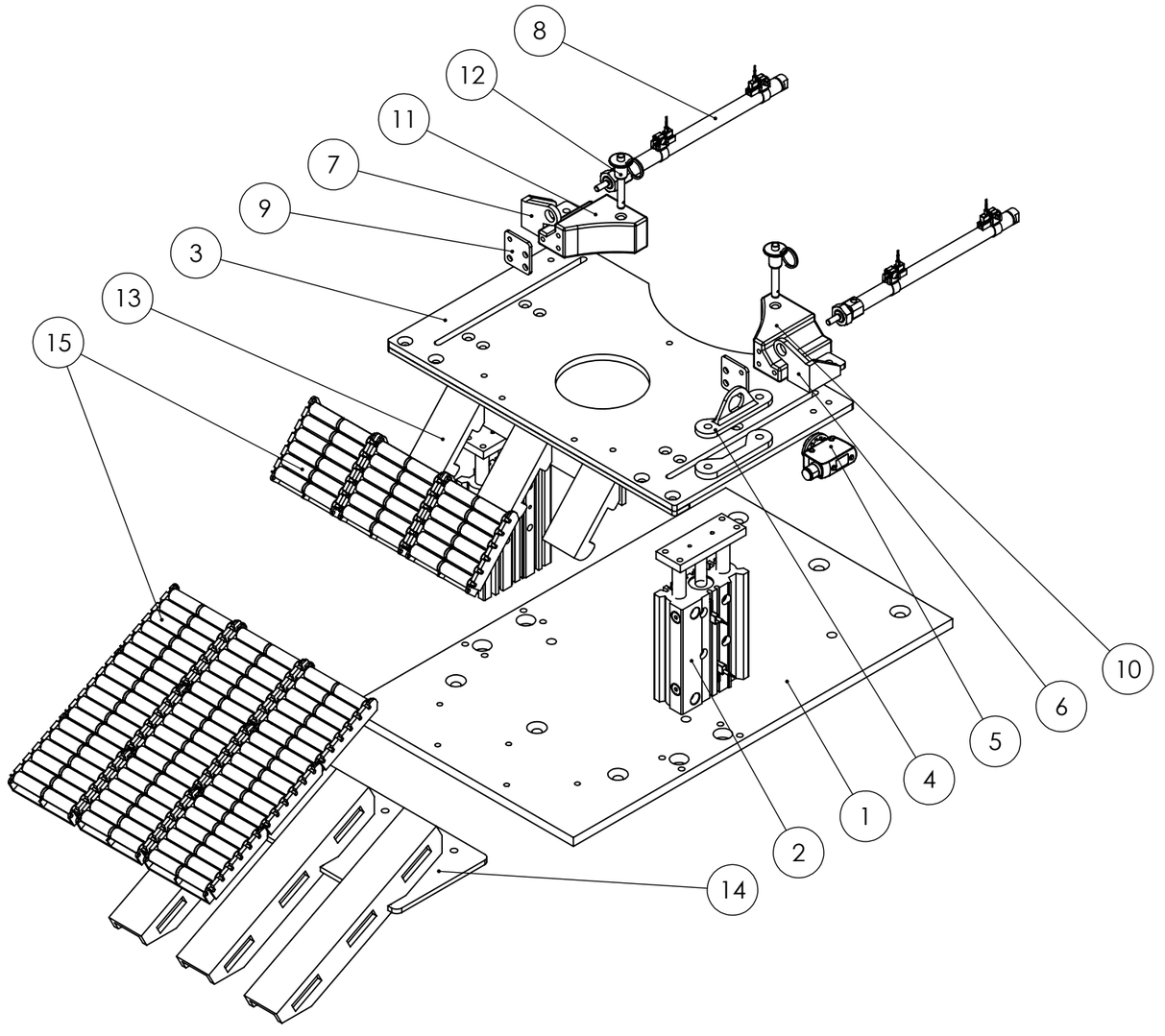
TITLE:

SA Wheel ejection

SIZE	DWG. NO.	REV
B	AA1000893	A

SCALE: 1:8 | WEIGHT: - | SHEET 1 OF 2

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Source
1	AA1000924	Plate, press & ejection system mounting	1	Arnold
2	MGPM20TN-75Z-M9BWVMDPC	Cylinder, 20mm bore x 75mm stroke guided	2	SMC
3	AA1000925	Plate, wheel lifting	1	Arnold
4	AA1000927	Bracket, wheel presence sensor	1	Arnold
5	LR-ZH490CB	Sensor, distance based laser	1	Keyence
6	AA1000928	Bracket, Right hand cylinder mounting	1	Arnold
7	AA1000929	Bracket, Left hand cylinder mounting	1	Arnold
8	NCDMB044-0600C-M9BWVMDPC	Cylinder, 7/16 bore x 6" stroke pneumatic	2	SMC
9	AA1000930	Plate, pusher connection	2	Arnold
10	AA1000931	Block, Right hand wheel pusher	1	Arnold
11	AA1000932	Block, Left hand wheel pusher	1	Arnold
12	90985A112	Quick-Release Pin, 1/4 x 1"	2	McMaster
13	AA1000935	Bracket, Upper part removal ramp	1	Arnold
14	AA1000936	Frame, Part removal ramp	1	Arnold
15	PP422 MODULE	Segment, two-row roller guide	12	Pobco
16	Wheel sensor spacer	Wheel sensor spacer	1	Arnold



10" Wheel arrangement

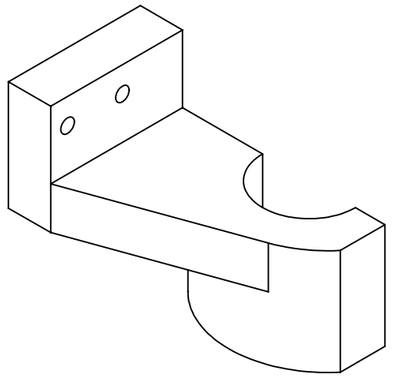
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL± 1/16 ANGULAR: MACH± 1° BEND ± 3° TWO PLACE DECIMAL ±0.030 THREE PLACE DECIMAL ±0.005	DRAWN	K. McHenry	7/1/2020
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		INTERPRET GEOMETRIC TOLERANCING PER:	COMMENTS:		
		MATERIAL -			
NEXT ASSY	USED ON	FINISH N/A			
APPLICATION		DO NOT SCALE DRAWING			

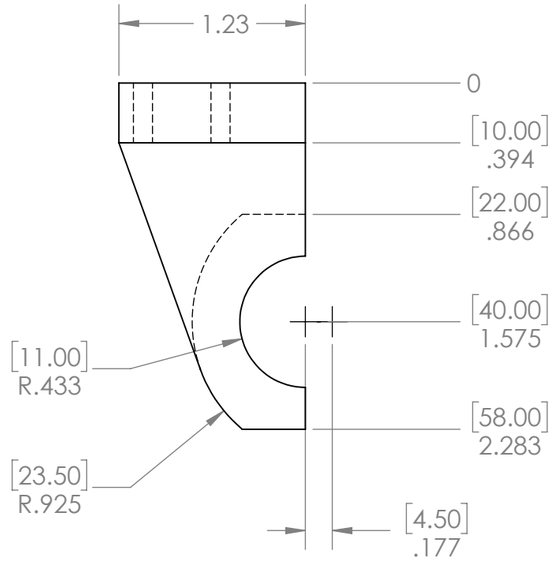
TITLE:

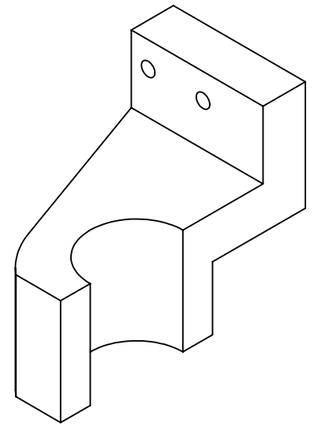
SA Wheel ejection

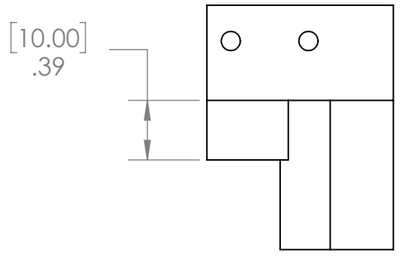
SIZE	DWG. NO.	REV
B	AA1000893	A

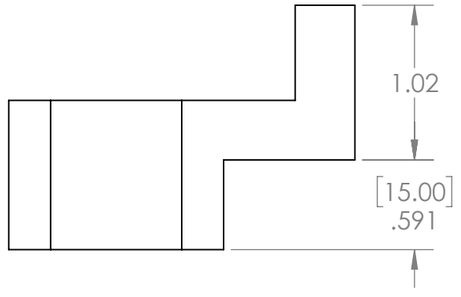
SCALE: 1:4	WEIGHT: -	SHEET 2 OF 2

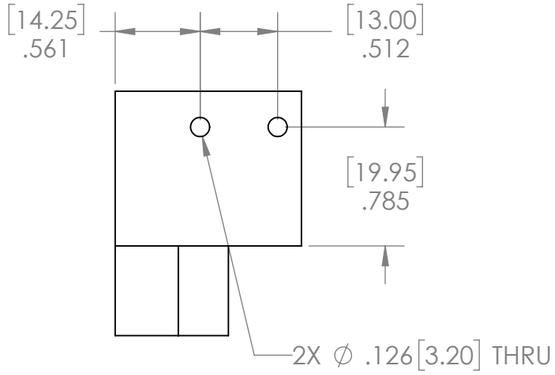


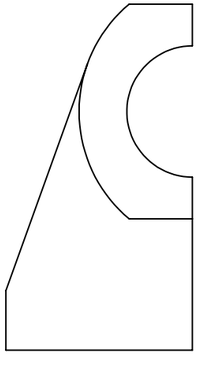












NOTES:
1. Break all sharp edges.
2. Can be produced in combination with AA1000898.

ARNOLD AUTOMATION

NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL: 6060-T6

FINISH: N/A

DO NOT SCALE DRAWING

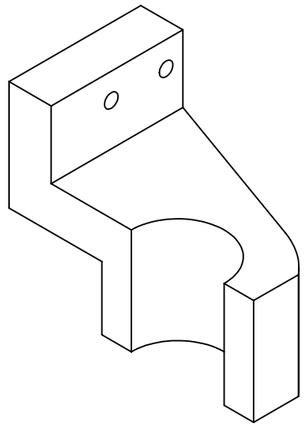
	NAME	DATE
DRAWN	K. McHenry	6/23/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

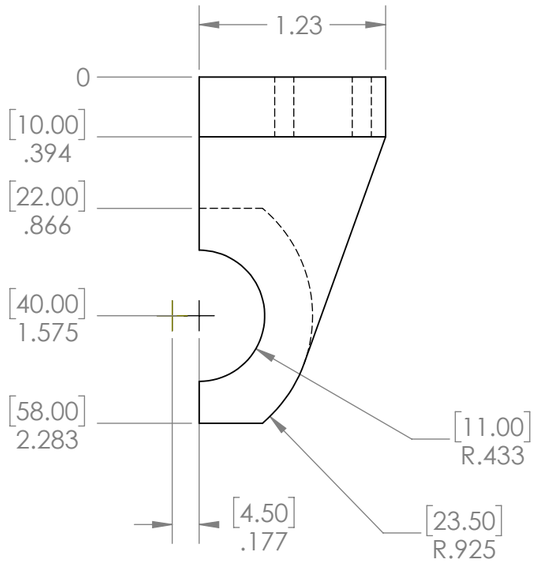
COMMENTS:

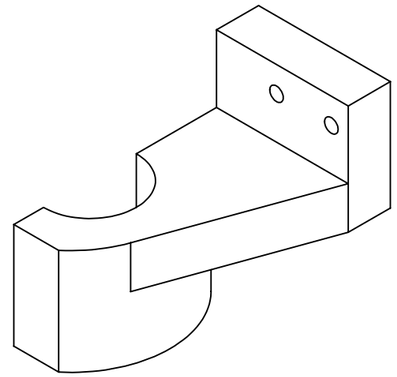
TITLE:
Finger, Right side Large wheel gripper

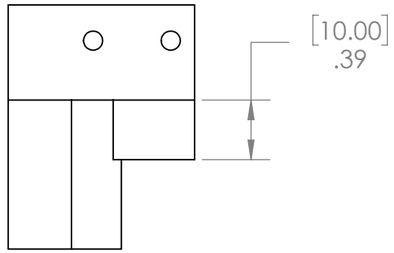
SIZE	DWG. NO.	REV
B	AA1000897	A

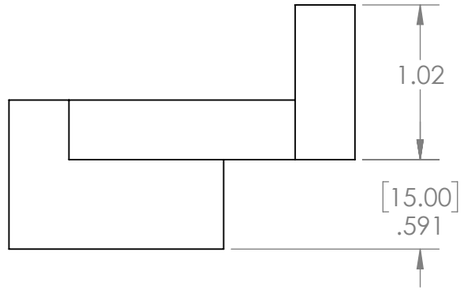
SCALE: 1:1 | WEIGHT: - | SHEET 1 OF 1

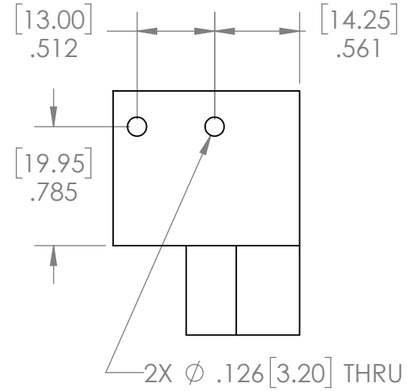


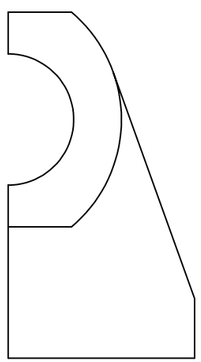












NOTES:
1. Break all sharp edges.
2. Can be produced in combination with AA1000897.

ARNOLD AUTOMATION

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL: 6060-T6

FINISH: N/A

DO NOT SCALE DRAWING

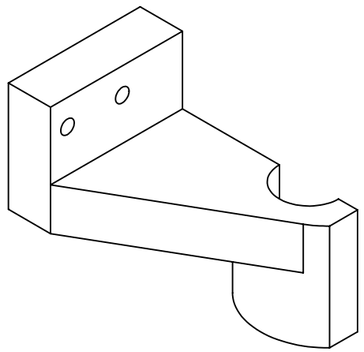
	NAME	DATE
DRAWN	K. McHenry	6/24/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

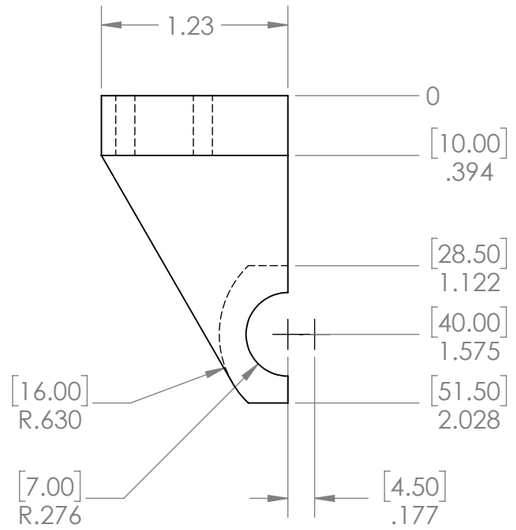
COMMENTS:

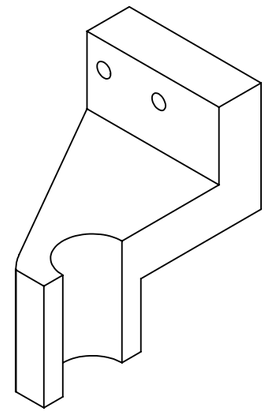
TITLE:
Finger, Left side Large wheel gripper

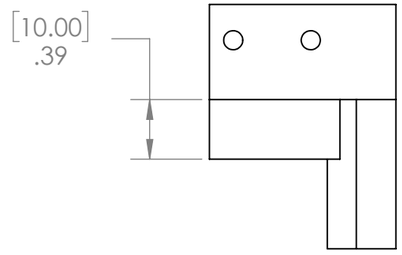
SIZE	DWG. NO.	REV
B	AA1000898	A

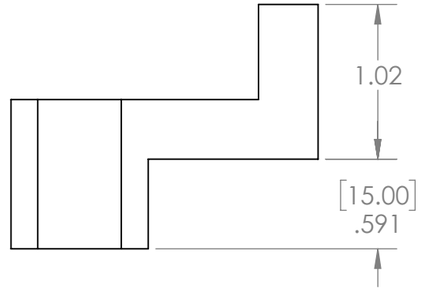
SCALE: 1:1 | WEIGHT: - | SHEET 1 OF 1

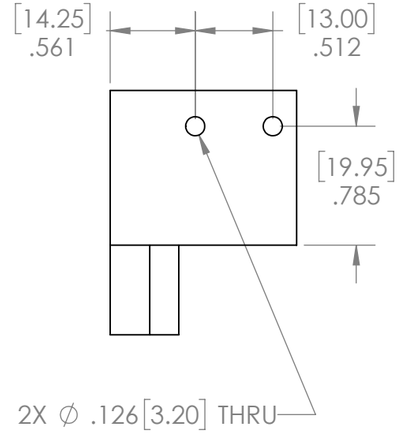


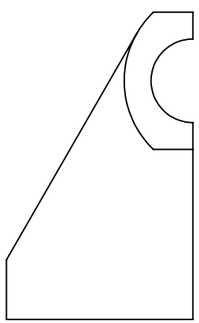












NOTES:
1. Break all sharp edges.
2. Can be produced in combination with AA1000900.

ARNOLD AUTOMATION

NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL: 6061-T6

FINISH: N/A

DO NOT SCALE DRAWING

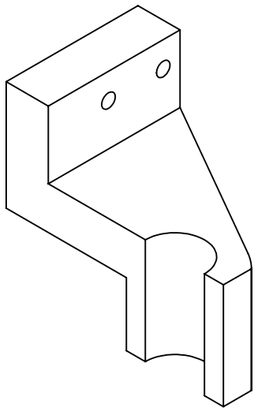
	NAME	DATE
DRAWN	K. McHenry	6/24/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

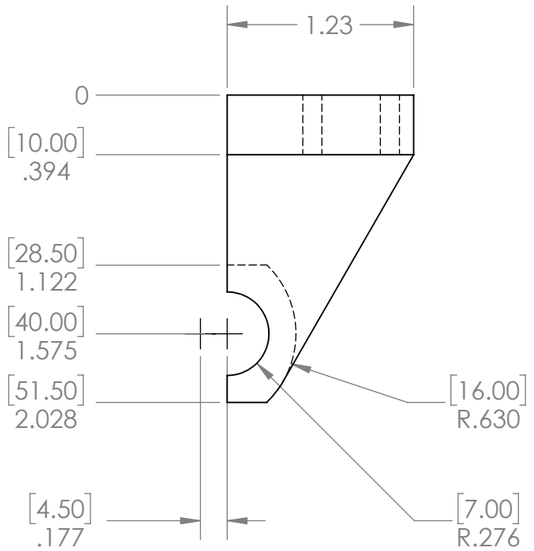
COMMENTS:

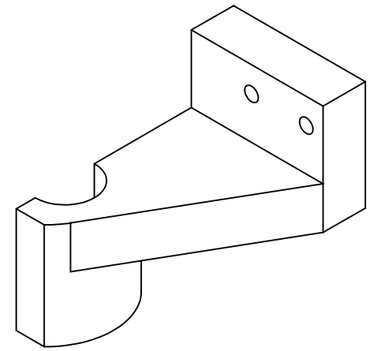
TITLE:
Finger, Right side small wheel gripper

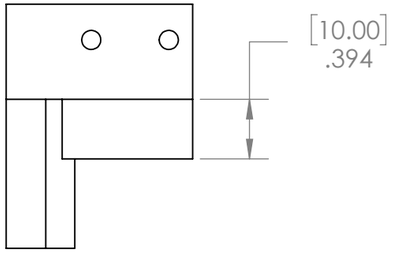
SIZE	DWG. NO.	REV
B	AA1000899	A

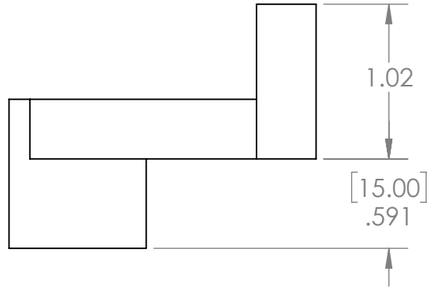
SCALE: 1:1 | WEIGHT: - | SHEET 1 OF 1

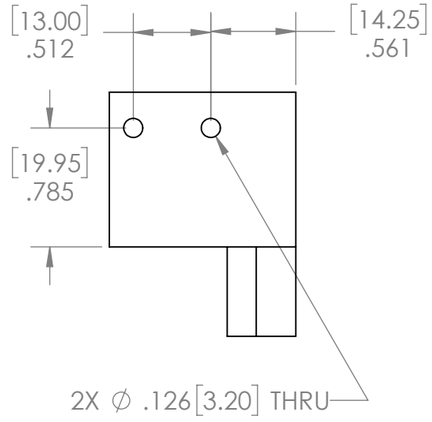


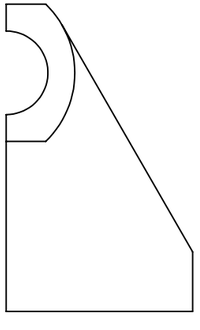












NOTES:
1. Break all sharp edges.
2. Can be produced in conbination with AA1000899.

ARNOLD AUTOMATION

NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
6061-T6

FINISH
N/A

DO NOT SCALE DRAWING

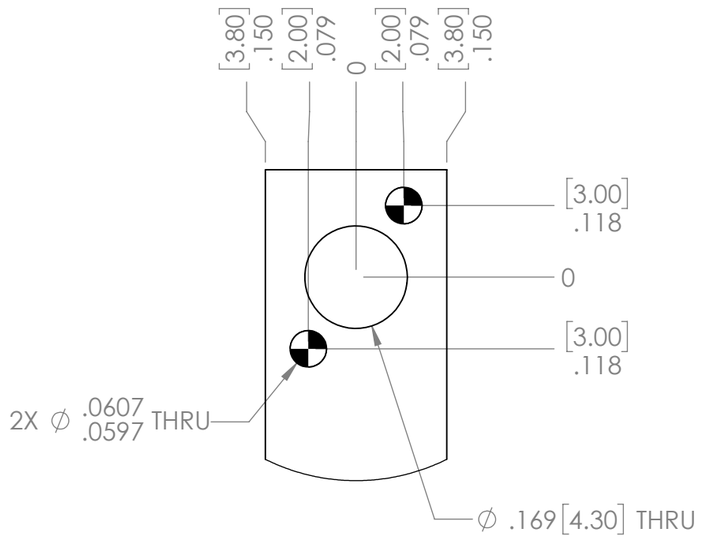
	NAME	DATE
DRAWN	K. McHenry	6/24/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

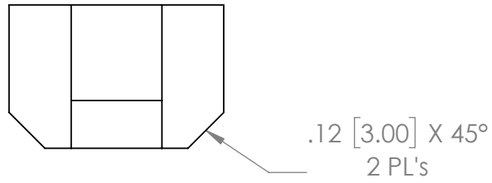
TITLE:
Finger, Left side small wheel gripper

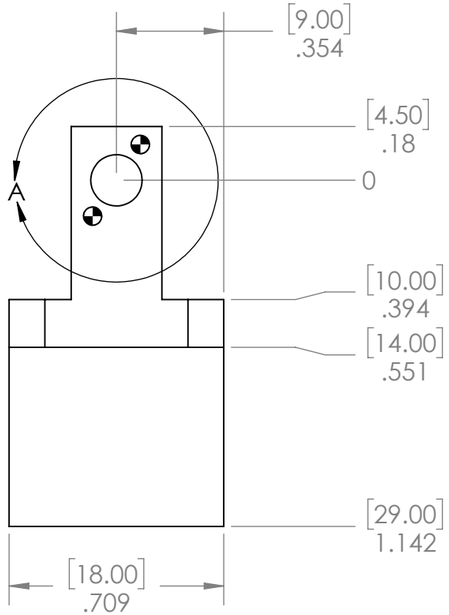
SIZE	DWG. NO.	REV
B	AA1000900	A

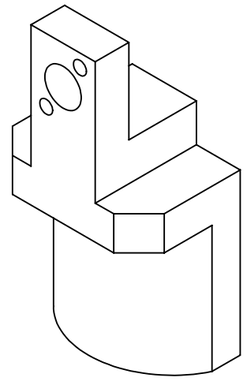
SCALE: 1:1 | WEIGHT: - | SHEET 1 OF 1

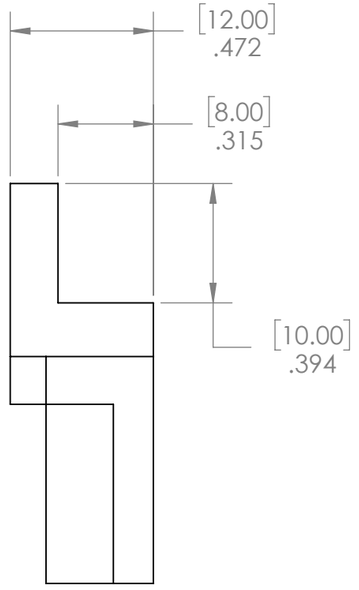


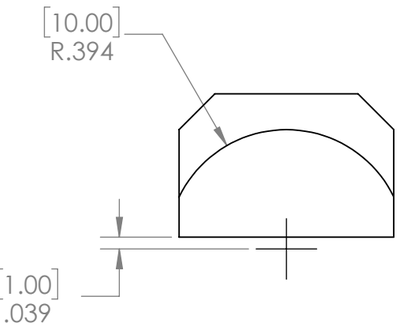
DETAIL A
SCALE 4 : 1











NOTES:
1. Break all sharp edges.

ARNOLD AUTOMATION

		UNLESS OTHERWISE SPECIFIED:
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± 1° BEND ± 3° TWO PLACE DECIMAL ±0.030 THREE PLACE DECIMAL ±0.005
		INTERPRET GEOMETRIC TOLERANCING PER:
		MATERIAL 6061-T6
NEXT ASSY	USED ON	FINISH N/A
APPLICATION		DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	6/24/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

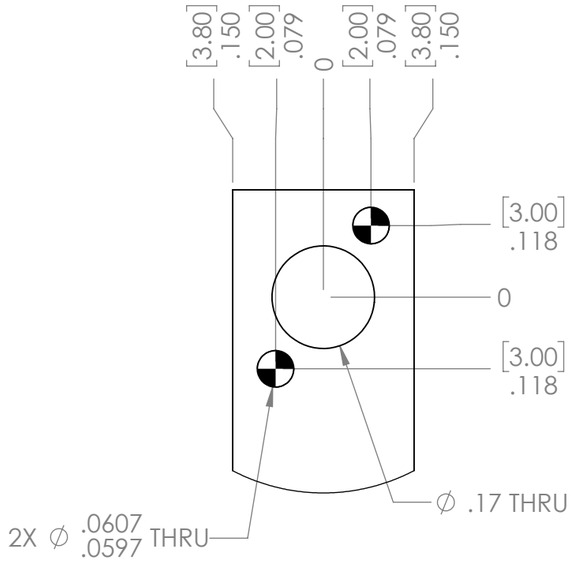
COMMENTS:

TITLE:

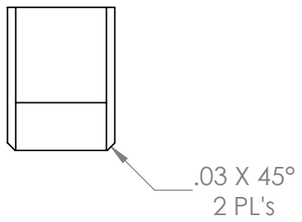
Finger, large bearing gripper

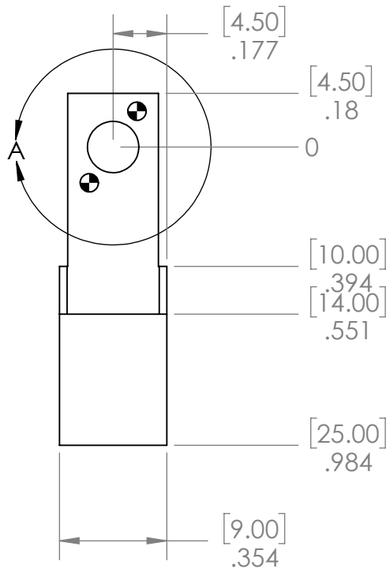
SIZE	DWG. NO.	REV
B	AA1000901	A

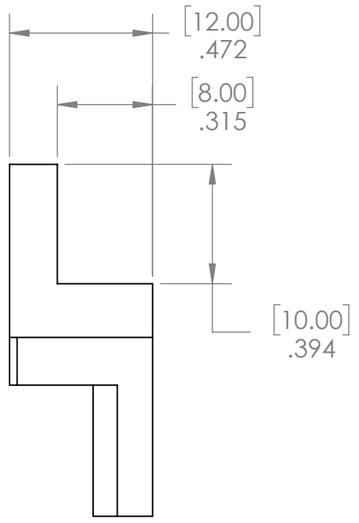
SCALE: 2:1 | WEIGHT: - | SHEET 1 OF 1

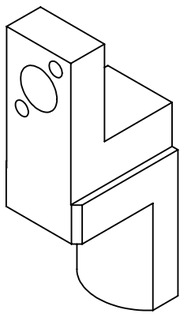


DETAIL A
SCALE 4 : 1

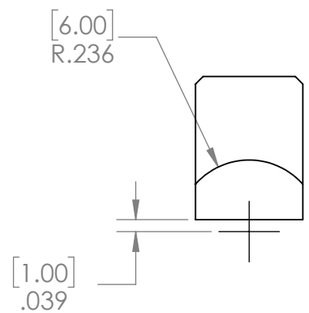








NOTES:
1. Break all sharp edges.



ARNOLD AUTOMATION

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1° BEND ± 3°
TWO PLACE DECIMAL ±0.030
THREE PLACE DECIMAL ±0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
6061-T6

FINISH
N/A

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	K. McHenry	6/24/2020
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

TITLE:
Finger, Small bearing gripper

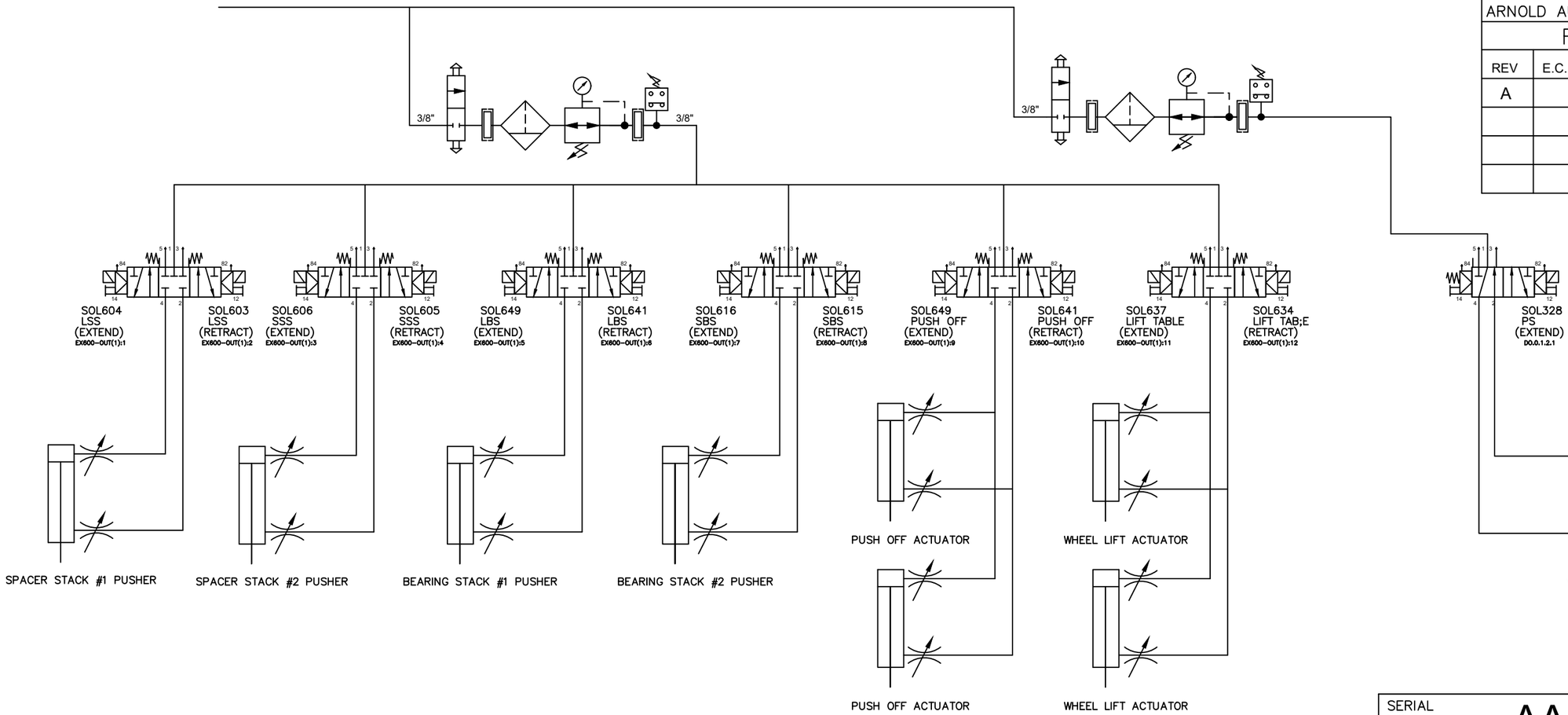
SIZE	DWG. NO.	REV
B	AA1000902	A

SCALE: 2:1 | WEIGHT: - | SHEET 1 OF 1

ELECTRICAL DRAWINGS

REVISIONS

REV	E.C.N.#	APPROVAL	DATE
A			



MATERIAL: --------	ENGR: K.McHENRY 5/2020
FINISH: --------	ELEC: W. Saumenig 5/2020
2 PL. DEC. ---	MECH:
3 PL. DEC. ---	LAYOUT:
ANGLES ± ---	DWG/DOC:
DO NOT SCALE DRAWING	APPVD/CHECKED:

DIMENSIONS IN INCHES (MM)
TOLERANCES ANSI-Y14.5M

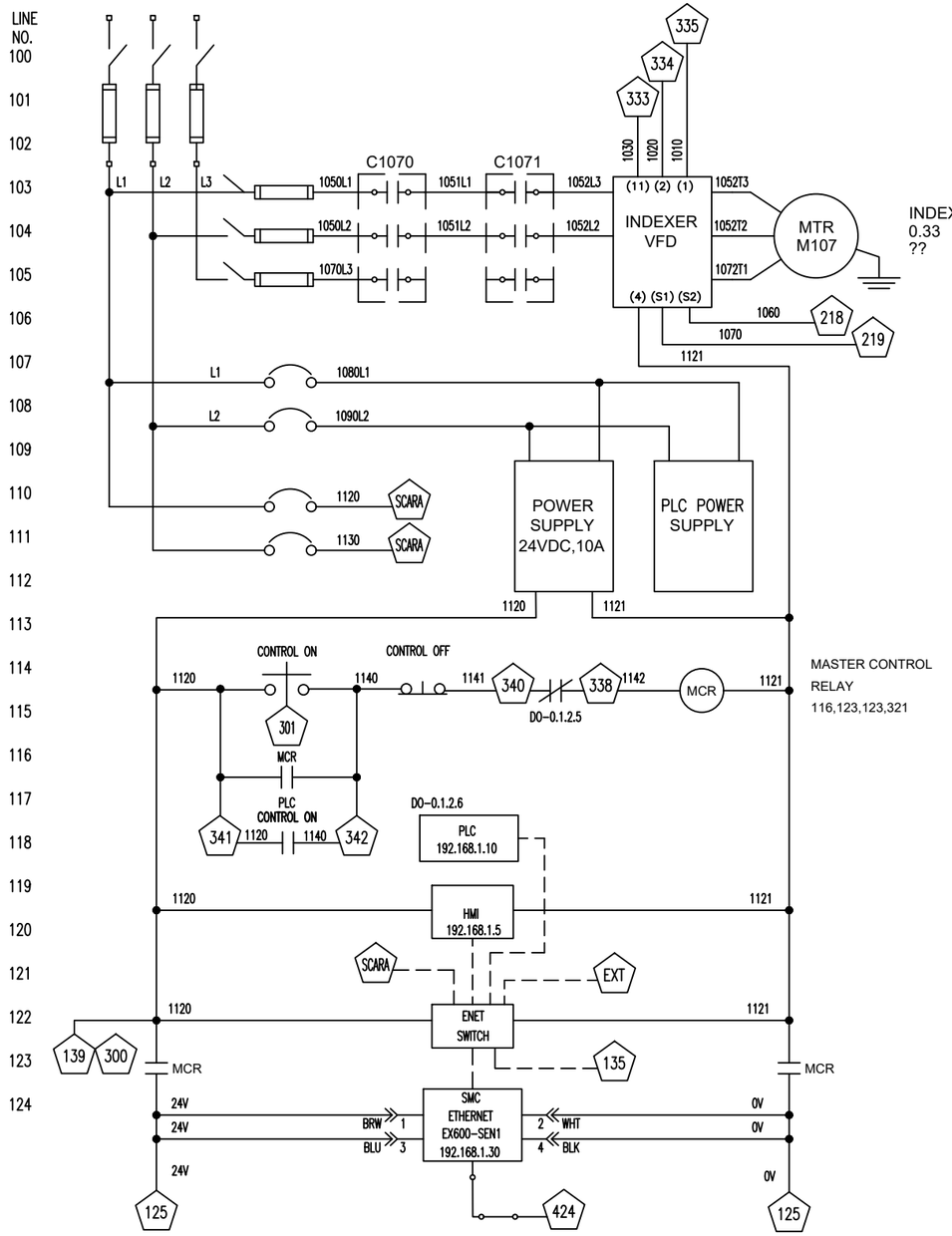
SERIAL NO. AA1008

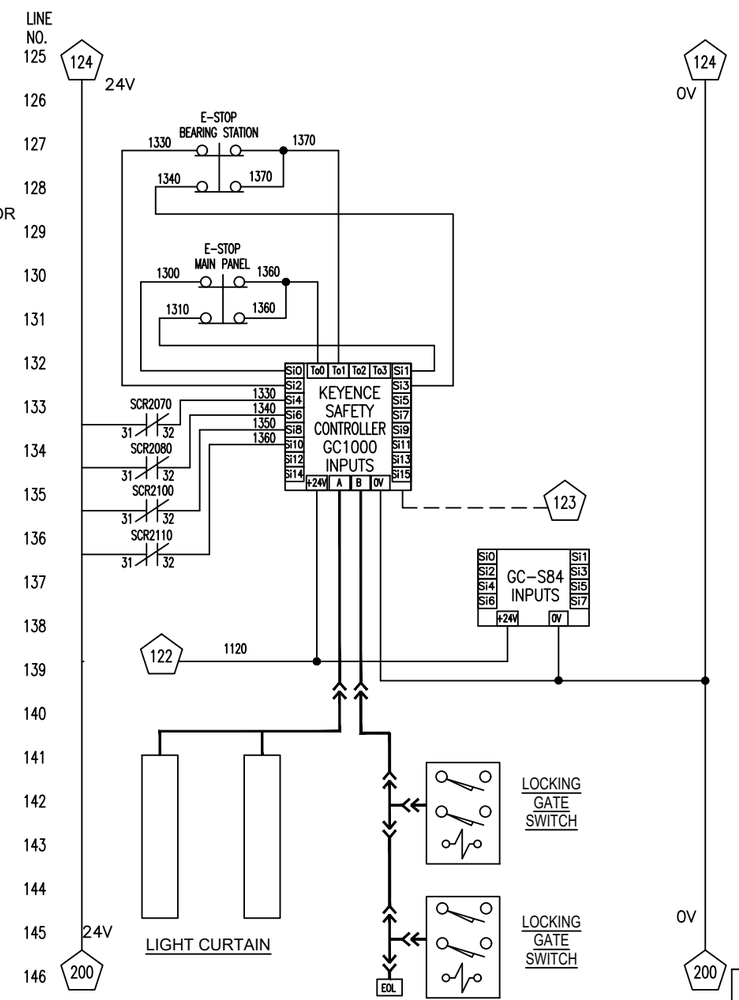
Automation ARNOLD AUTOMATION

ELSCO PNEUMATIC SCHEMATIC

DWG. NO. AA1000886-PNEU REV 1

SIZE: | SCALE NONE | SHEET 1 OF 1





REVISIONS

REV	E.C.N.#	APPROVAL	DATE
A			

MATERIAL: --------	ENGR: K. McHenry
FINISH: --------	ELEC: W. Saumenig
2 PL. DEC. ---	MECH:
3 PL. DEC. ---	LAYOUT:
ANGLES ± ---	DWG/DOC:
DO NOT SCALE DRAWING	APPVD/CHECKED:

DIMENSIONS IN INCHES (MM)
TOLERANCES ANSI-Y14.5M

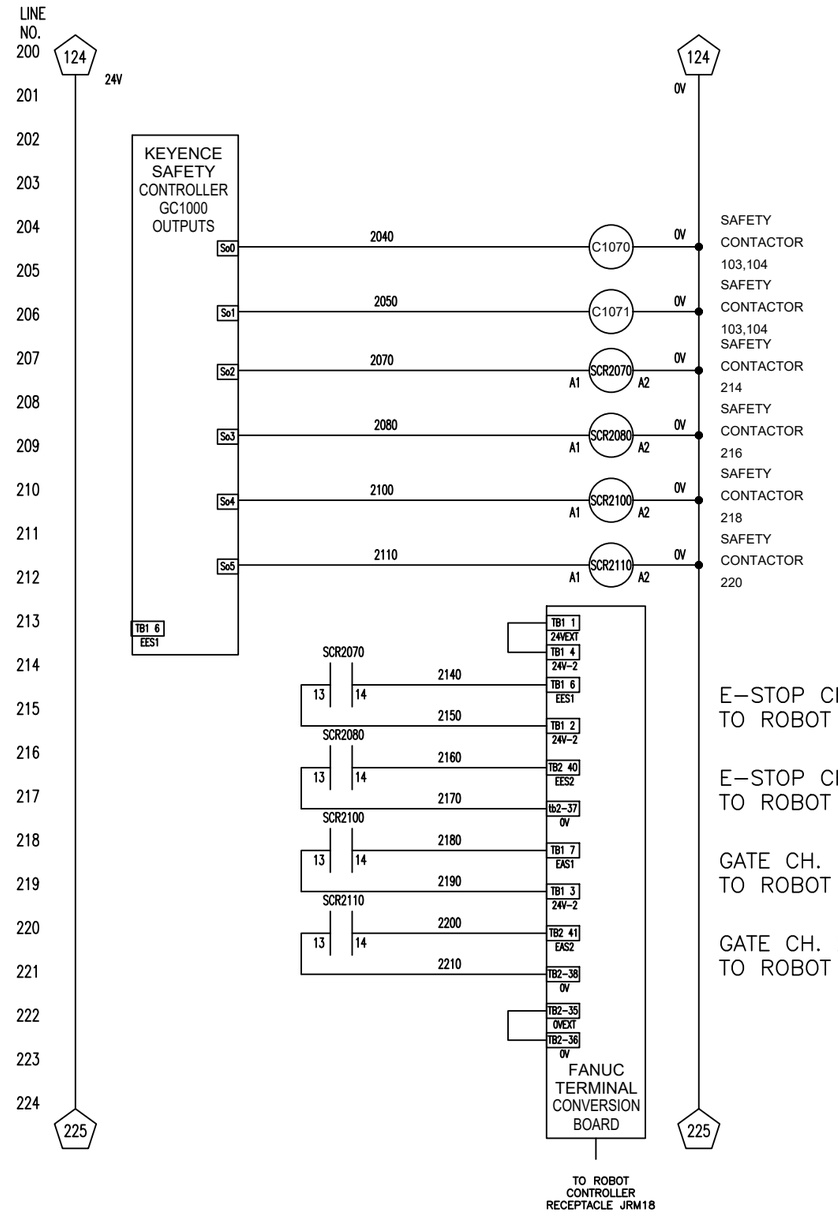
SERIAL NO. AA1006

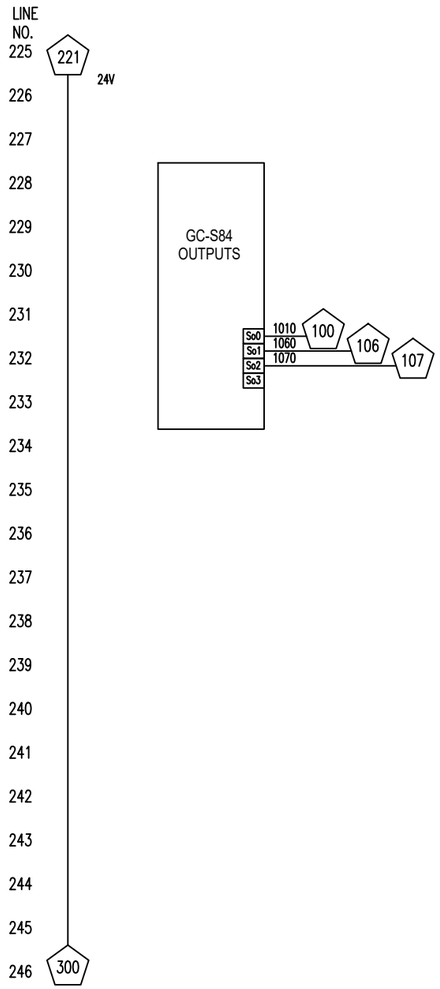
Automation ARNOLD AUTOMATION

SCHEMATIC DIAGRAM ELSCO

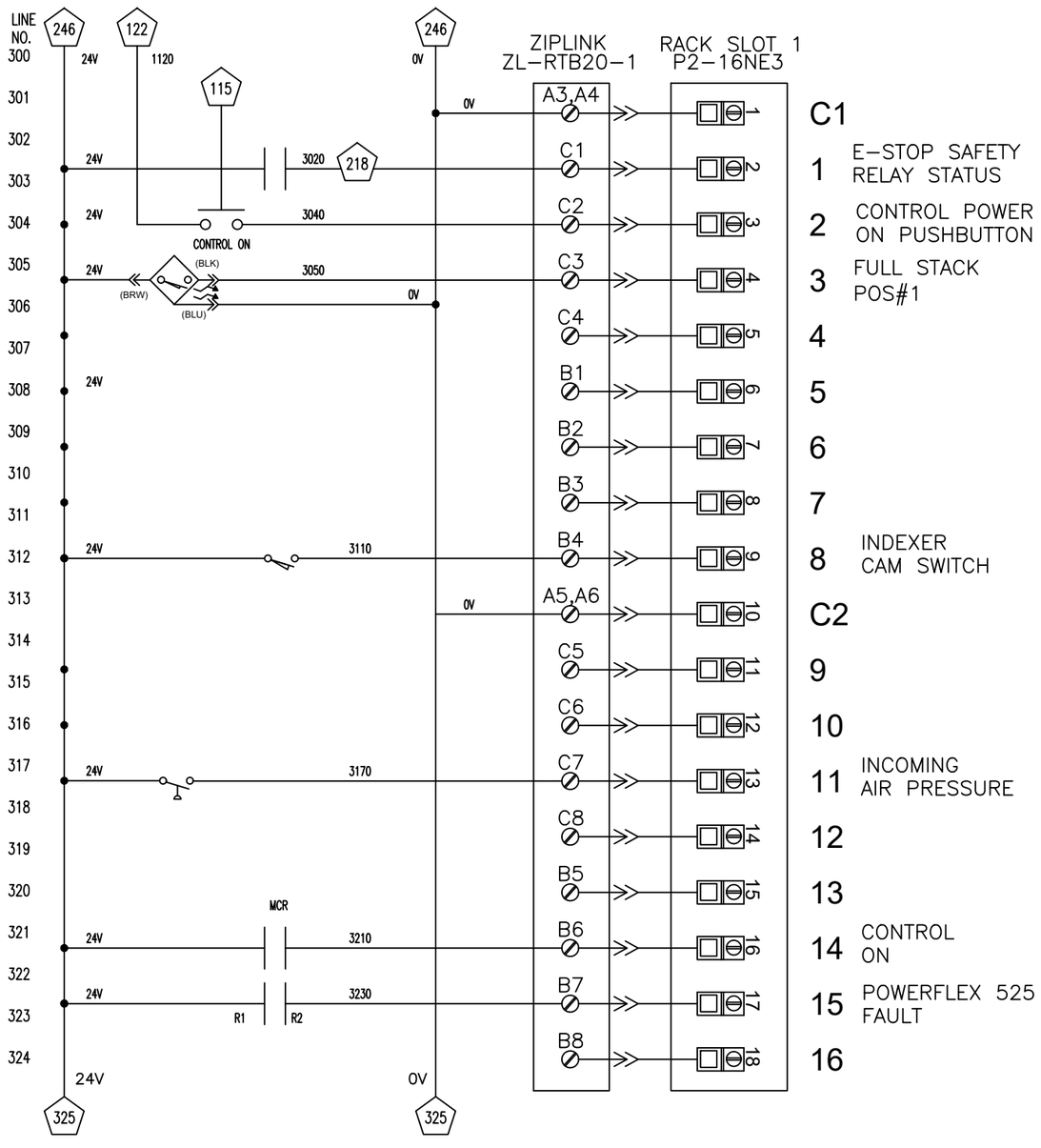
DWG. NO. AA1000886-SCHEM REV 1

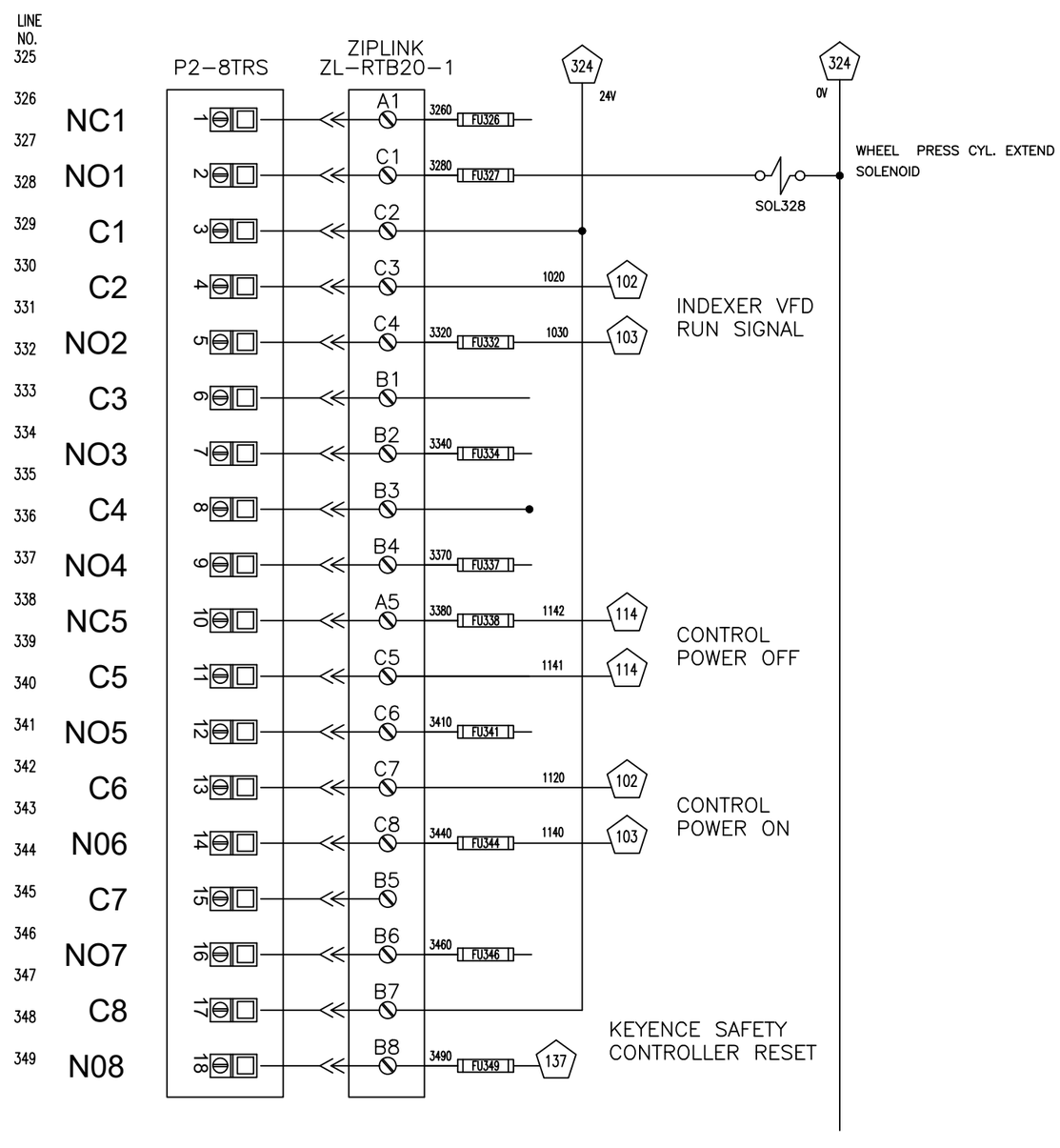
SIZE: | SCALE | SHEET 1 OF 7



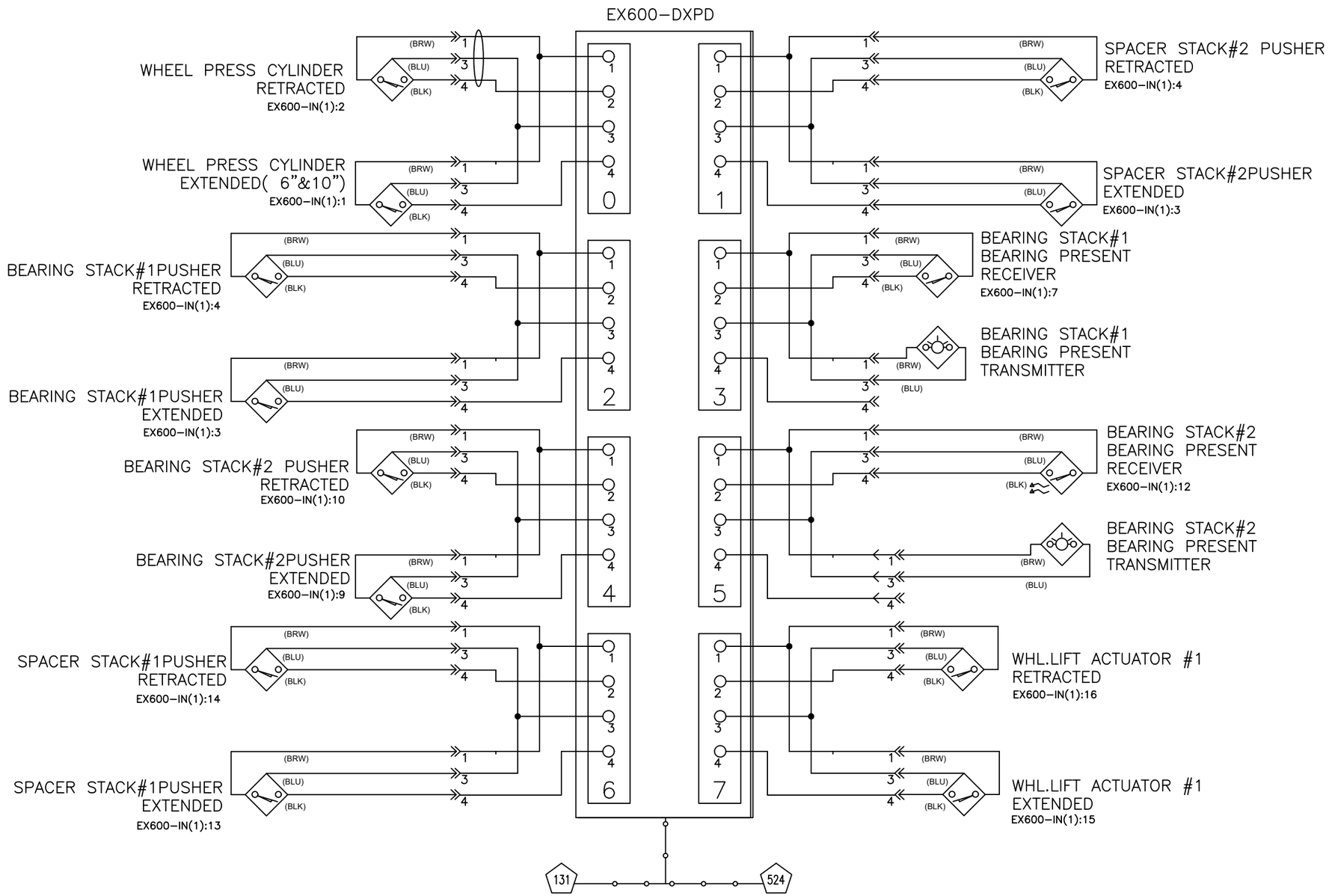


DRAWING NO.	AA1000886	REV
		1
SIZE: B	SCALE N/A	SHEET 2

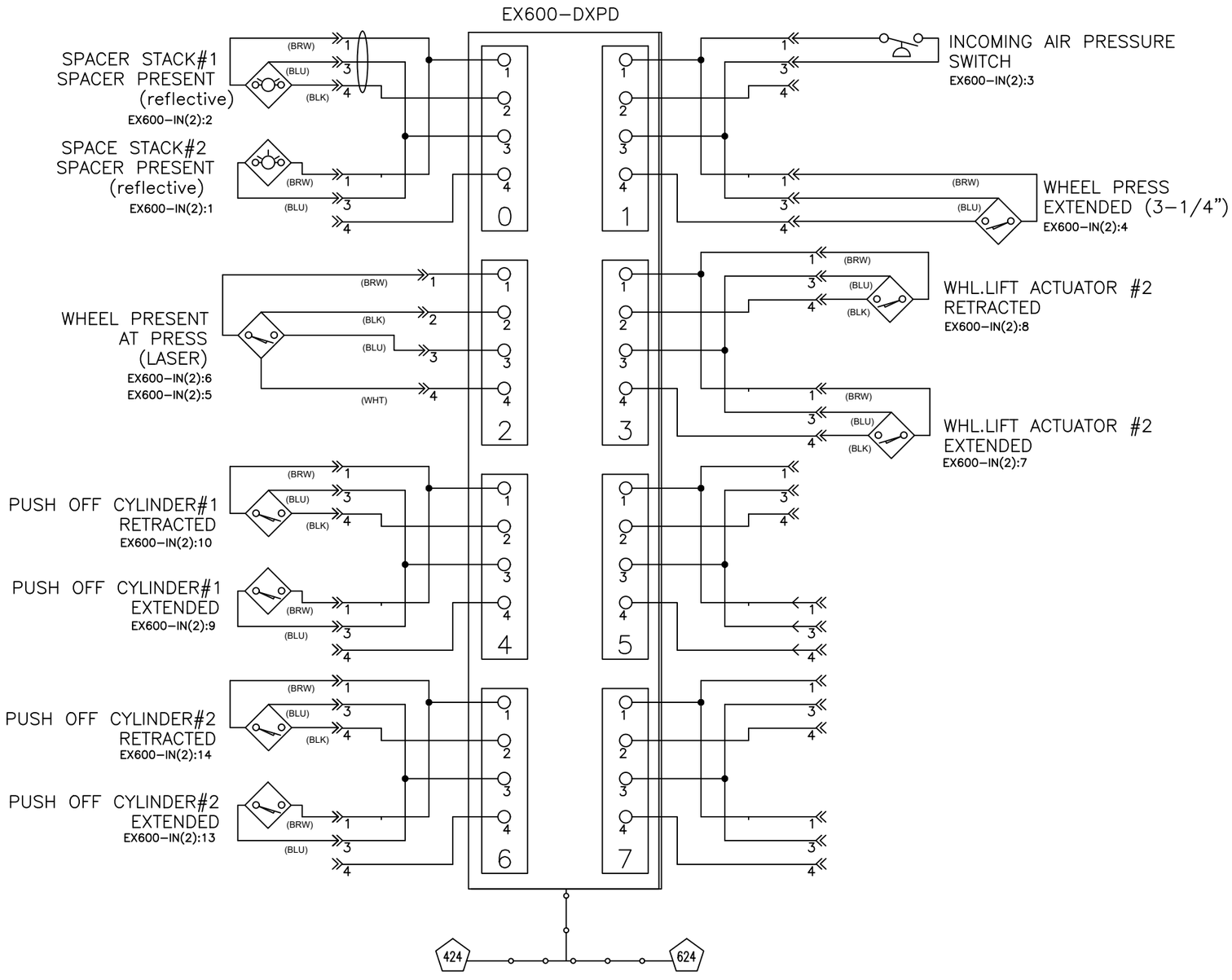




DRAWING NO. AA1000886-SCHEM			REV 1
SIZE: B	SCALE N/A	SHEET 3	



DRAWING NO.	AA1000886-SCHEM	REV
SIZE: B	SCALE N/A	SHEET 4



DRAWING NO.	AA1000886-SCHEM	REV
SIZE: B	SCALE N/A	SHEET 5

LINE NO.

EX600–SEN1

SPCR. STCK. 1 PUSHER RETRACT SOLENOID
EX600–OUT(1):2
SOL603

SPCR. STCK. 1 PUSHER EXTEND SOLENOID
EX600–OUT(1):1
SOL604

SPCR. STCK. 2 PUSHER RETRACT SOLENOID
EX600–OUT(1):4
SOL605

SPCR. STCK. 2 PUSHER EXTEND SOLENOID
EX600–OUT(1):3
SOL606

BRG. STCK. 2 PUSHER RETRAT SOLENOID
EX600–OUT(1):8
SOL615

BRG. STCK. 2 PUSHER EXTEND SOLENOID
EX600–OUT(1):7
SOL616

PUSH OFF CYLS. RETRACT SOLENOID
EX600–OUT(1):10
SOL628

PUSH OFF CYLS. EXTEND SOLENOID
EX600–OUT(1):9
SOL632

WHEEL LIFT ACT. RETRACT SOLENOID
EX600–OUT(1):12
SOL634

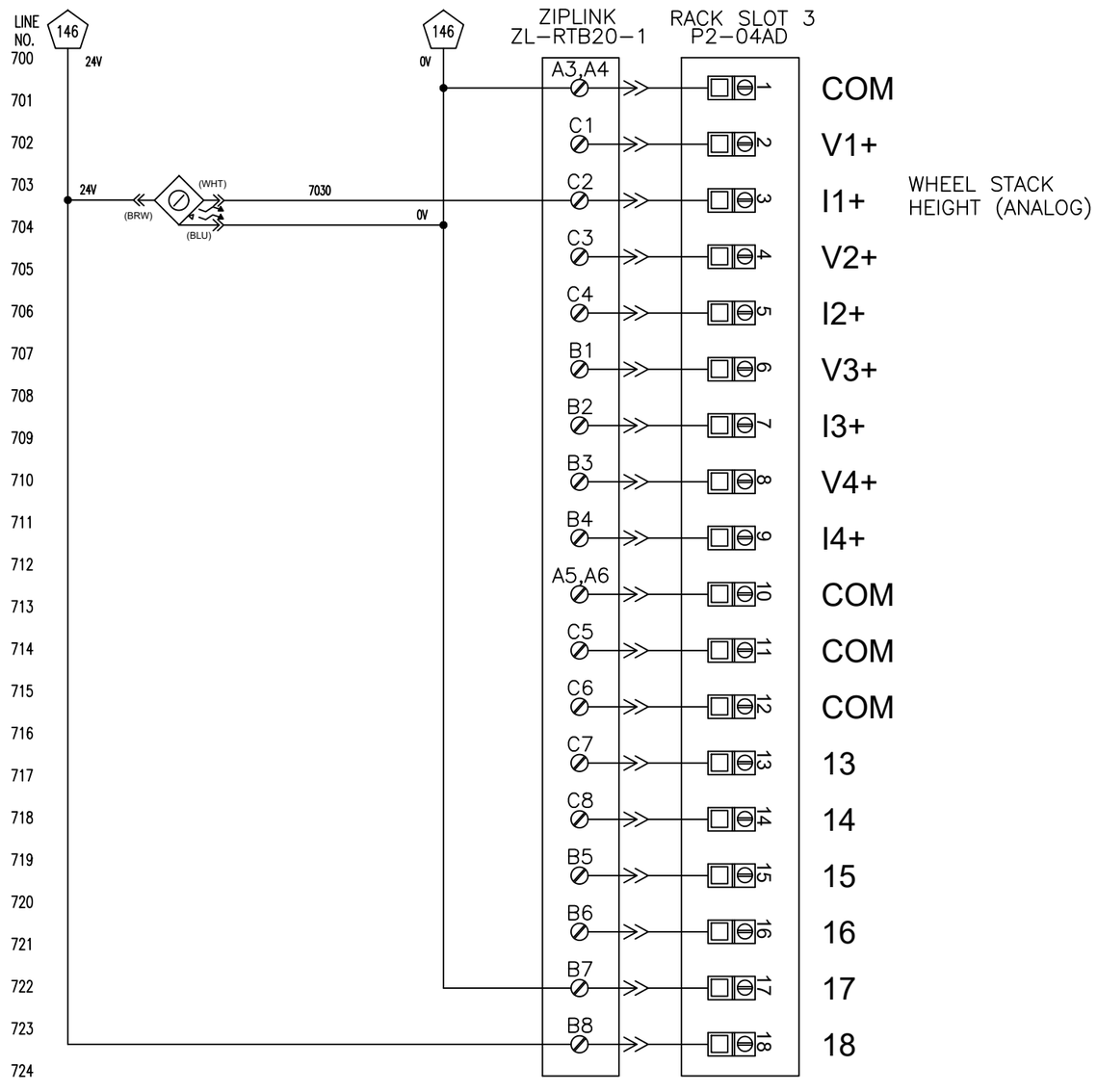
WHEEL LIFT ACT. EXTEND SOLENOID
EX600–OUT(1):11
SOL637

BRG. STCK. 1 PUSHER RETRACT SOLENOID
EX600–OUT(1):6
SOL641

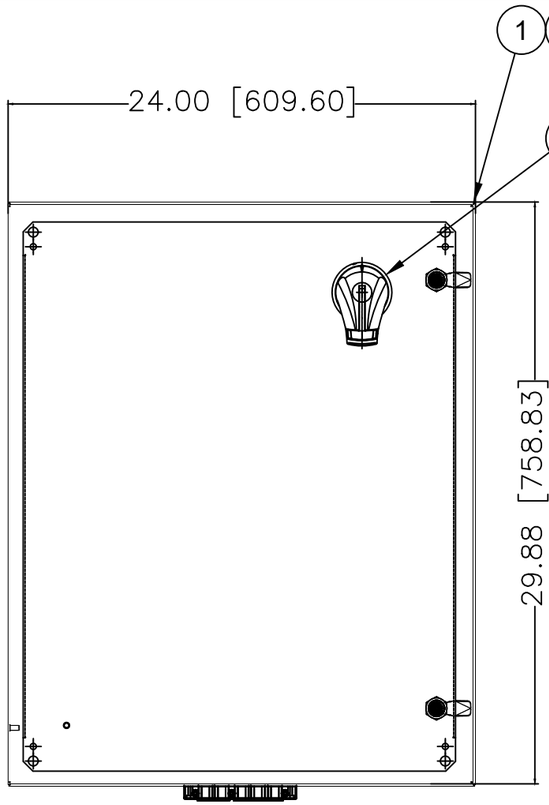
BRG. STCK. 1 PUSHER EXTEND SOLENOID
EX600–OUT(1):5
SOL649

524

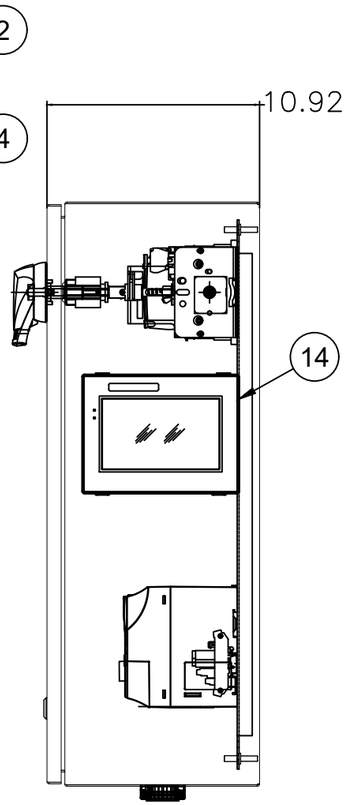
DRAWING NO.	AA1000886–SCHEM	REV
SIZE: B	SCALE N/A	SHEET 6



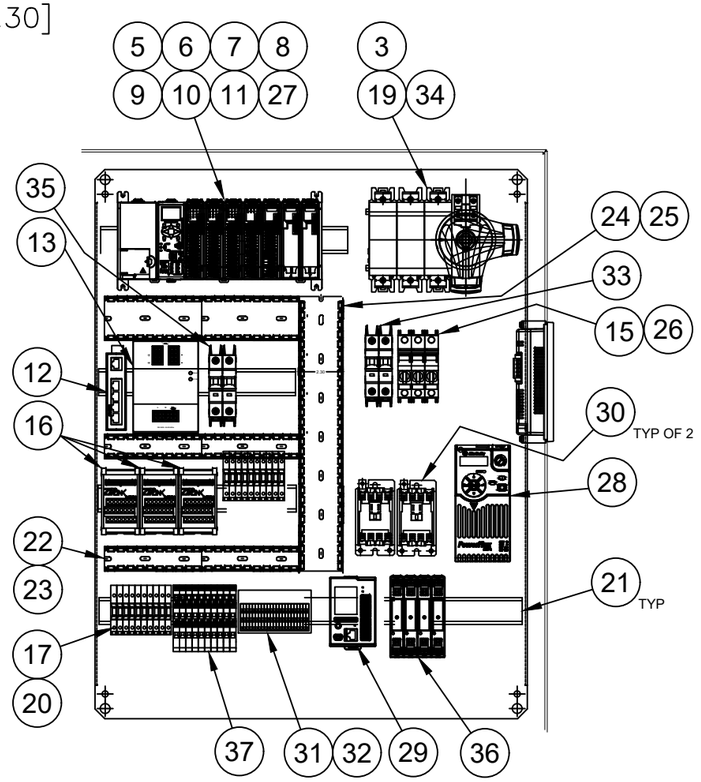
DRAWING NO.	AA1000886-SCHEM	REV
		1
SIZE: B	SCALE N/A	SHEET 7



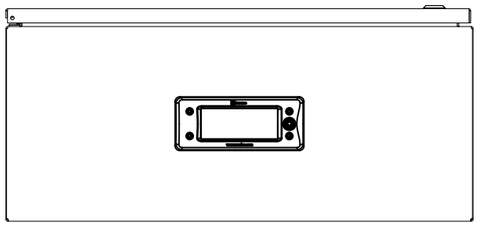
FRONT ELEVATION



SIDE ELEVATION



PANEL



BOTTOM VIEW

ENCLOSURE DETAILS

REVISIONS

REV	E.C.N.#	APPROVAL	DATE
A			

MATERIAL:	--------
FINISH:	--------
2 PL. DEC.	---
3 PL. DEC.	---
ANGLES ±	---
DO NOT SCALE DRAWING	

ENGR:	K. McHenry	6/2020
ELEC:	W. Saumenig	6/2020
MECH:		
LAYOUT:		
DWG/DOC:		
APPVD/CHECKED:		

DIMENSIONS IN INCHES (MM)
TOLERANCES ANSI–Y14.5M

SERIAL NO. AA1006

Automation ARNOLD AUTOMATION

ELSCO WHEEL ASSEMBLER
ELECTRICAL ENCLOSURE

DWG. NO. AA1000886 REV 1

SIZE: | SCALE NONE | SHEET 1 OF 2

BILL OF MATERIALS

MK. NO.	SCHEMATIC DESIGNATION	QTY. REQ'D.	ARNOLD PT. NO.	DESCRIPTION	MANUFACTURER	MFG. NO.
1		1	N412302410CLG	ENCLOSURE, 30 X 24 X 10, NEMA 12	HUBBELL WEIGMANN	N412302410CLG
2		1	NP3024C	SUBPANEL, CARBON STEEL	HUBBELL WEIGMANN	NP3024
3		1	38613004	ROTARY DISCONNECT, 30A, 600V, CLASS J FUSING	SOCOMEC	38613004
4		1	141E2911	HANDLE, DISCONNECT, NEMA 4, RED/YELLOW	SOCOMEC	141E2911
5		1	P2-550	CPU, PRODUCTIVITY 2000	AUTOMATION DIRECT	P2-550
6		1	P2-01AC	POWER SUPPLY, BASE, PRODUCTIVITY 2000, 120/240VAC IN	AUTOMATION DIRECT	P2-01AC
7		1	P2-01AC	BASE, 7 SLOT. PRODUCTIVITY 2000	AUTOMATION DIRECT	P2-07B
8		1	P2-16NE3	INPUT MODULE, DISCREET, 16 PT, 24 VAC/VDC, SNK/SRC	AUTOMATION DIRECT	P2-16NE3
9		1	P2-16TR	OUTPUT MODULE, RELAY, 16 PT,	AUTOMATION DIRECT	P2-16TR
10		1	P2-04AD	INPUT MODULE, ANALOG, 4 CHANNEL	AUTOMATION DIRECT	P2-04AD
11		4	P2-FILL	FILLER MODULE	AUTOMATION DIRECT	P2-FILL
12		1	SE2-SW5U	ETHERNET SWITCH, 5 PORT, UNMANAGED	AUTOMATION DIRECT	SE-SW5U
13		1	PSB24-240	POWER SUPPLY, 24VDC, 10 A	AUTOMATION DIRECT	PSB24-240
14		1	EA9-T7CL-R	HMI, 7 INCH, COLOR, TOUCH SCREEN	AUTOMATION DIRECT	EA9-T7CL-R
15		1	CFS-3PM30	DISCONNECT SWITCH FUSED,30A	AUTOMATION DIRECT	CFS-3PM30
16		3	ZL-RTB20-1	ZIPLINK FEED THRU MODULE	AUTOMATION DIRECT	ZL-RTB20-1
17		10	KN-F10-10	FUSE TERMINAL POINT	AUTOMATION DIRECT	KN-F10
18		3	ZL-P2-CBL18-1	ZIPLINK CABLE, 1M	AUTOMATION DIRECT	ZL-P2-CBL18-1
19		3	JDL30	FUSE, TYPEJ, 30 AMP	EDISON FUSE	JDL30
20		16	GMC2	FUSE, GLASS, 5 X 20MM, 2 AMP, 250VAC, TIME DELAY	BUSSMAN	GMC2
21		39 IN	70301005	DIN RAIL		
22		36 IN	F1X2LG6	WIRNG DUCT, 1 X 2	PANDUIT	F1X2LG6
23		36 IN	C1LG6	WIRING DUCT COVER, 1 IN.	PANDUIT	C1LG6
24		36 IN	G2X2LG6	WIRNG DUCT, 2 X 2	PANDUIT	G2X2LG6
25		36 IN	C2LG6	WIRING DUCT COVER, 2 IN.	PANDUIT	C2LG6
26		3		FUSE, MIDGET, TBD AMP		
27		1	P2-07B	BASE UNIT, 7 SLOT, PRODUCTIVITY 2000	AUTOMATION DIRECT	P2-07B
28		1	25B-B2P5N104	VARIABLE FREQUENCY DRIVE, POWRFLEX 525	ROCKWELL	25B-B2P5N104
29		1	GC 1000	SAFETY CONTROLLER	KEYENCE	GC 1000
30		2	AFS09Z-30-22-30	SAFETY CONTACTOR, 9A, 24VDC COIL	ABB	AFS09Z-30-22-30
31		1	A05B-2690-K440	TERMINAL CONVERSION MODULE	FANUC	A05B-2690-K440
32		1	A05B-2690-K430	PREIPHERAL DEVICE CABLE K30, 1m	FANUC	A05B-2690-K430
33		1	FAZ-C10-2-NA-L	BREAKER, 2P, 10A, C CURVE, 240VAC/96VDC, UL489	AUTOMATION DIRECT	FAZ-C10-2-NA-L
34		1	14001020	SHAFT, DISCONNECT, 200MM	SOCOMEC	14001020
35		1	FAZ-C16-2-NA-L	BREAKER, 2P, 16A, C CURVE, 240VAC/96VDC, UL489	AUTOMATION DIRECT	FAZ-C16-2-NA-L
36		4	HC3906N-52-900-24	RELAY W/ SKT., FORCE GUIDED, 2NO/2NC SP, 24VDC COIL	AUTOMATION DIRECT	HC3906N-52-900-24
37		10	KN-TL14	TERMINAL BLOCK, 3 HIGH FEED THROUGH	AUTOMATION DIRECT	KN-TL14
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DRAWING NO.	AA1000886	REV
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SIZE: B	SCALE N/A	SHEET 2

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APPENDICES

Keyence LR-ZH Series Instruction Manual
Keyence LR-TB5000 Series Instruction Manual
Keyence G L-R Series -Safety Light Curtain Instruction Manual
Keyence GS (Lock) Safety Interlocking Switch Instruction Manual
Keyence PR-M/F Instruction Manual