



GRAND VALLEY
STATE UNIVERSITY
SCHOOL OF ENGINEERING

Team 20: Swoboda

Winton Recycler Automation



Lance Deemter
Sponsor Correspondent



Crystal Kinney
Faculty Correspondent

Meet the Team



Aziz Gram Sarhan Jr.
Team Captain



Daniel Weller
Secretary



Jordan Hayes
Floater



What is the problem?

Without Disassembling
Whole Scrap Part =
\$0.30/lb of scrap parts

With Disassembling
Overmolded coil alone =
\$1.50/lb of scrap parts



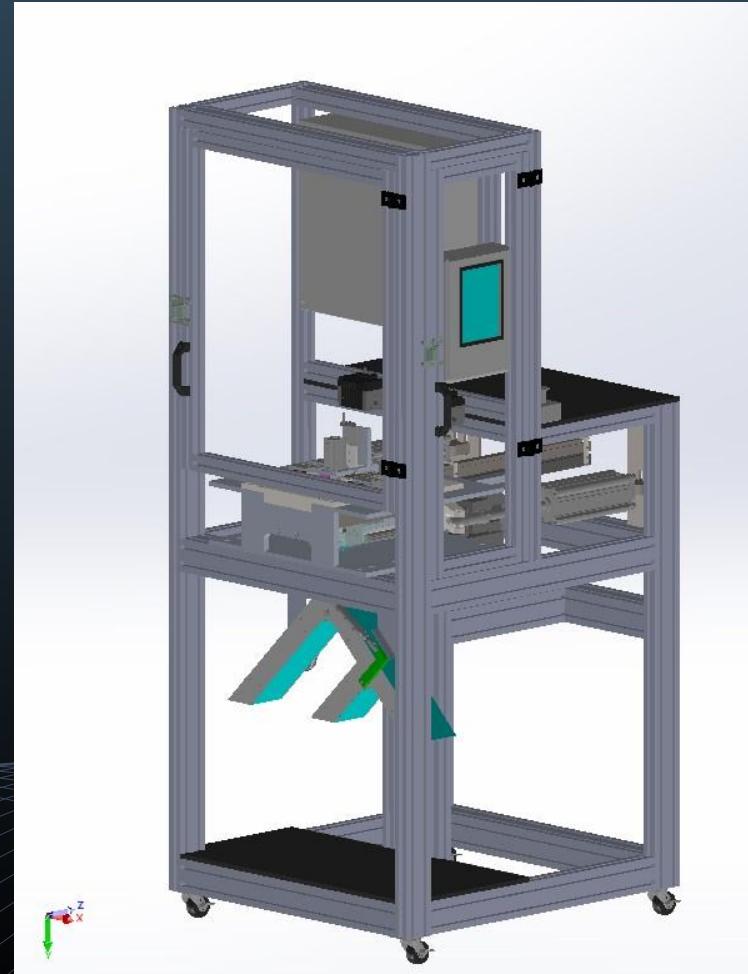
Head

Washer

Overmolded
Coil

Overview of Presentation

- Important Specifications
- Function Structure Diagram
- Mechanical Overview
 - Orientation of the Part
 - Part Movement within the machine
 - Head Removal
 - Washer Removal
 - Sorting Mechanism
- Electrical Overview
 - Orientation of the Part
 - Part Movement within the machine
 - Head Removal
 - Washer Removal
 - Sorting Mechanism
- Cost and Revenue



Specifications Summary

Specification	Required or Optional	Value	Units	Test Method
Maximum Input Power	Required	110 V	volts	Yes/No
Maximum Input Air Pressure	Required	7 bar	bar	Yes/No
Use of hydraulic power not allowed	Required	Yes/No	-	Yes/No
Portability	Required	>400 kg	kilograms	Mass Scale
Tutorial - written, following attached template	Optional	-	-	Yes/No
Use metric units	Required	Yes/No	-	Engineer Drawing
Maximum Size of Machine	Required	Length: 0.9 m Height: 2.2 m Width: 1.0 m	meters	Tape measure

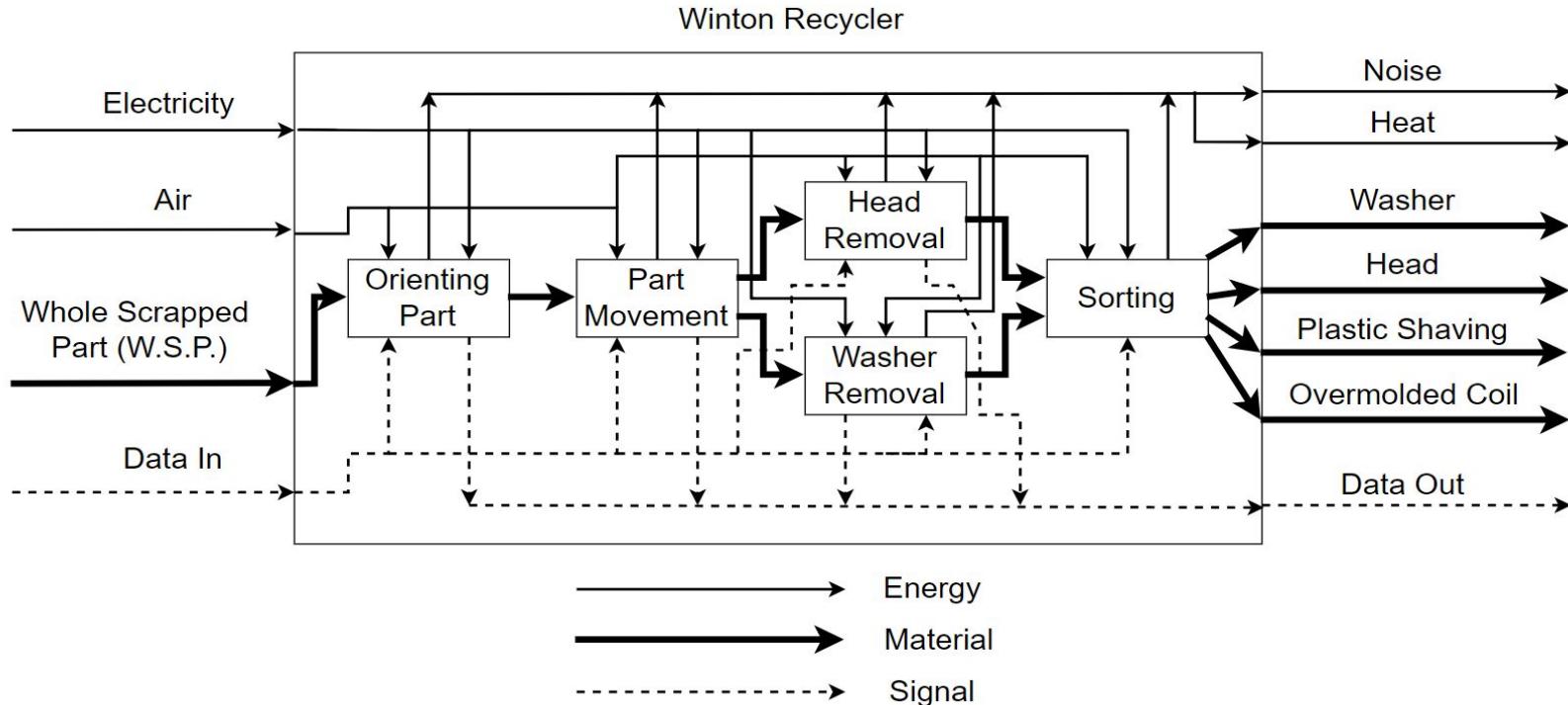
Specifications Summary

Specification	Required or Optional	Value	Units	Test Method
Maximum Cycle Time	Required	10 s	seconds	Run for one hour
Maximum interaction time with operator/technician per hour of use	Required	15 mins per 1 hour of run time	minutes	Run for one hour
Proper separation of Solenoid into 3 components (head, washer, overmolded coil)	Required	99/100 (99%)	parts	Run for one hour
HMI	Required	-	-	Yes/No
Maximum Opening Size	Required	38 mm	millimeters	Sphere test

Specifications Summary

Specification	Required or Optional	Value	Units	Test Method
Machine Safety Equipment Status Indicator	Required	-	-	Yes/No
Minimum 1 Emergency stop equipped and reachable	Required	-	-	Yes/No
Communication to I/O and HMI via ProfiBUS	Required	-	-	Yes/No
I/O achieved with Festo CPI valve banks and input blocks	Required	-	-	Yes/No
PLC Control	Required	-	-	Yes/No

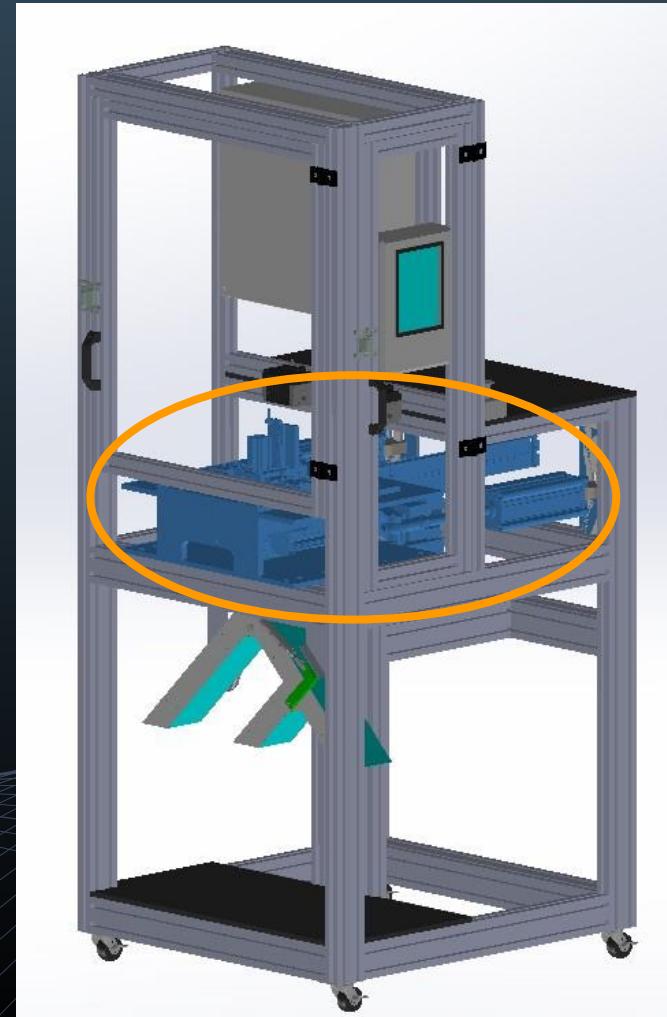
Function Structure Diagram



Mechanical Aspect

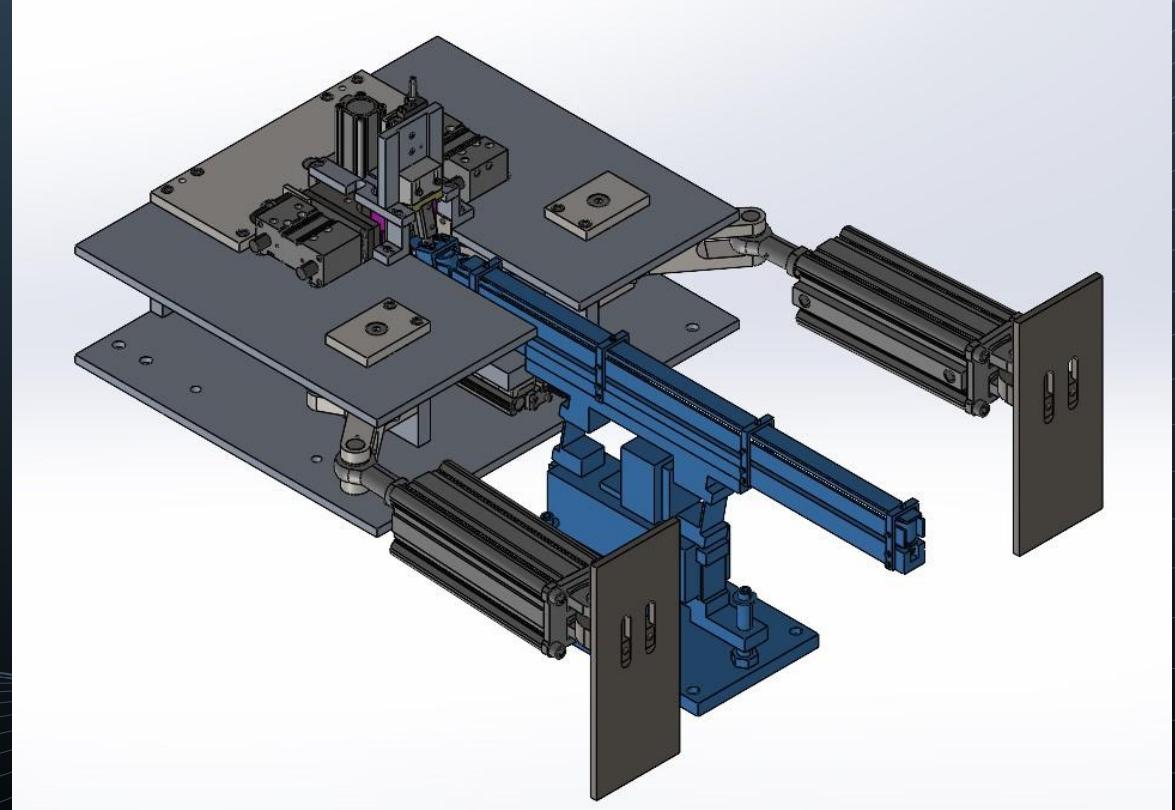
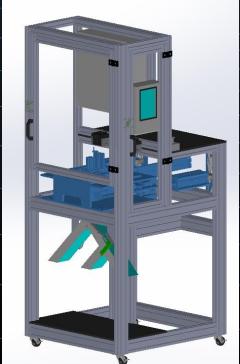
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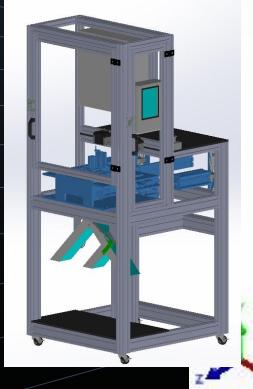
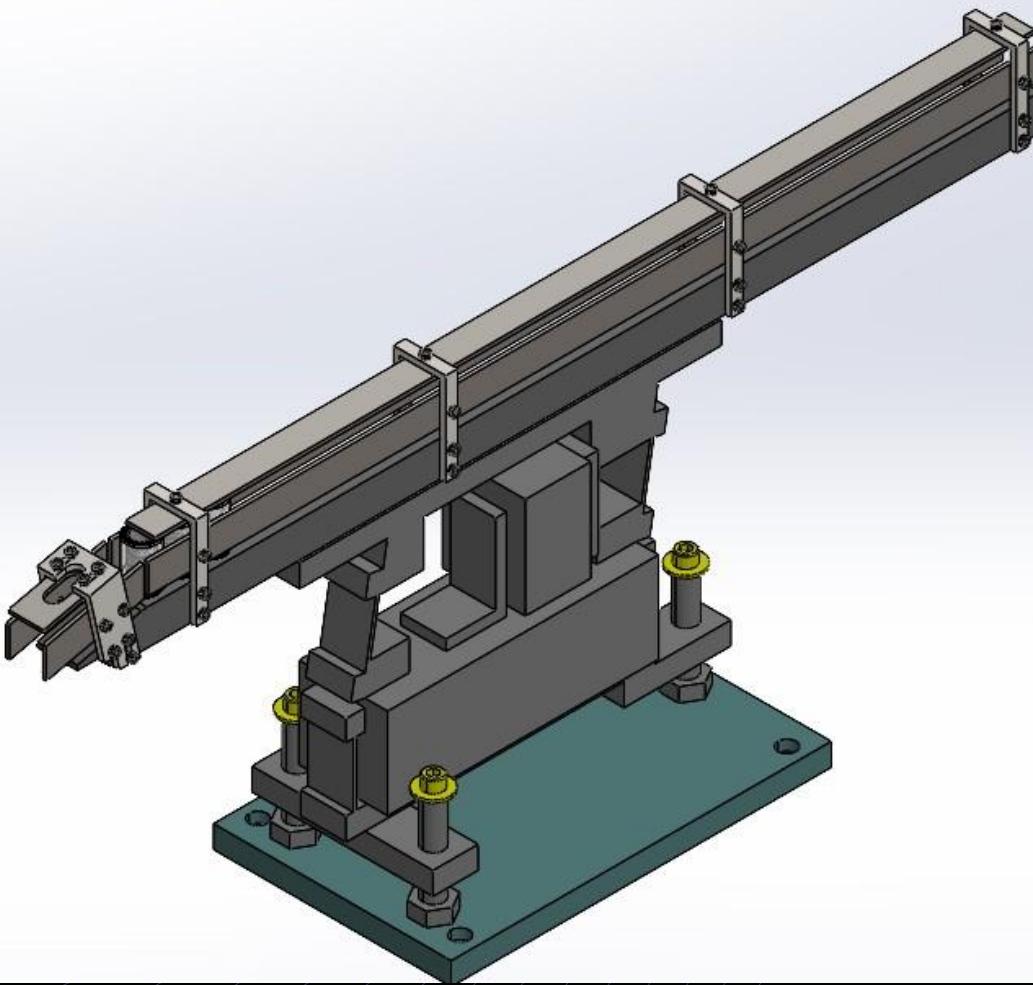
- Orienting Part
- Part Transfer
- Head Removal
- Washer Removal

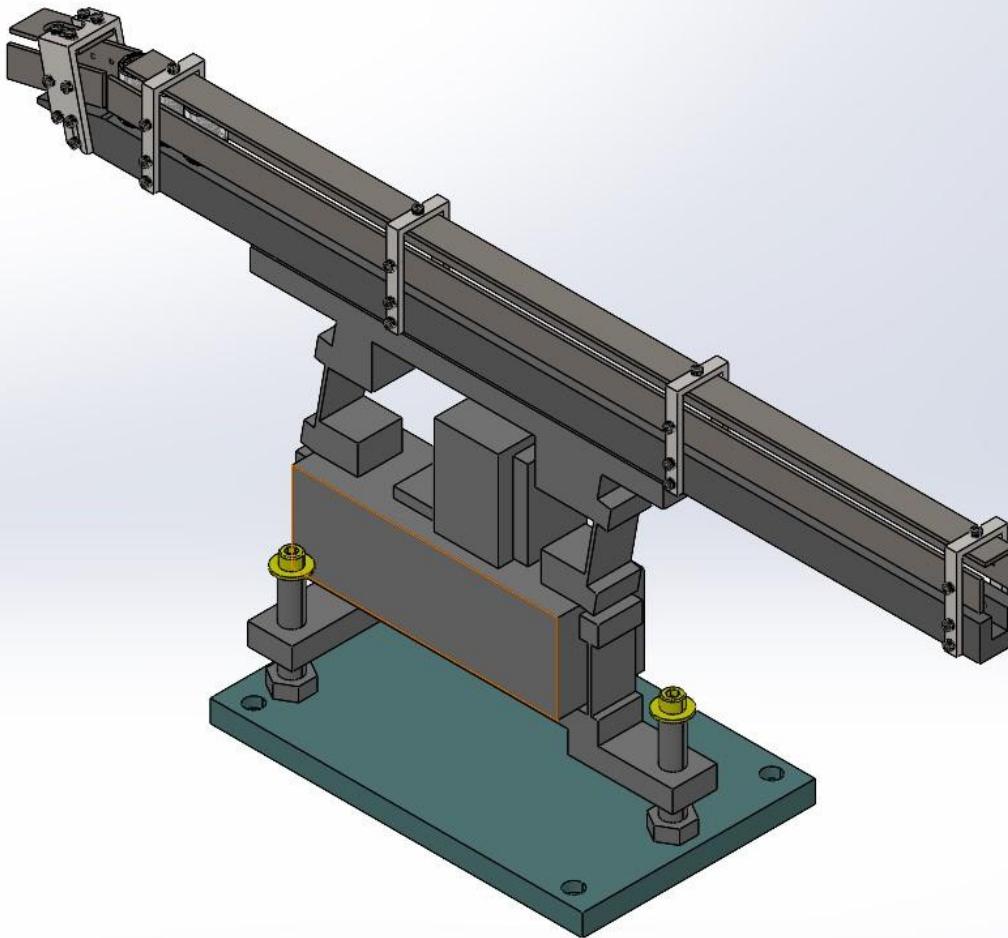
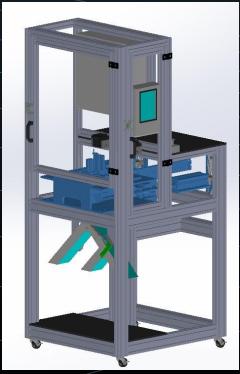


Orienting Part

- Vibratory unit
- Similar to current feeding mechanisms
- Re-use old line components

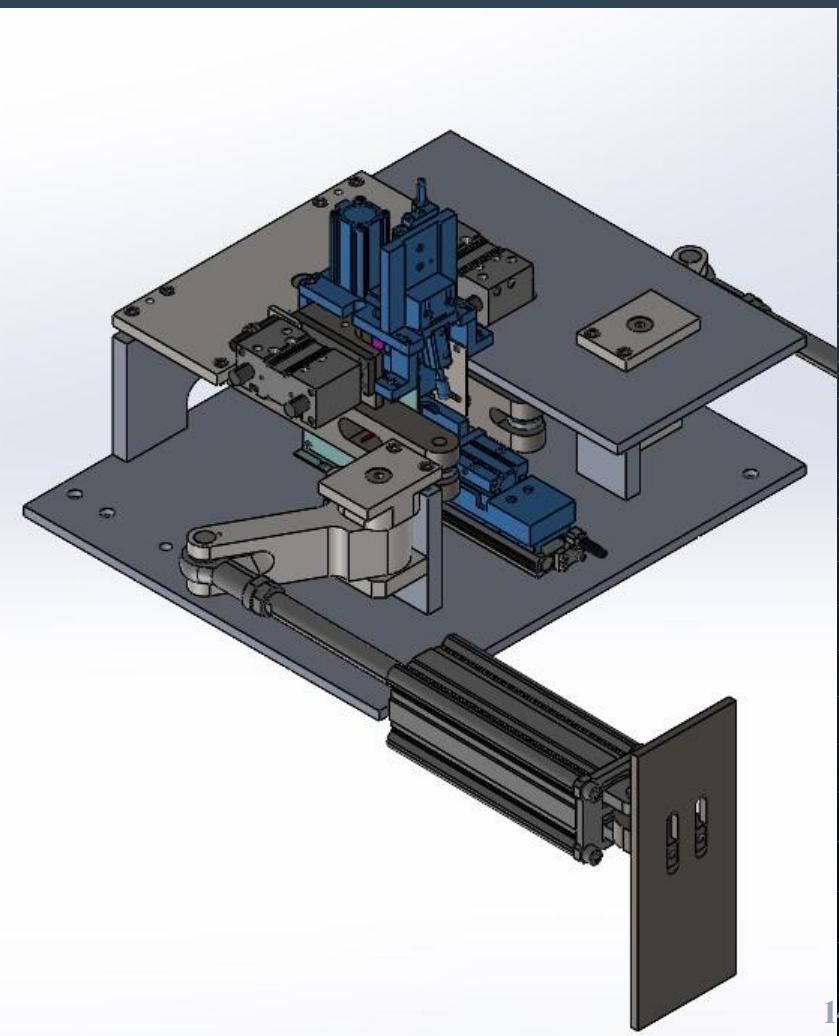
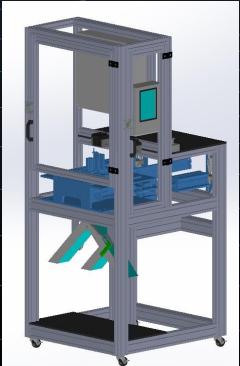


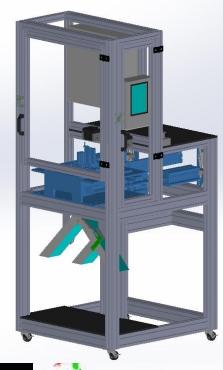
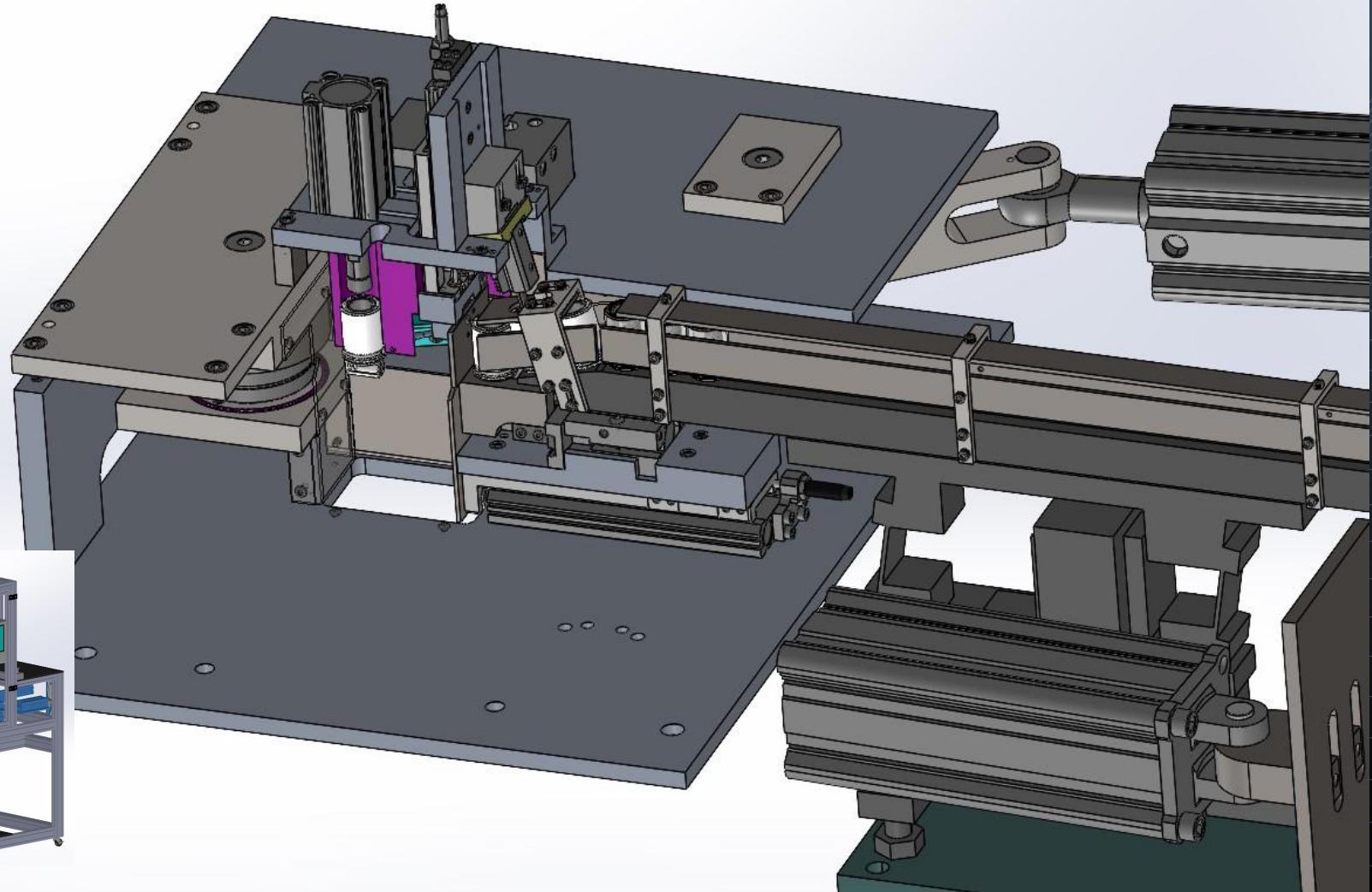


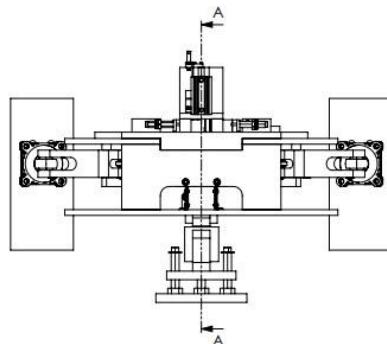
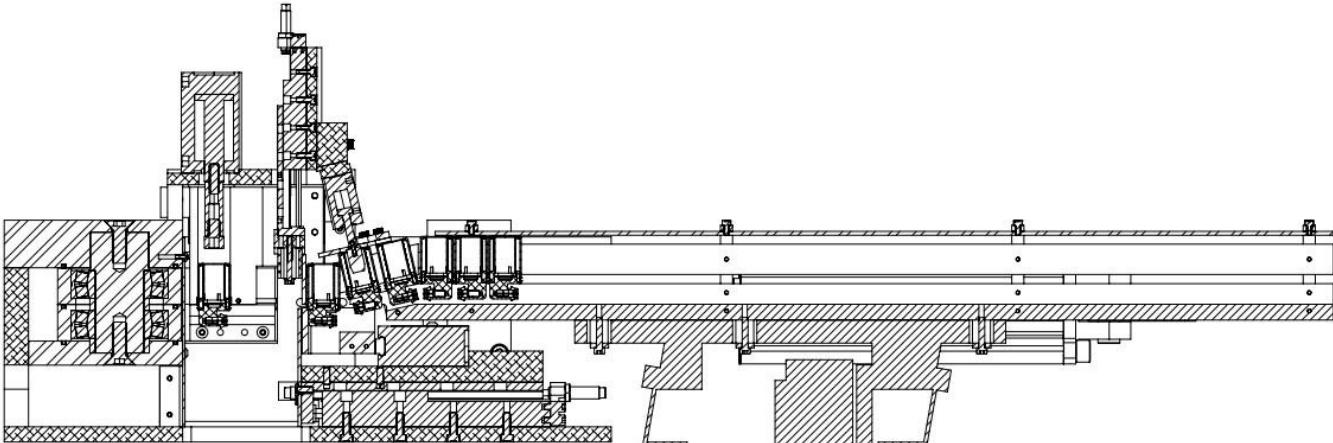
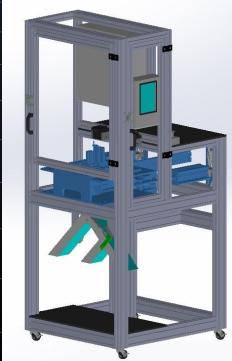


Part Movement

- Utilizes dead nest
- Pre stop & End stop
- Clamping mech.



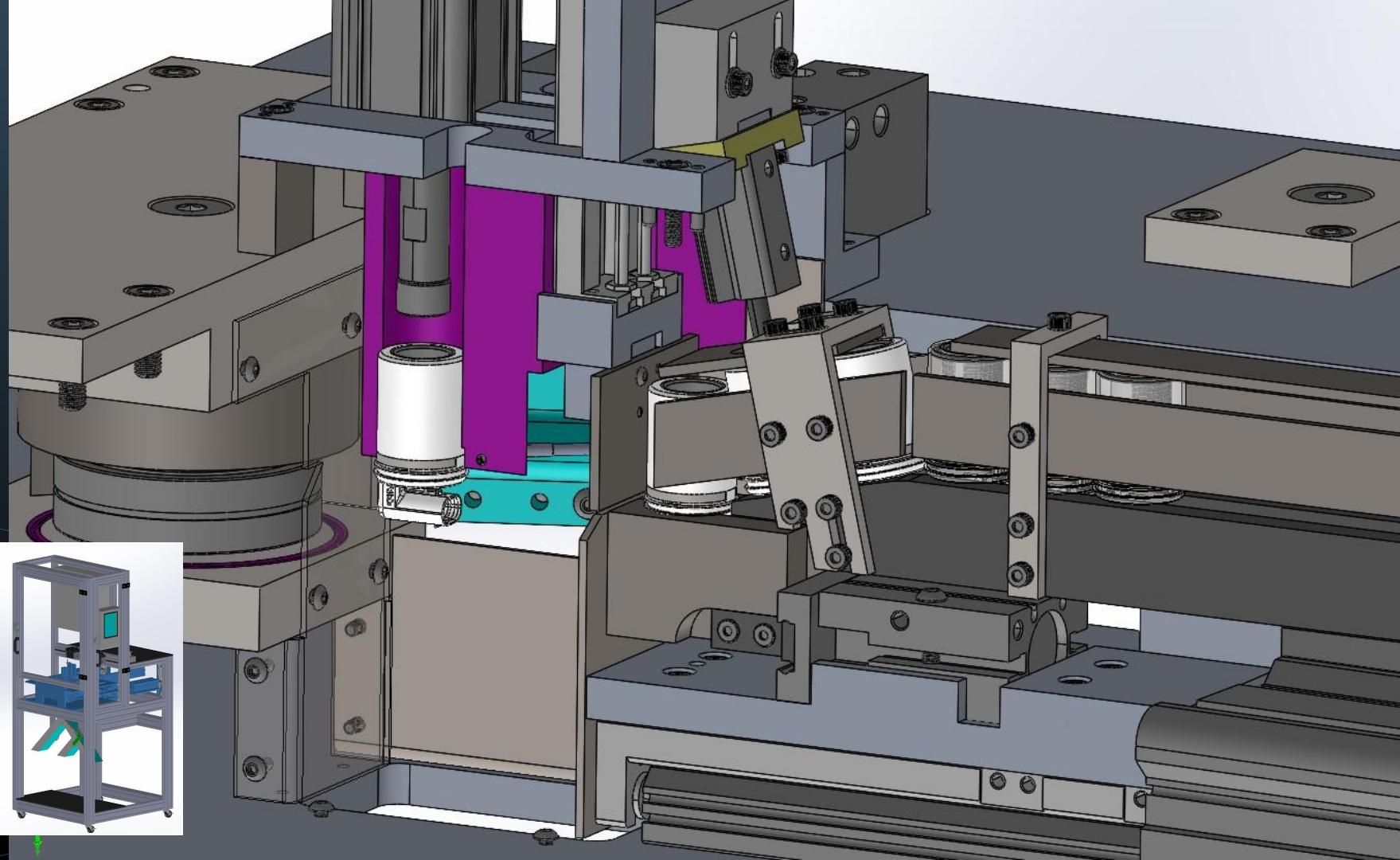
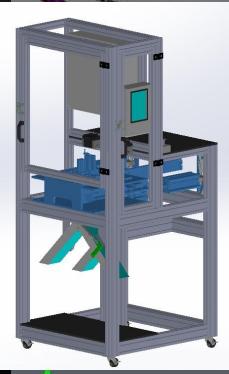


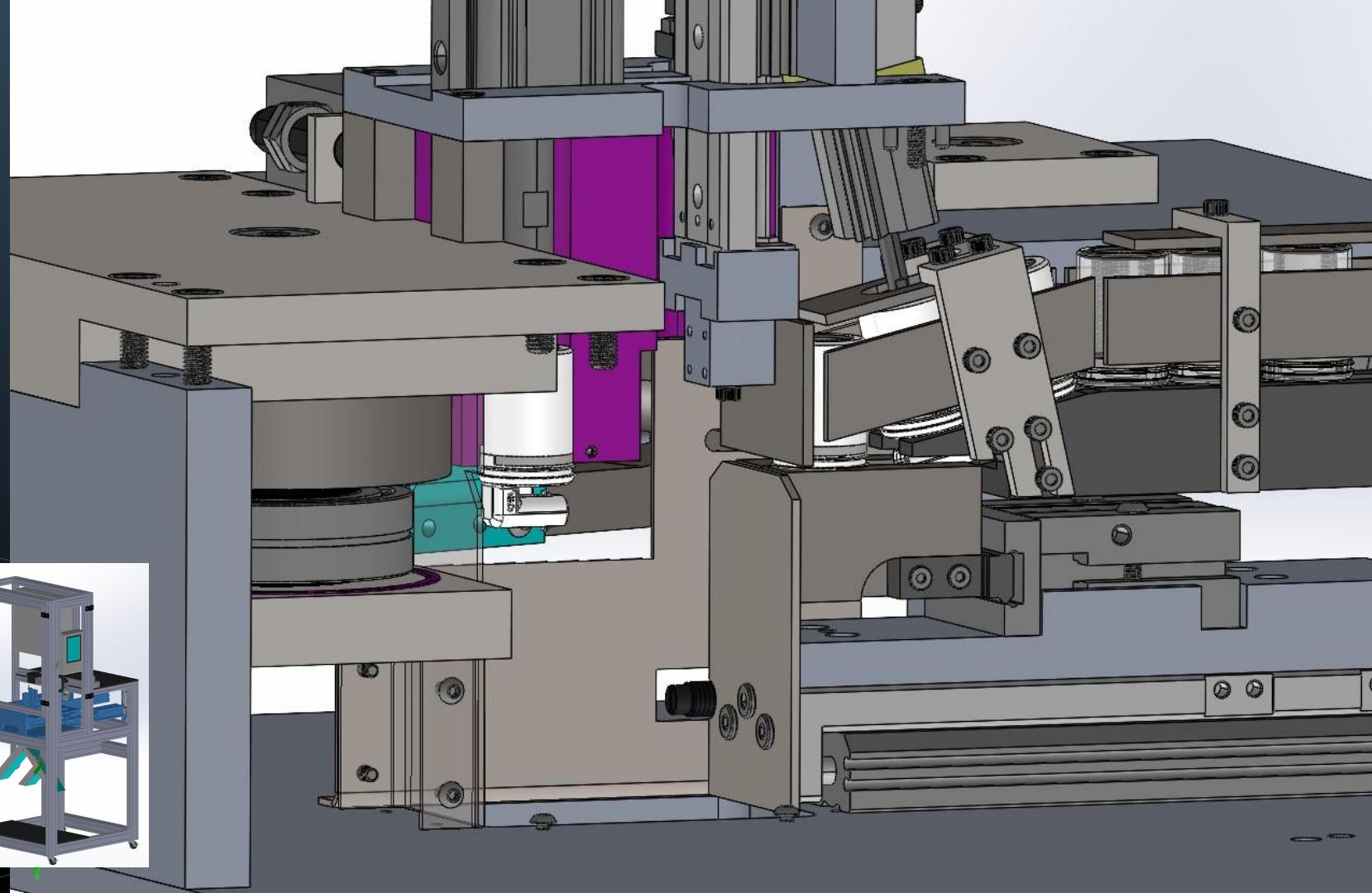


SECTION A-A
SCALE 1:1.5

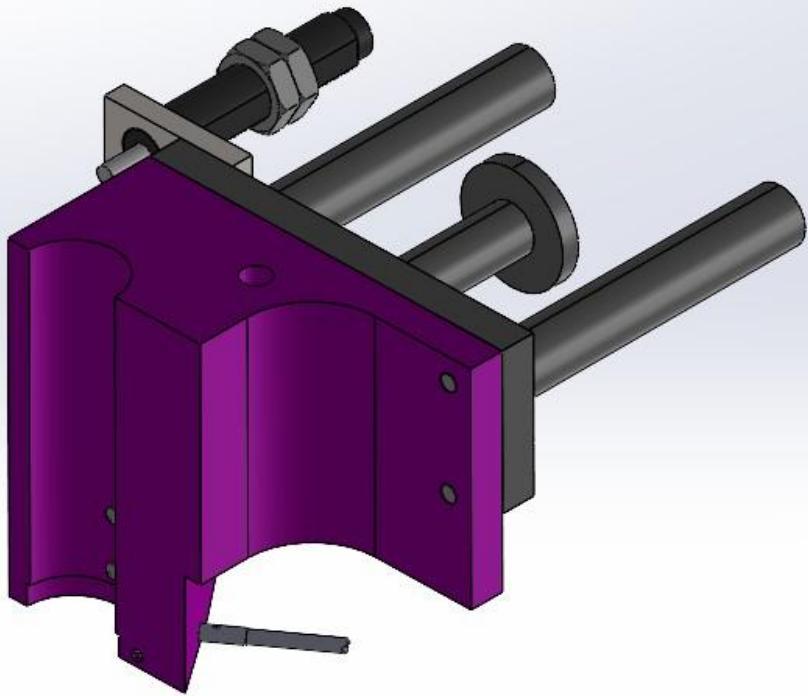
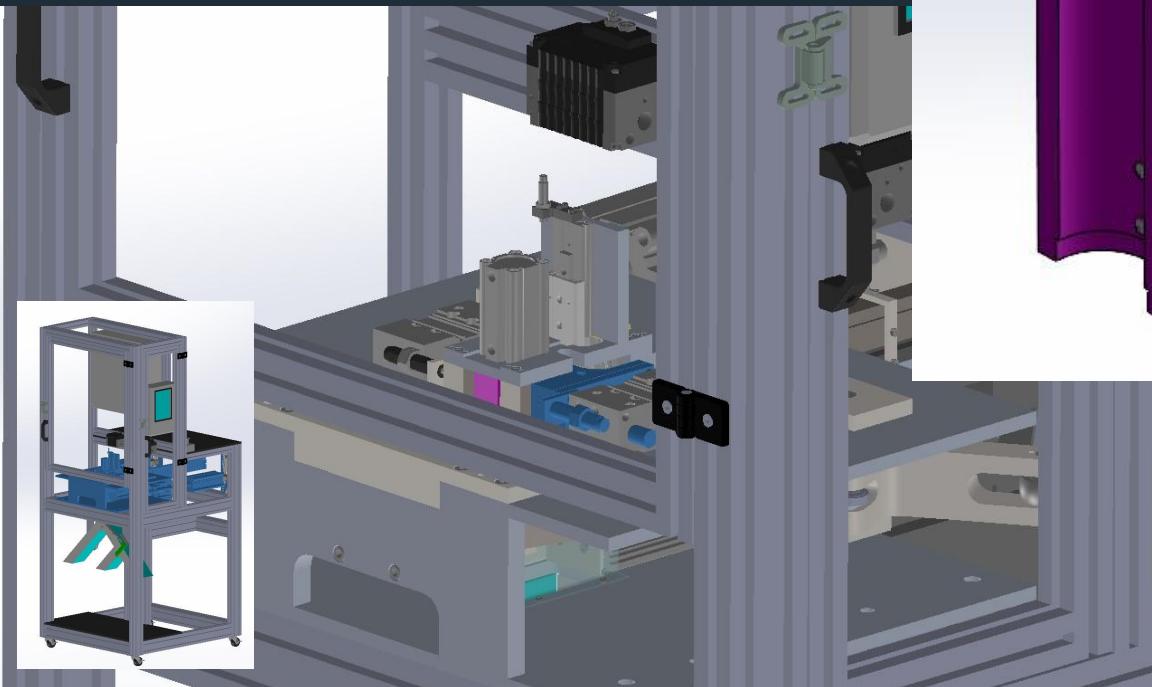
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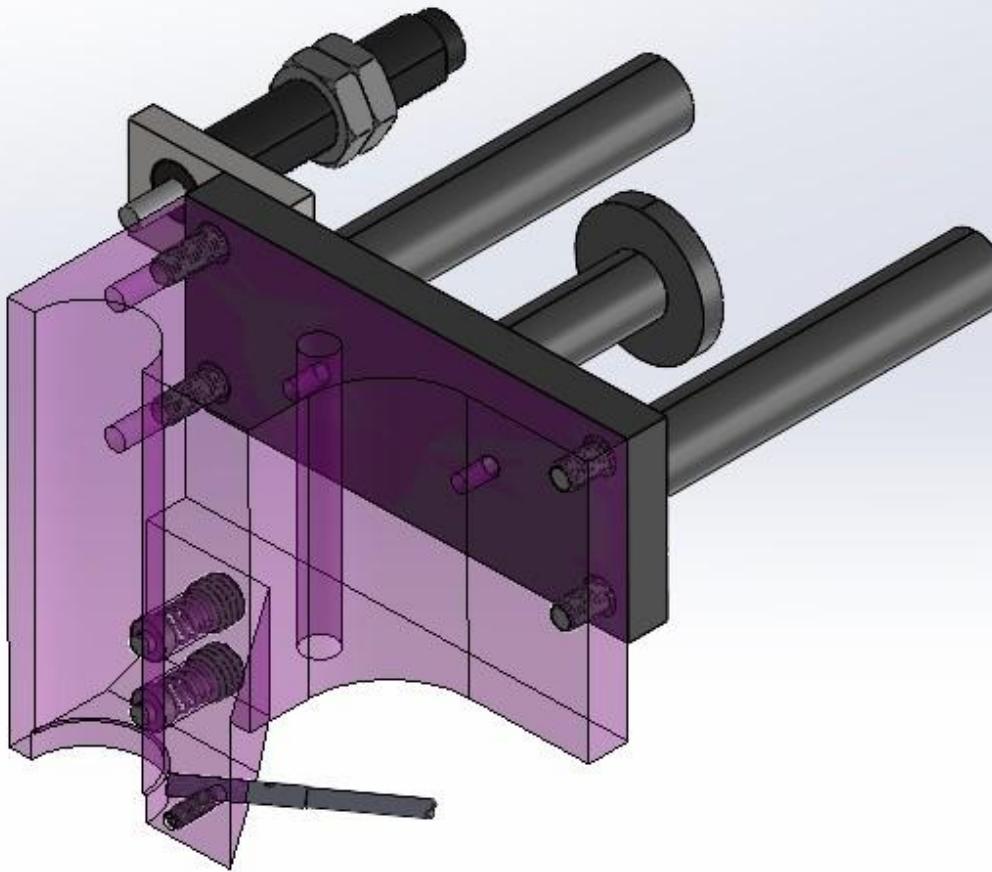
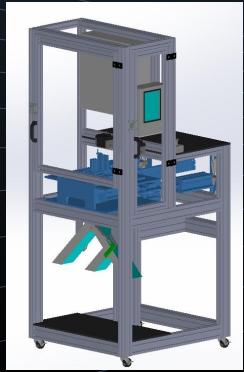
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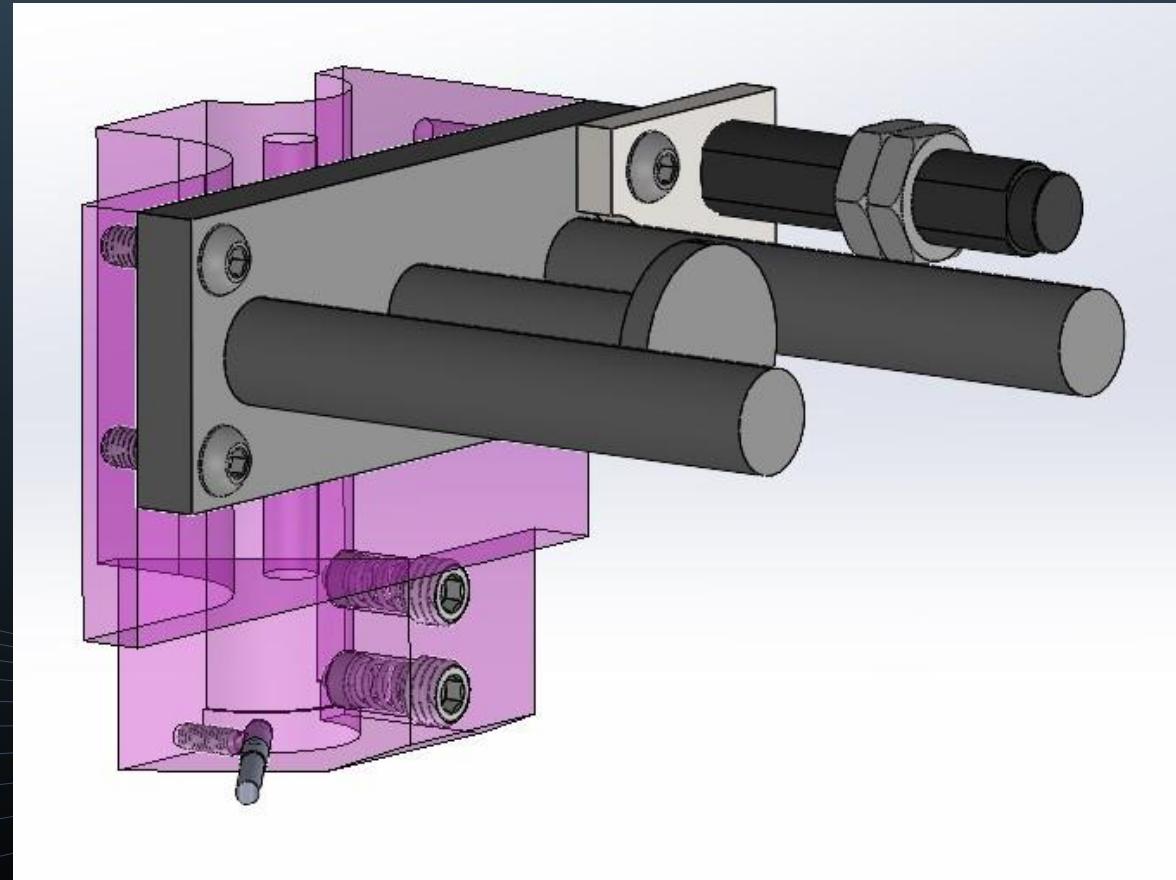
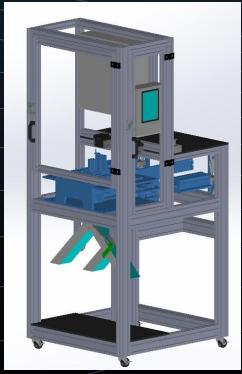


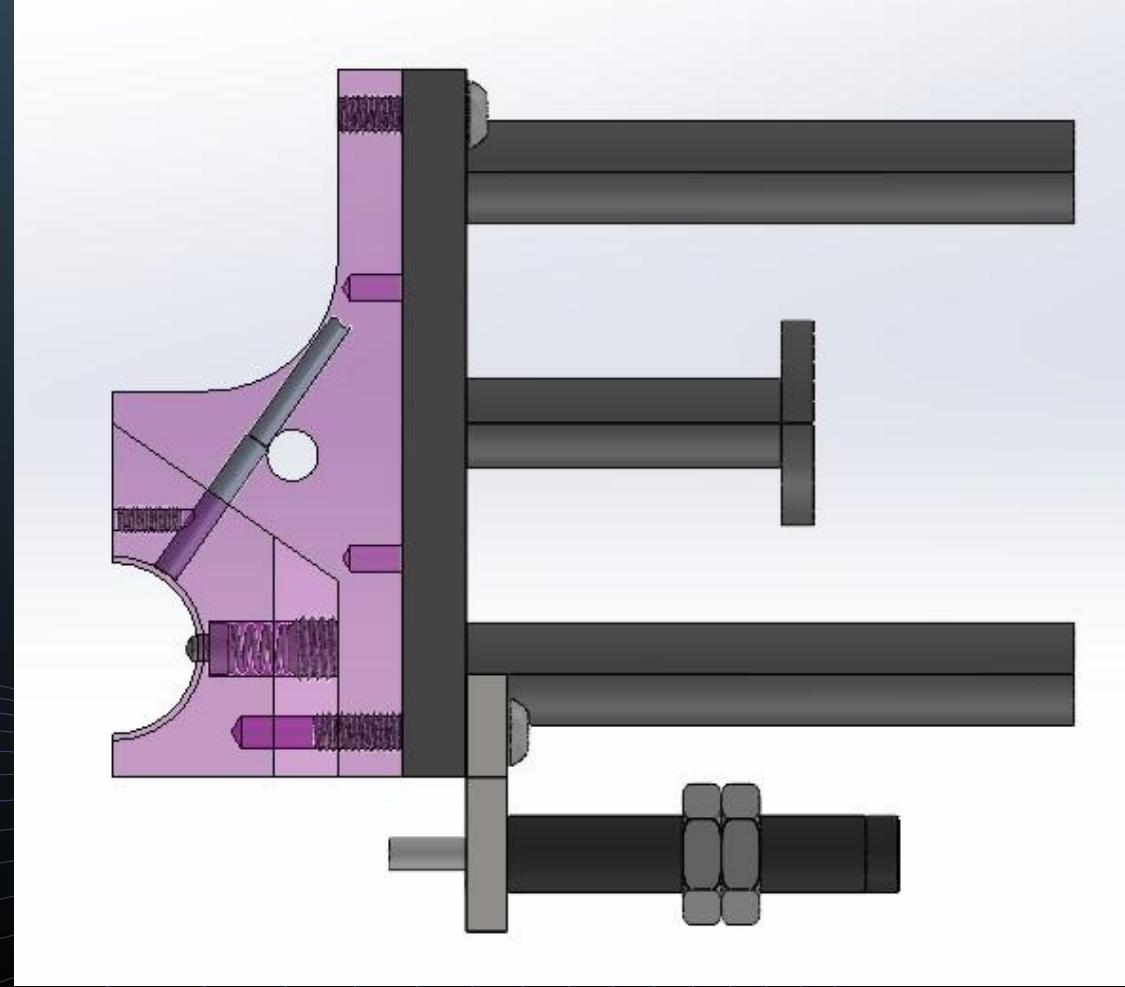
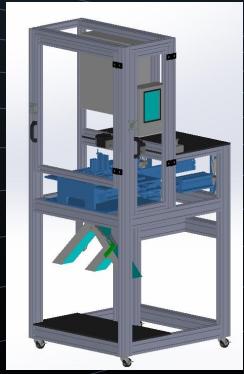


Part Movement, Clamping Mechanism

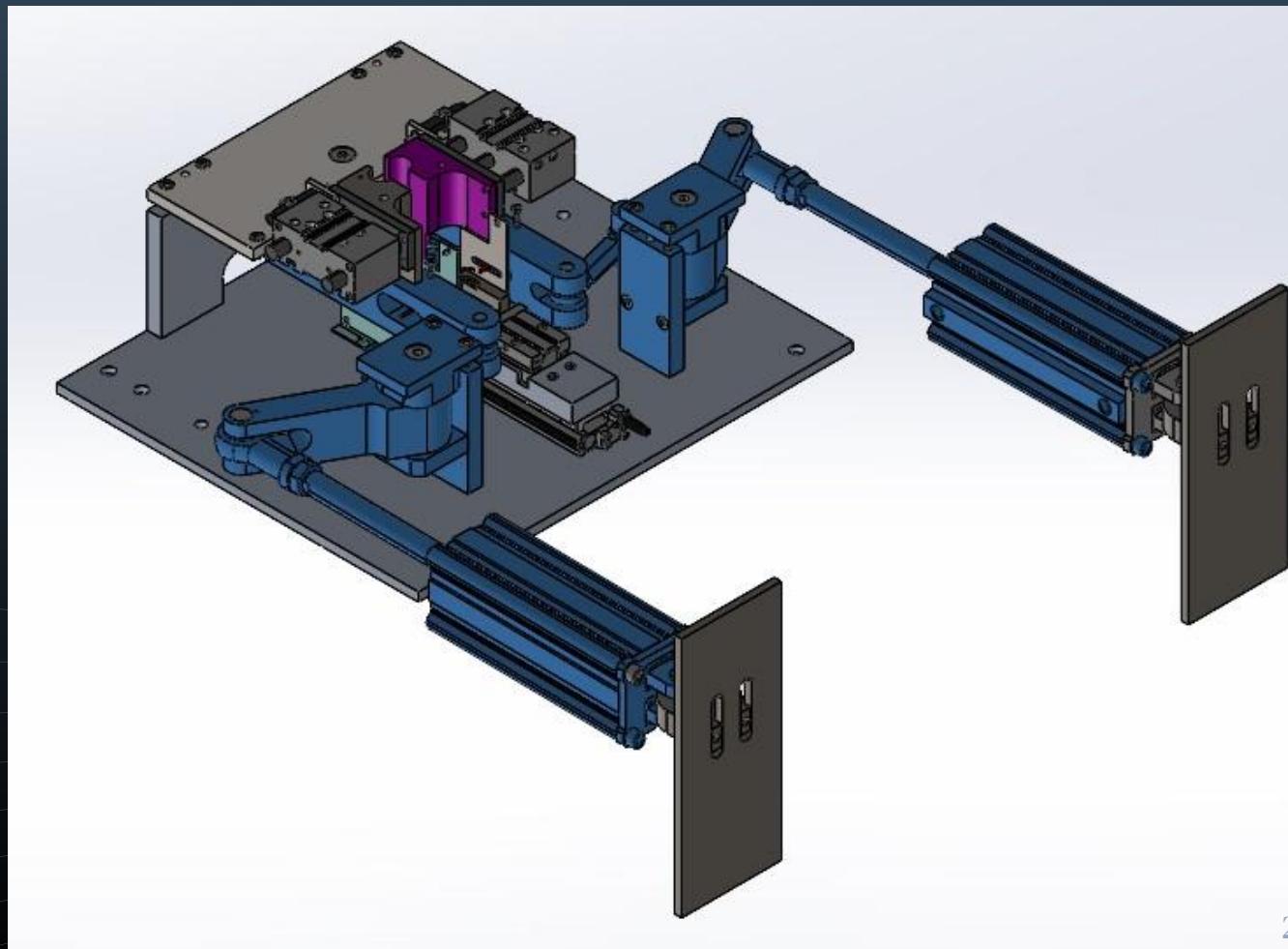
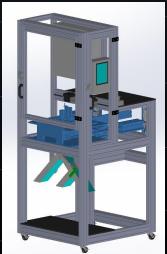


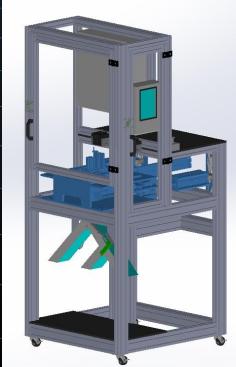
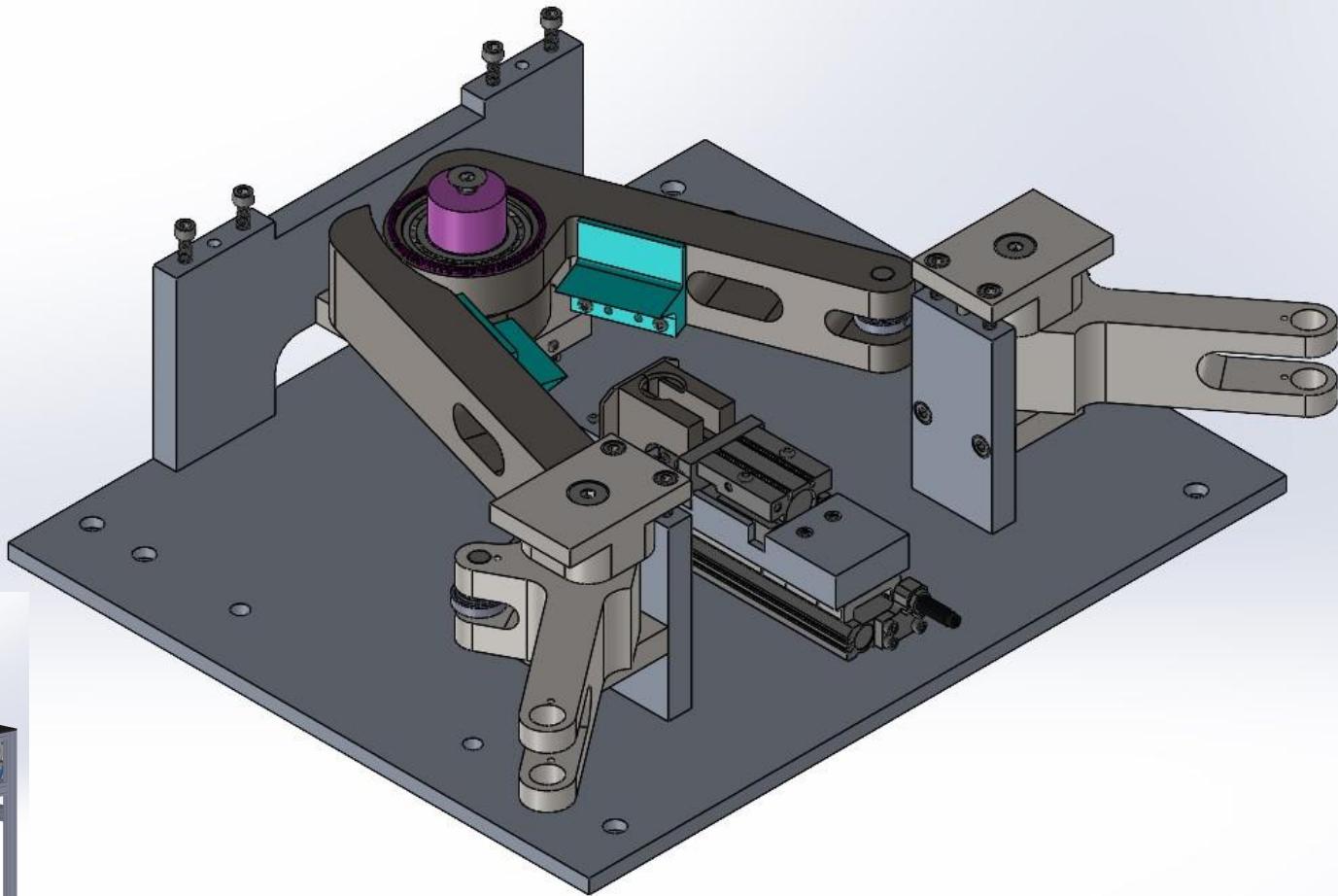






Head Removal - Mechanical



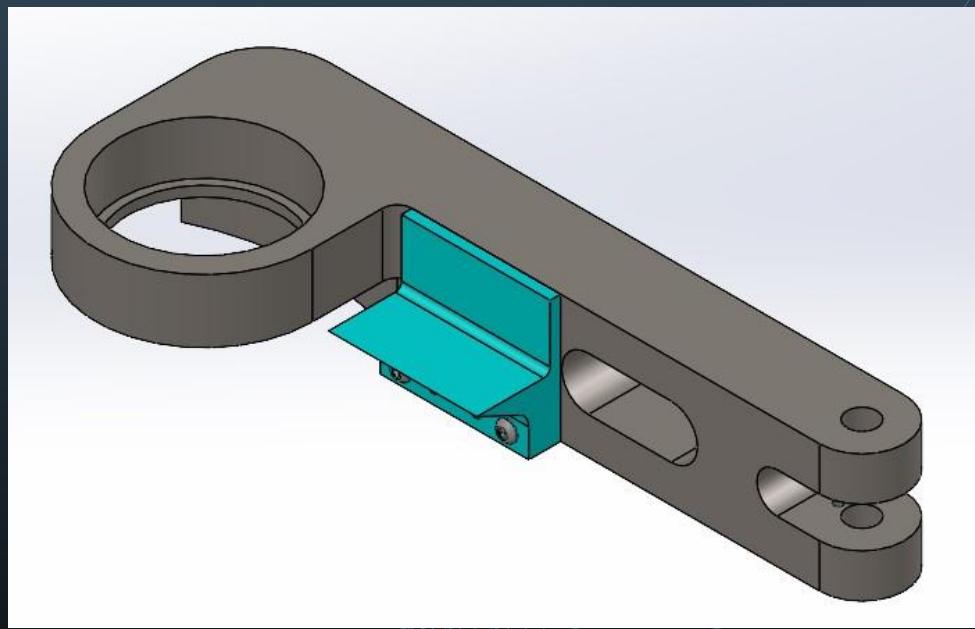


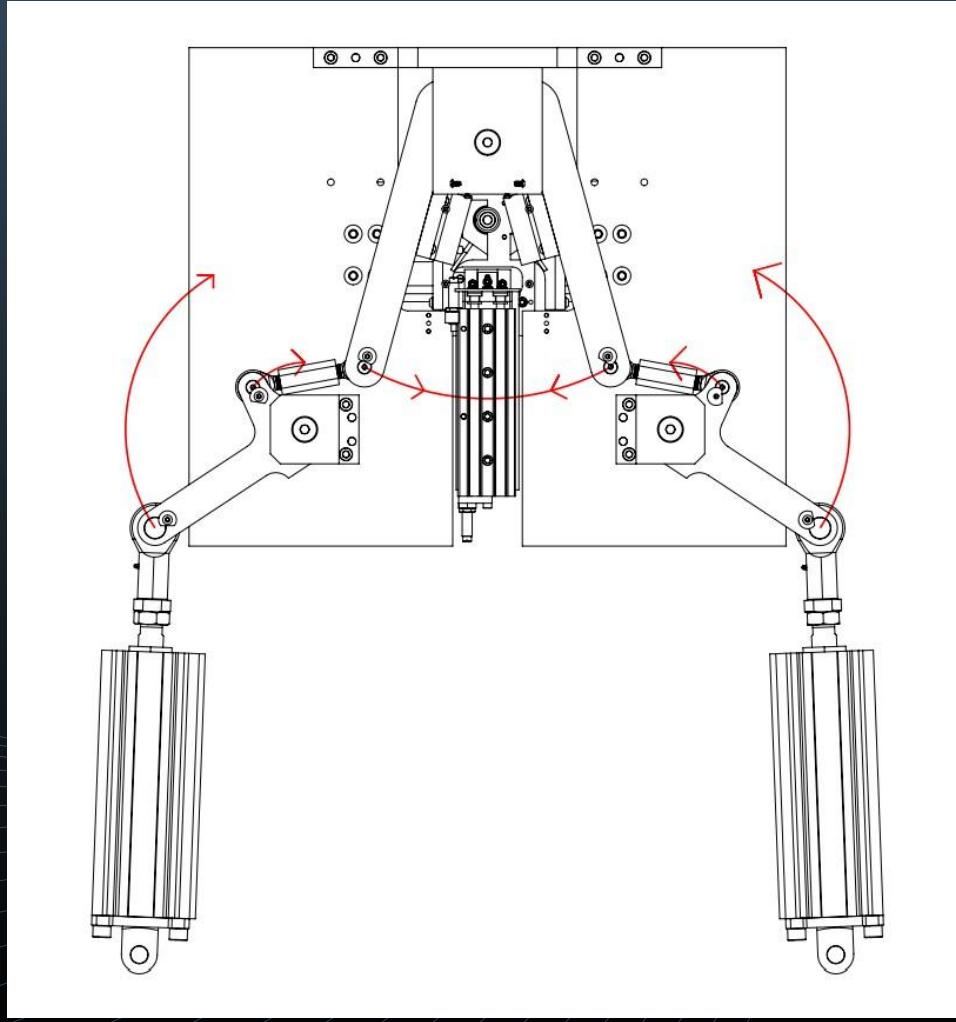
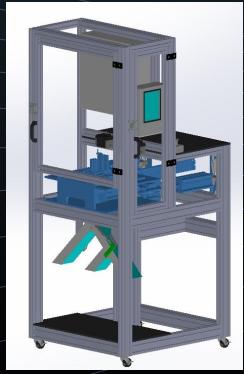
Shear arm design

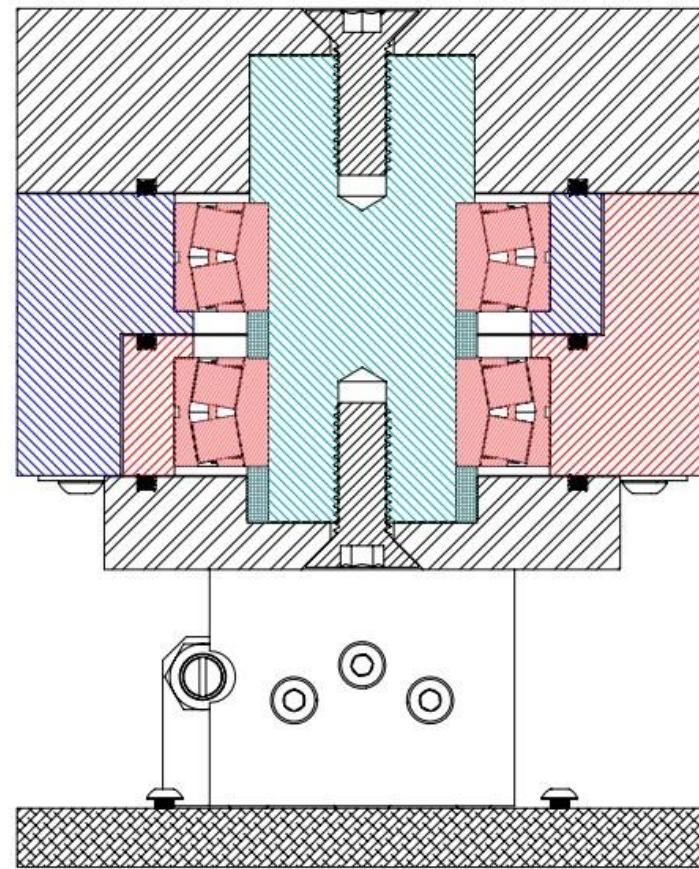
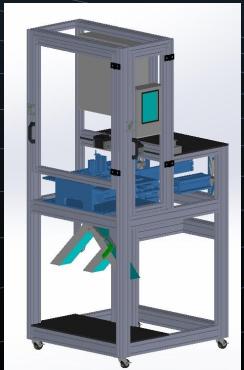
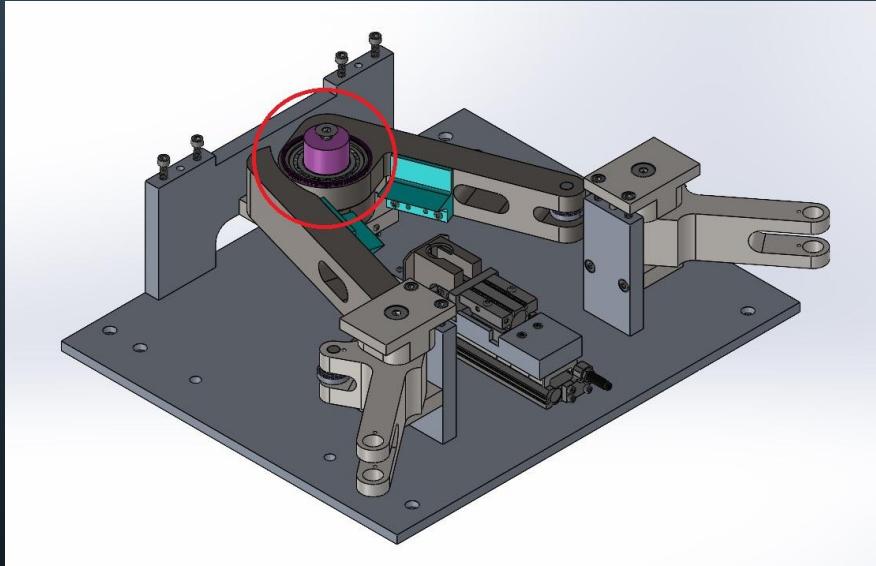
- 1018 CRS
- Cutout for clearance of part presence sensor
- Designed so cutting action occurs at midline
- 0.2mm clearance between shear arms

Blade design

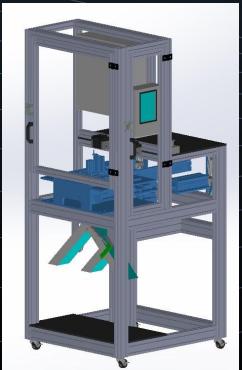
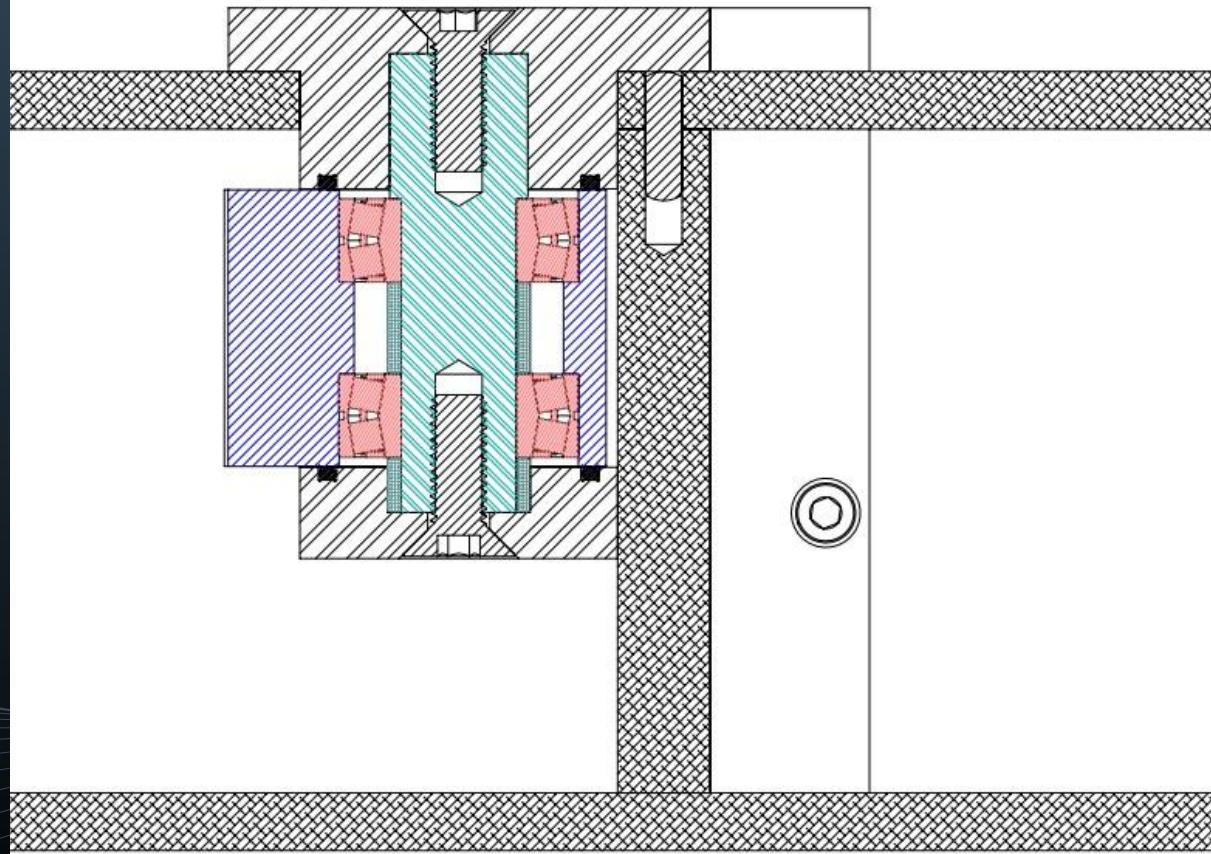
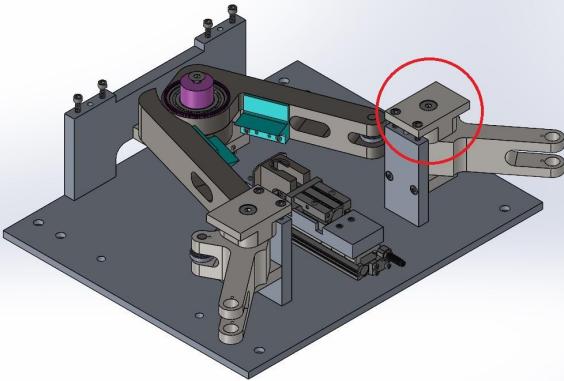
- Replaceable
- D2 Steel
 - Used for shears and knives
 - Good impact resistance
 - Holds edge
- 25 degree chamber
 - Adds Strength
 - Wedge shape acts to increase force acting to remove head
 - Wood splitter inspired







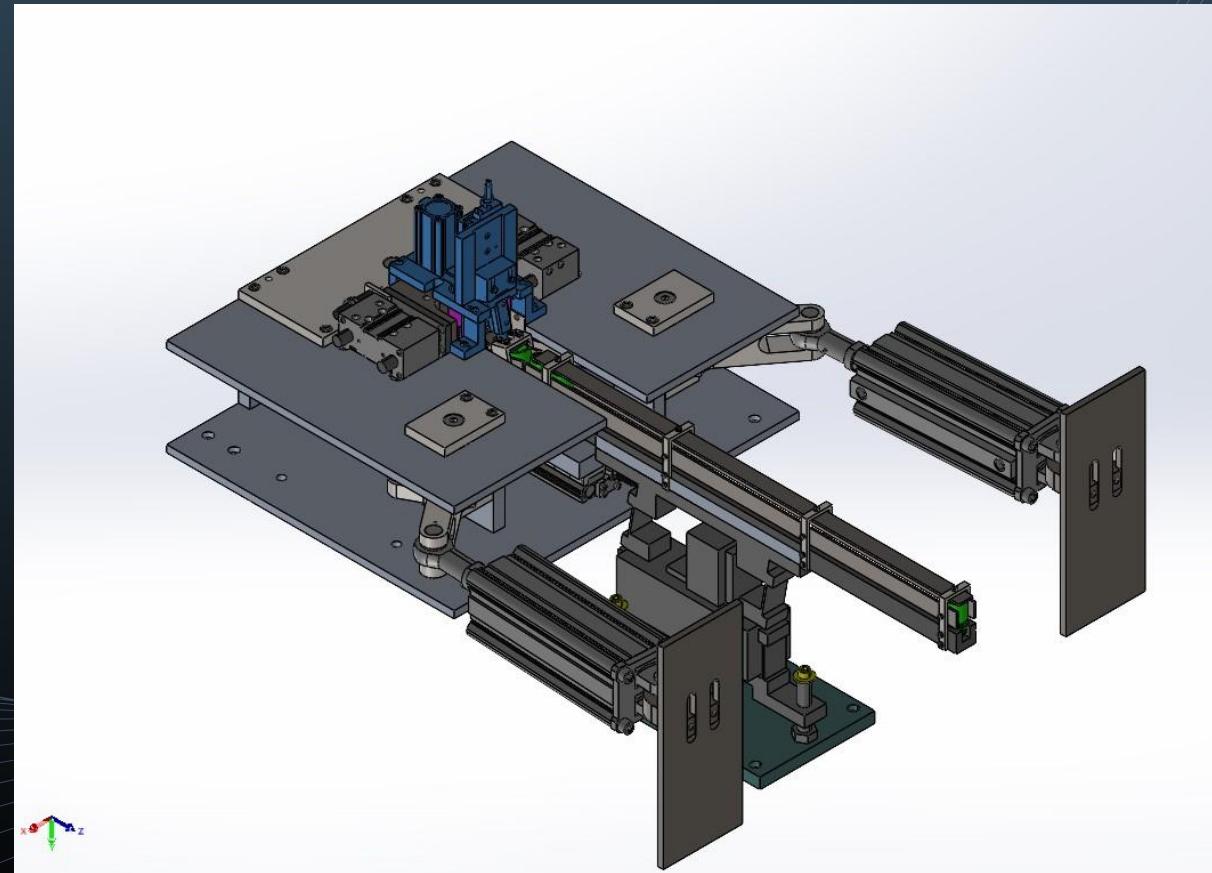
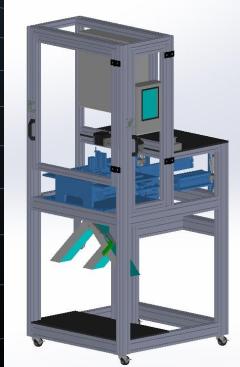
SECTION A-A
SCALE 2 : 1

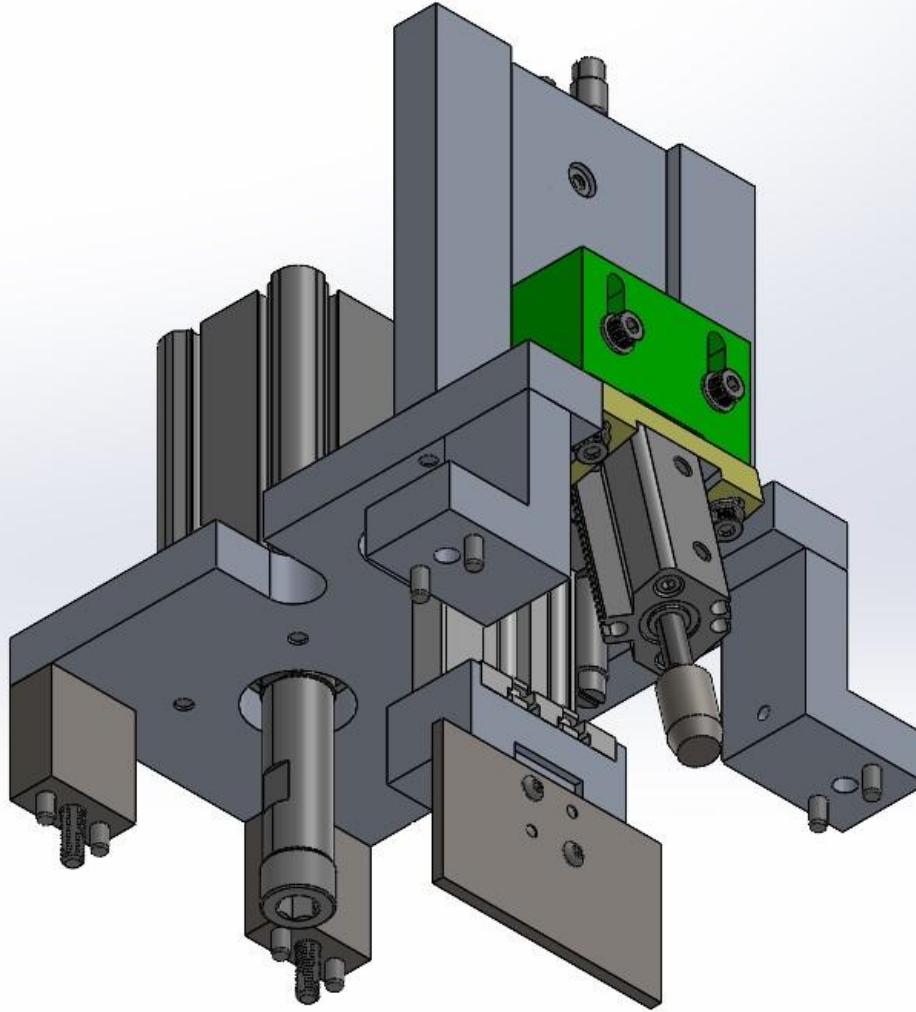
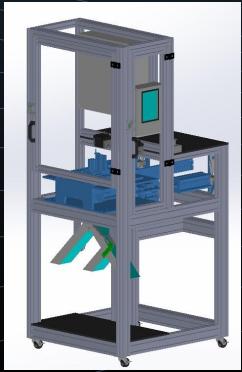


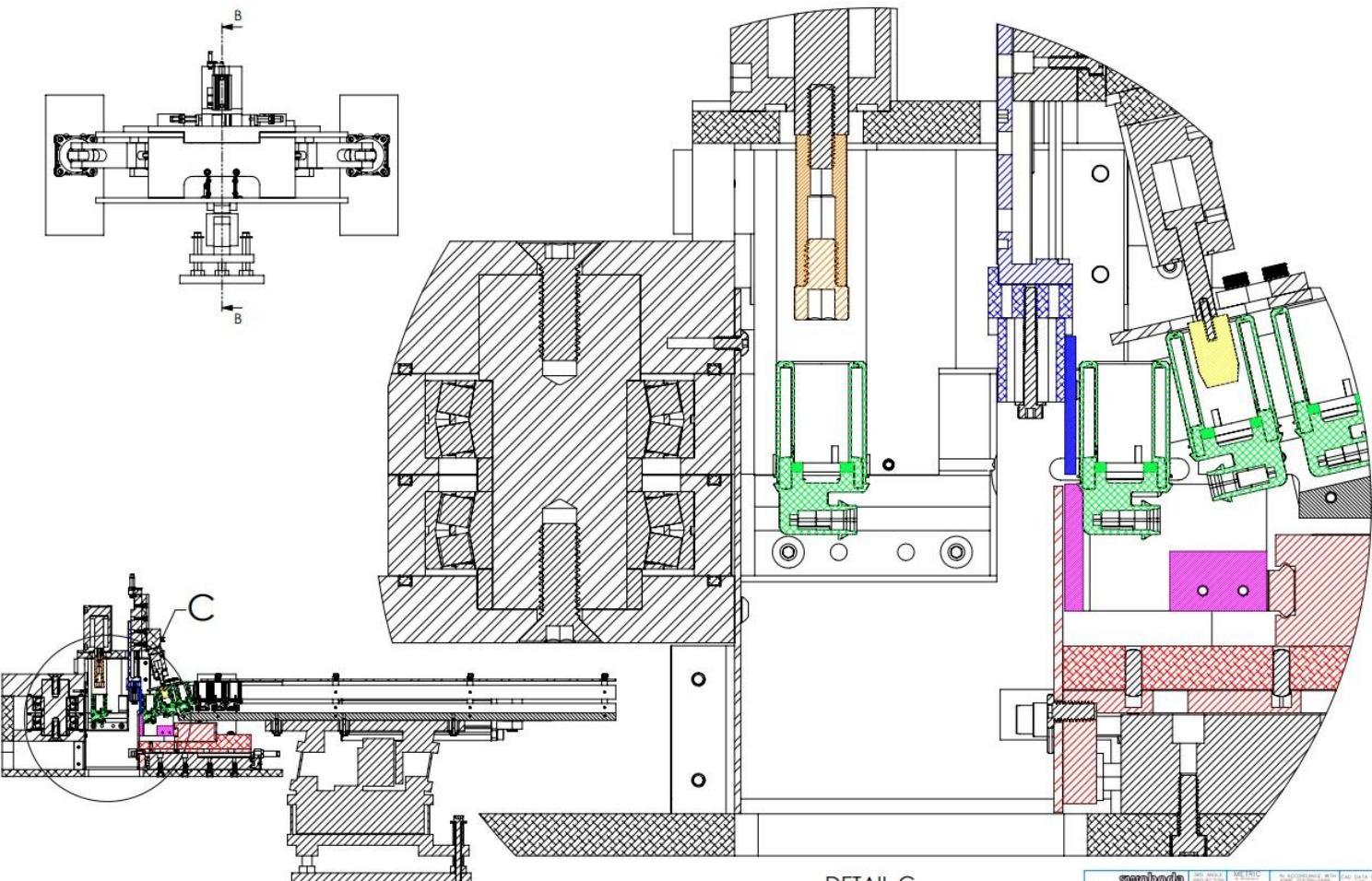
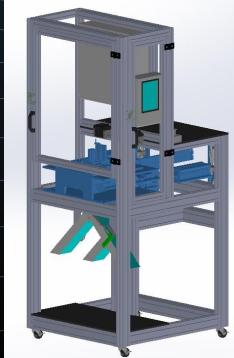
SECTION B-B
SCALE 2 : 1

Washer Removal

- Integrated into part movement base
- Simple cylinder punch
- Socket Head Cap Screw as punch tip
 - Easily replaceable







SECTION B-B
SCALE 1:3

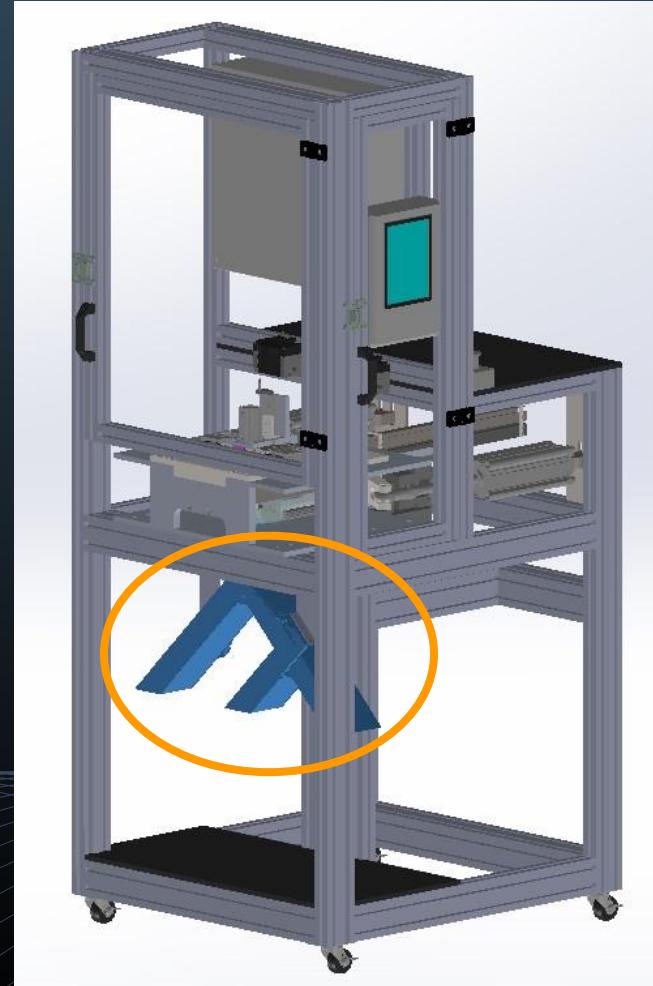
DETAIL C
SCALE 2:1

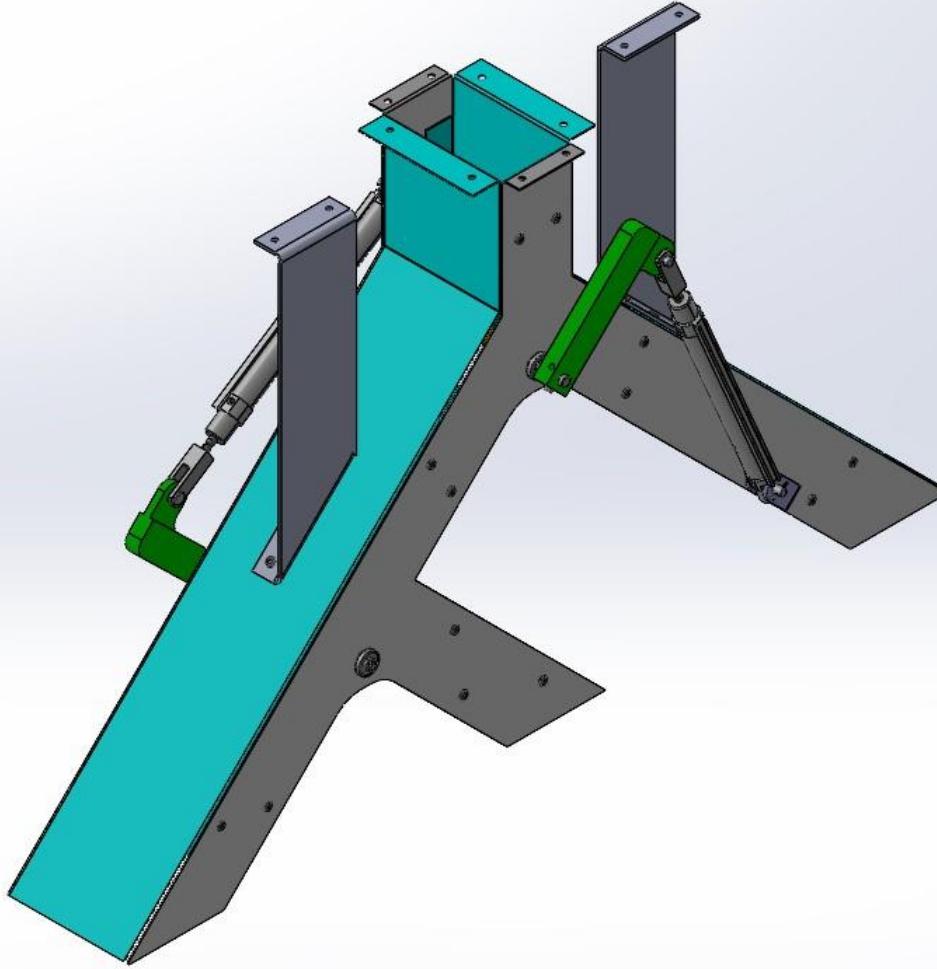
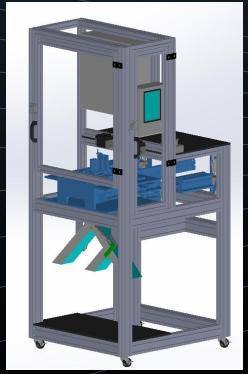
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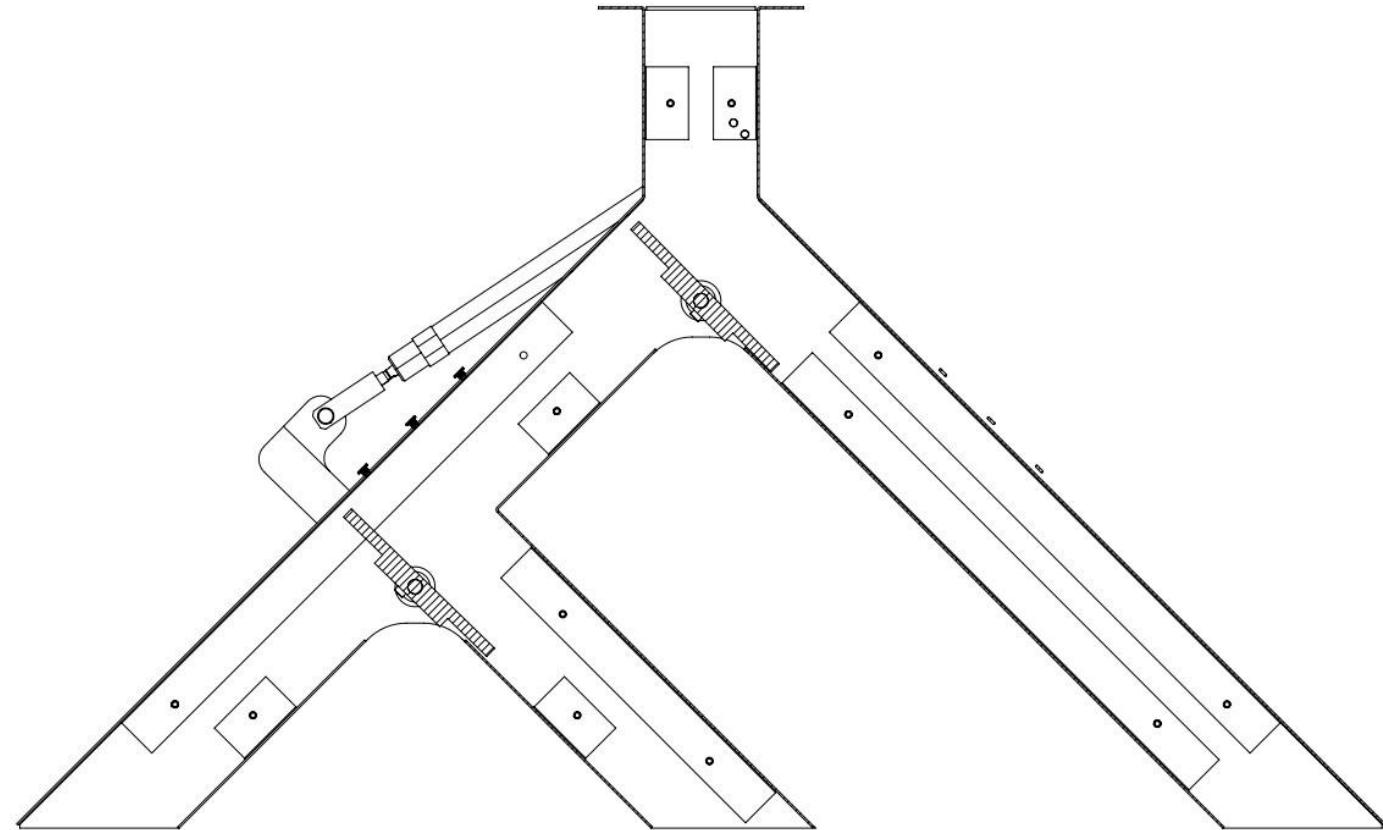
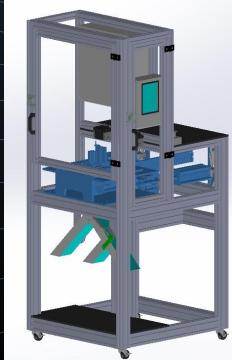
swoboda		IN ACCORDANCE WITH EU DIRECTIVE 2006/42/EC AND DIRECTIVE 2009/125/EC ON THE REDUCTION OF ENVIRONMENTAL HARMFULNESS BY REQUIRING THE DESIGN AND MANUFACTURE OF CIVIL ENGINES TO REDUCE THE EMISSION OF PARTICULATE MATTER AND NOX INTO THE ATMOSPHERE		EU REGISTRATION N/A		PART NUMBER N/A		PART NAME N/A	
QTY:	1	REF ID:	SA-1-Detail	PRINTED:	N/A	PAGE:	1/10	SCALE:	1:10
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Sorting

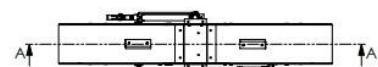
- Trap Door Mechanism
- 3 separate bins
 - Head
 - Washer
 - Body
- Use of Air Cylinders



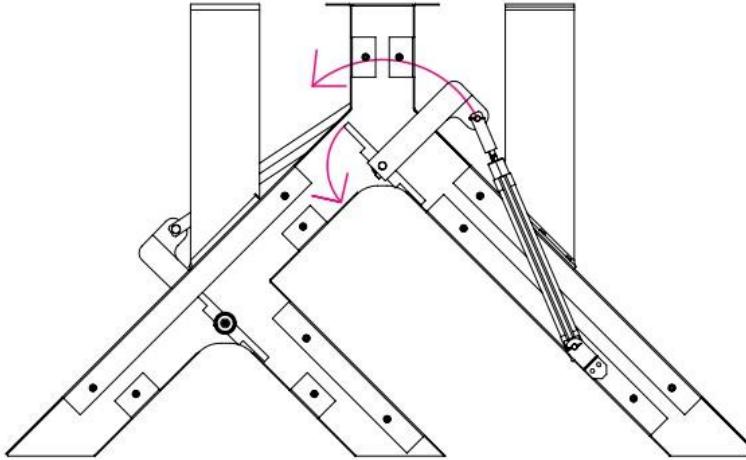
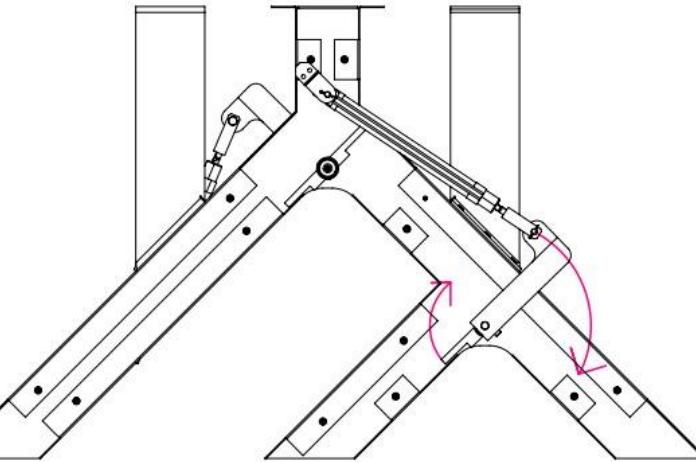
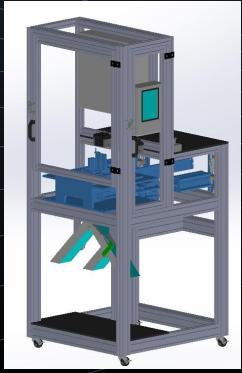


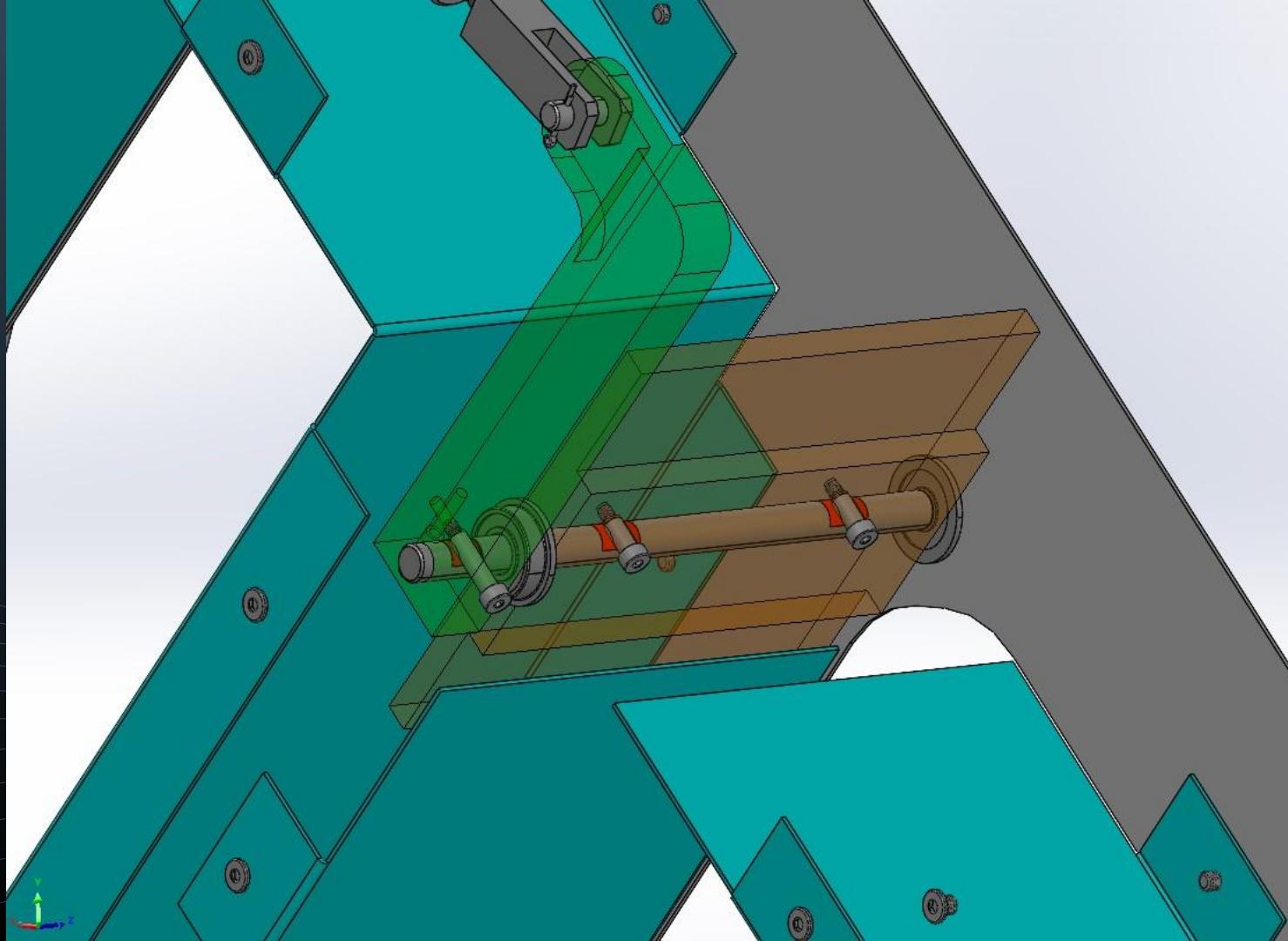


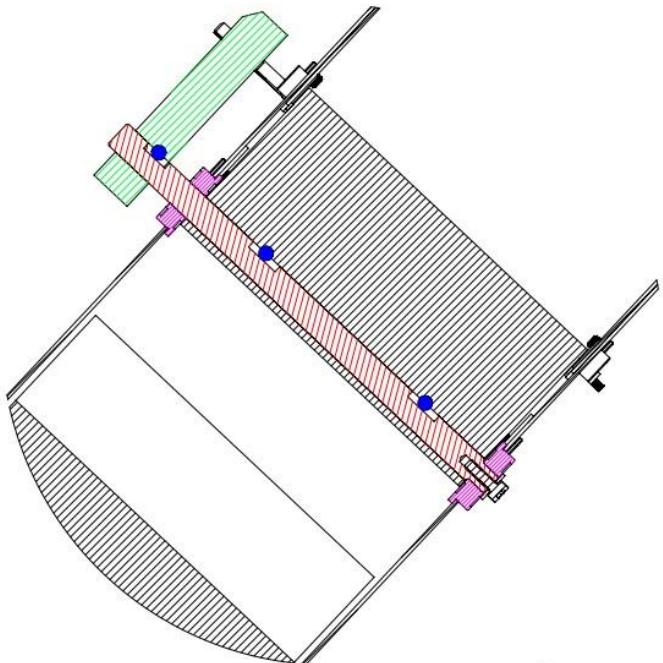
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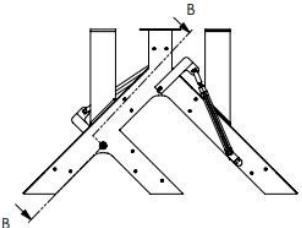
swedbeda	PLATE THICKNESS	MATERIAL	PL. ACCORDING WITH
10 mm	10 mm	STEEL, STAINLESS STEEL, ALUMINIUM	ASME 21.8/21.9
LD	4/24/2022	COATINGS	NO
REMARKS	COATED SURFACE SPECIFIED	SLIP ROLL COATING	NO
QTY: 1	PART NUMBER	PART NAME	SA-2
1/2"	N/A		
DESIGN DRAWN BY		REVISED BY	DO NOT SCALE
1/2"		1/2"	1/2"







DETAIL B
SCALE 2 : 1

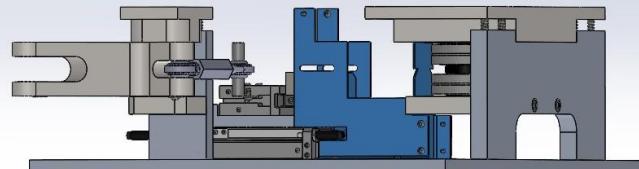
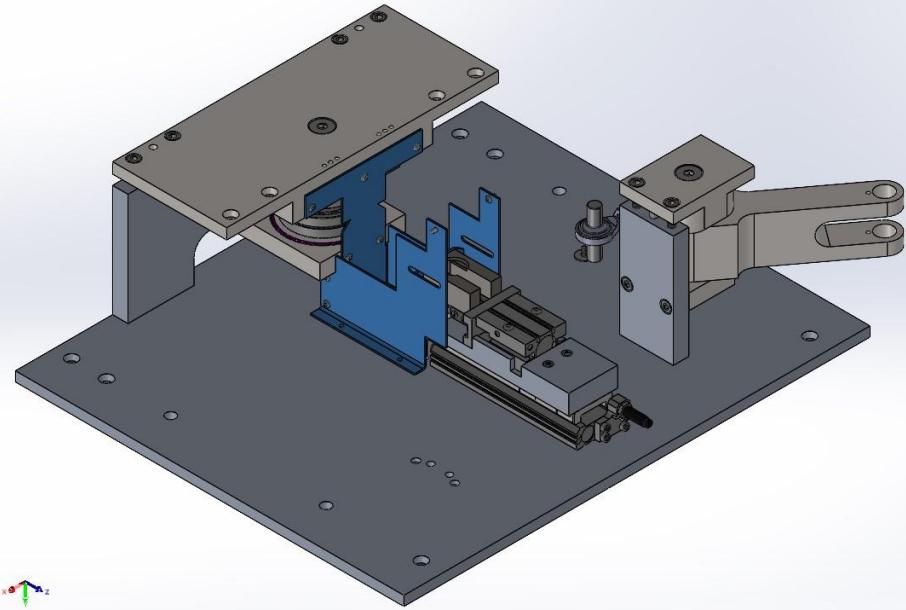


SECTION B-B
SCALE 1:2

swaboda		PRO ANGEL PROJECT	MIL-STD-1208 IN ACCORDANCE WITH GENERAL DIMENSIONAL TOLERANCING PRINCIPLES	PRINTED IN U.S.A.
Swaboda Technologies, Inc. 10000 N. 100th Street Milwaukee, WI 53223-3500 (414) 766-1000			SW	
DRAWING NO.	DATE 10/10/00	SCALE N/A	HEAT TREAT NO	
MATERIALS NOTES NOTES CONCERNING SPECIFICATIONS		QUANTITY CHECKING	NO	<input type="checkbox"/>
QTY: 1		PART NUMBER	PART NAME	
		SA-2		
UN. DESIGNATOR PARTS		N/A	DO NOT SCALE	1:1
				2 OF 2

Sorting, Shrapnel Shield - Mechanical Aspect

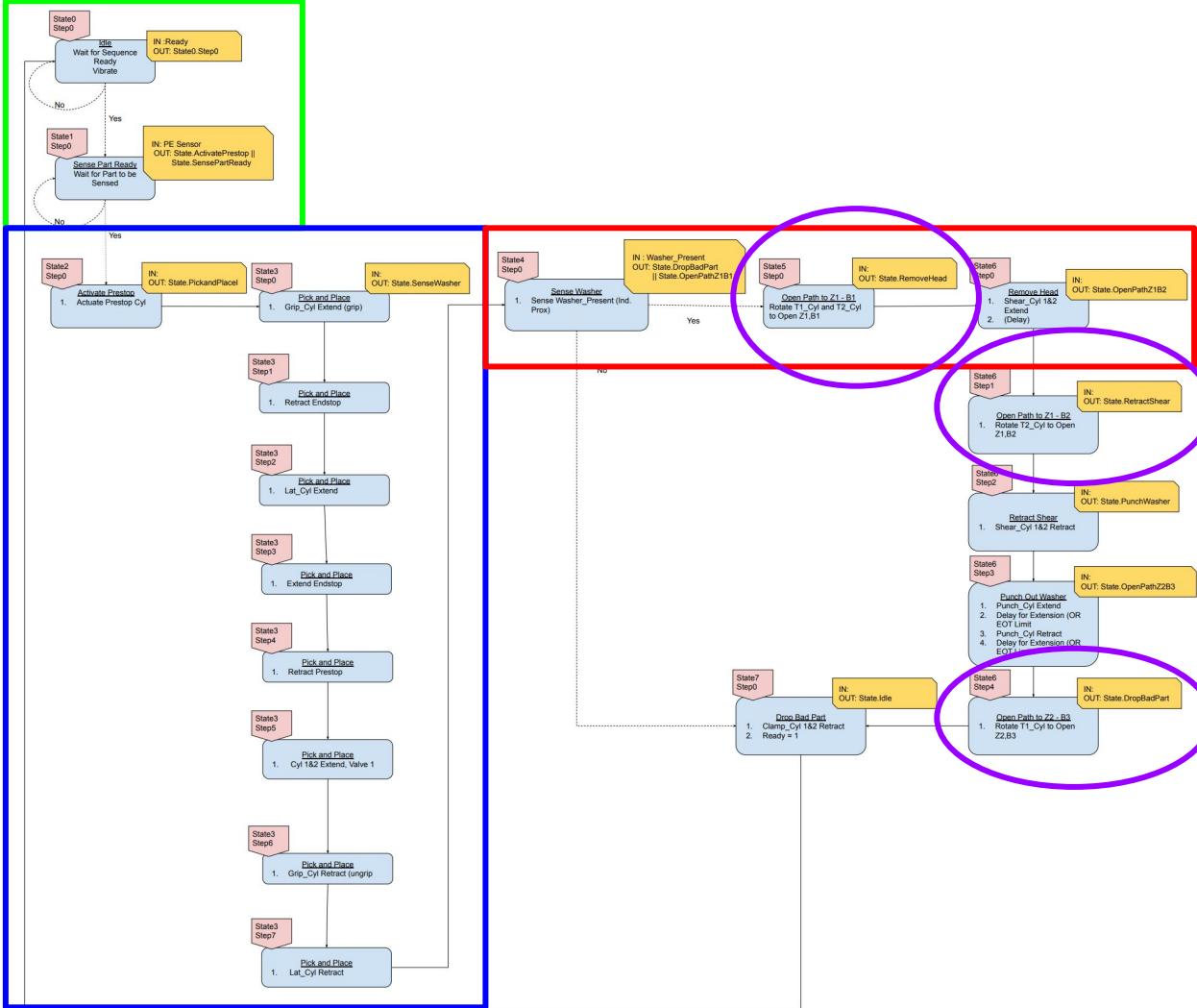
- Transition from cutting area to sorting mech.
- Prevent debris collecting outside cutting area
- Sheet metal construction
- 4 separate pieces
 - Left/right sides
 - House photo eye part presence sensor
 - Adjustable with slot
 - Back
 - Part transfer guard
 - Attached to front of part transfer



Electrical Aspect

Electrical Summary

- Head Removal (Red)
- Orienting Part (Green)
- Part Movement (Blue)
- Sorting (Purple)
- Human Interface through HMI
- Using Input block with proximity sensors
- Output Block with valves and solenoids



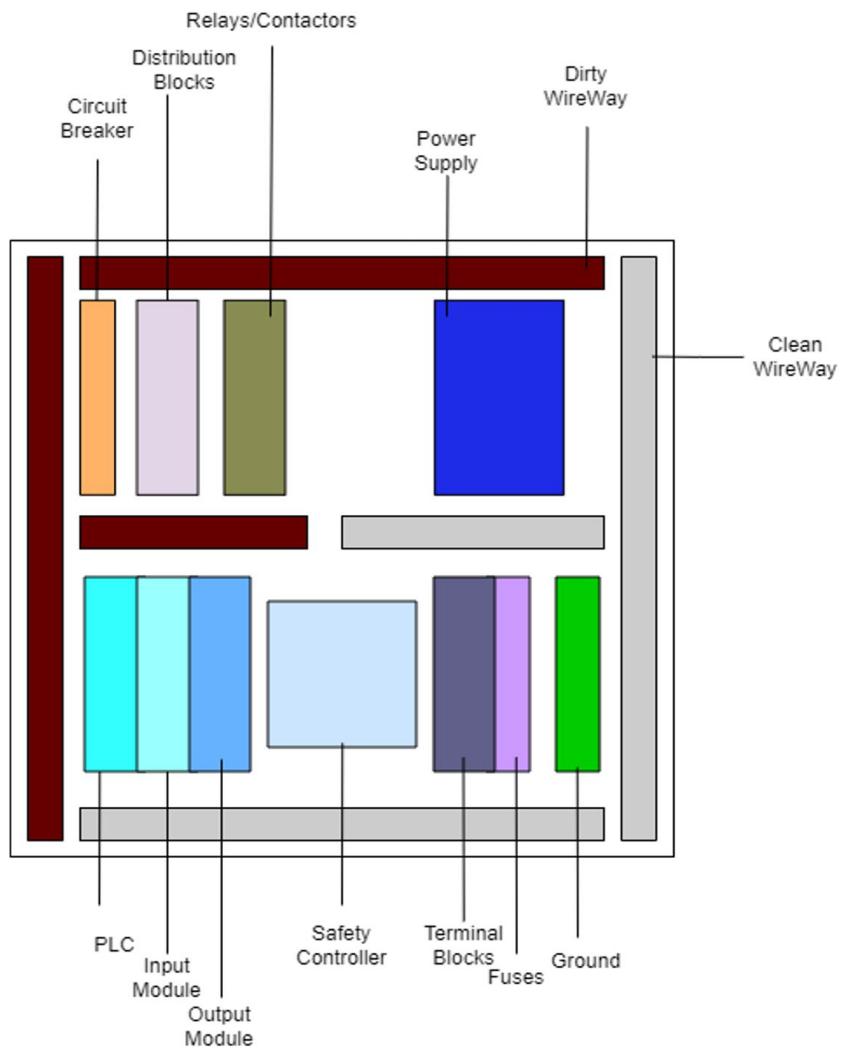
Program Overview

State	Step	IO Desc	Cyl States												
			Digital IN	Digital O	Analog I	Analog O	I/O Desc	Lat_Cyl	Grip_Cyl	Clamp_Cyl 1 & 2	RotAir_	RotAir_	Prestop	EndStop	Shear_Cyl 1 &
Idle	0	Idle/Reset	1				Cycle Start	R	R	R	R	R	E	R	R
Sense Part Ready	0	Wait for Sequence Ready	1				Software : Ready	R	R	R	R	R	E	R	R
	1	Sense Part Ready	1				Photo Eye 1	R	R	R	R	R	E	R	R
Activate Prestop	0	Prestop Extend	1				Prestop_Cyl	R	R	R	R	R	E	E	R
Pick and Place	0	Grip Extend	1				Grip_Cyl	R	E	R	R	R	E	E	R
	1	Endstop Retract	1				Endstop_Cyl	R	E	R	R	R	E	R	R
	2	Lateral Extend	1				Lat_Cyl	E	E	R	R	R	E	R	R
	3	Endstop Extend	1				(Endstop_Cyl)	E	E	R	R	R	E	E	R
	4	Prestop Retract	1				(Prestop_Cyl)	E	E	R	R	R	R	E	R
	5	Clamp Cyl 1 & 2 Extend	1				Clamp Valve	E	E	E	R	R	R	E	R
	6	Grip Retract	1				(Grip_Cyl)	E	R	E	R	R	R	E	R
	7	Lateral Retract	1				(Lat_Cyl)	R	R	E	R	R	R	E	R
Sense Washer	0	Sense Washer in Part	1				Ind. Prox 1	R	R	E	R	R	R	E	R
Open Path to Z1.B1	0	Rotate Air Cyl 1	1				RotAir_Cyl 1	R	R	E	E	R	R	E	R
	1	Rotate Air Cyl 2	1				RotAir_Cyl 2	R	R	E	E	E	R	E	R
Remove Head	0	Shear Cyl 1 & 2 Extend	1				Shear Valve	R	R	E	E	E	R	E	R
Open Path to Z1.B2	0	Rotate Air Cyl 2	1				(RotAir_Cyl2)	R	R	E	E	R	R	E	R
Retract Shear	0	Shear Retract	1				(Shear Valve)	R	R	E	E	R	R	E	R
Punch Out Washer	0	Punch Extend	1				Punch_Cyl	R	R	E	E	R	R	E	R
	1	Delay or EOT					Delay or Limit Swi	R	R	E	E	R	R	E	R
	2	Punch Retract	1				(Punch_Cyl)	R	R	E	E	R	R	E	R
	3	Delay or EOT					(Delay or Limit Swi)	R	R	E	E	R	R	E	R
Open Path to Z2.B3	0	Rotate Air Cyl 1	1				(RotAir_Cyl 1)	R	R	E	R	R	E	R	R
Drop Bad Part	0	Clamp Cyl 1 & 2 Retract	1				Clamp Valve	R	R	R	R	R	E	R	R
	1	Is Last Step	1				(Software : Ready)	R	R	R	R	R	R	E	R
Total			4	19	0	0									

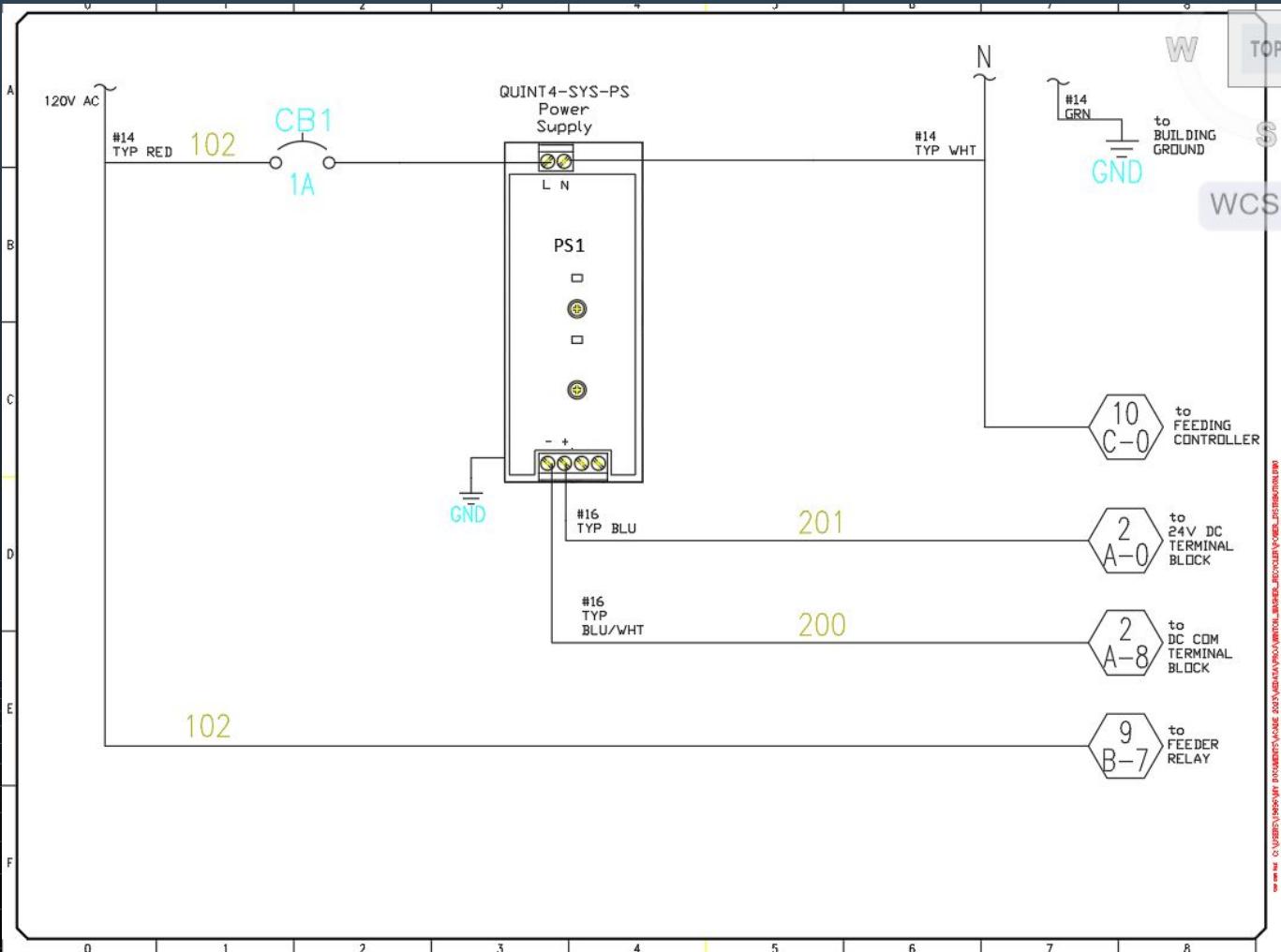
Panel Overview

Approximate Locations for:

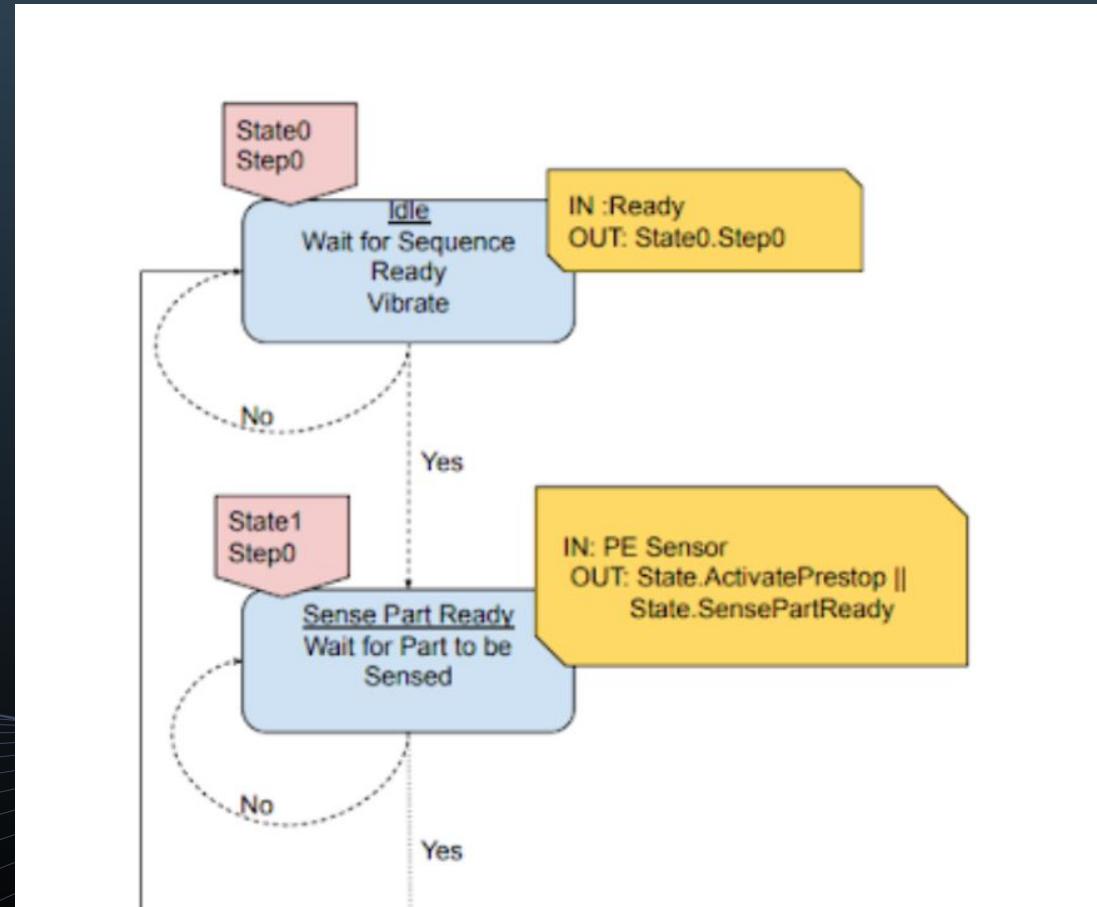
- Circuit Breaker
- Distribution Blocks
- Relays/Contractors
- Power Supply
- PLC
- Input Module
- Output Module
- Safety Controller
- Terminal Blocks
- Fuses
- Ground
- Dirty WireWay
- Clean WireWay

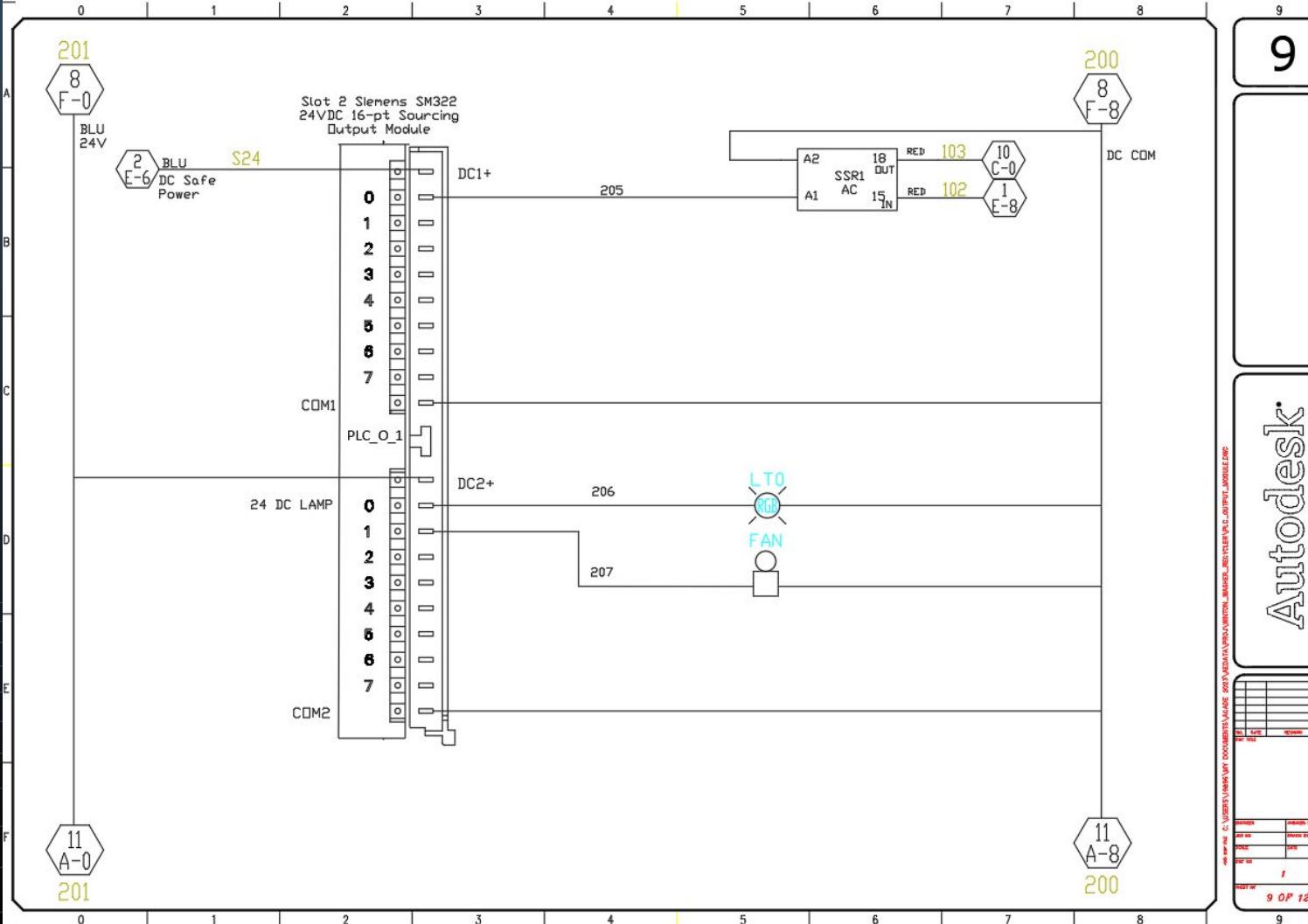


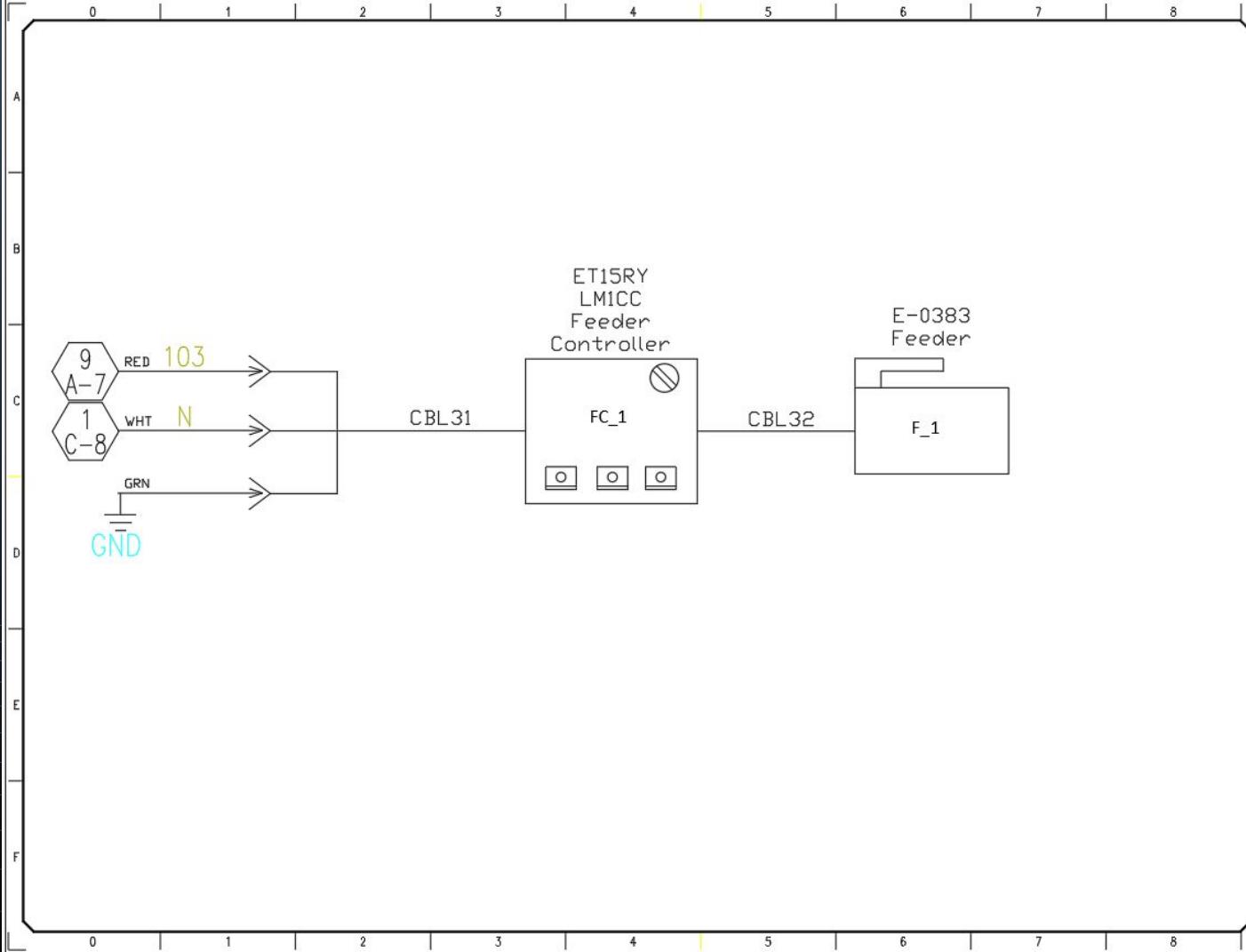
Power Distribution



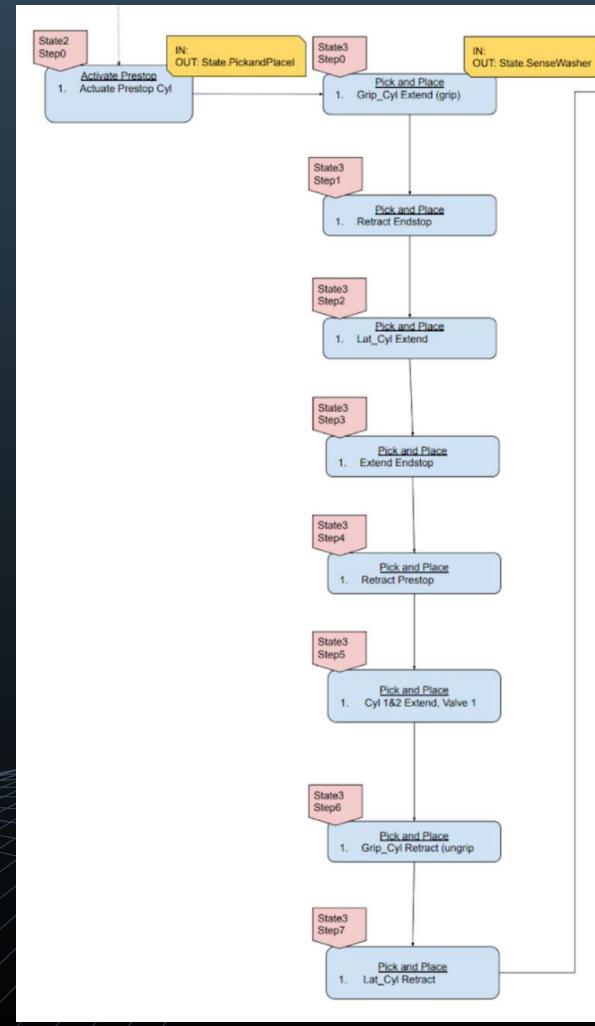
Orienting Part



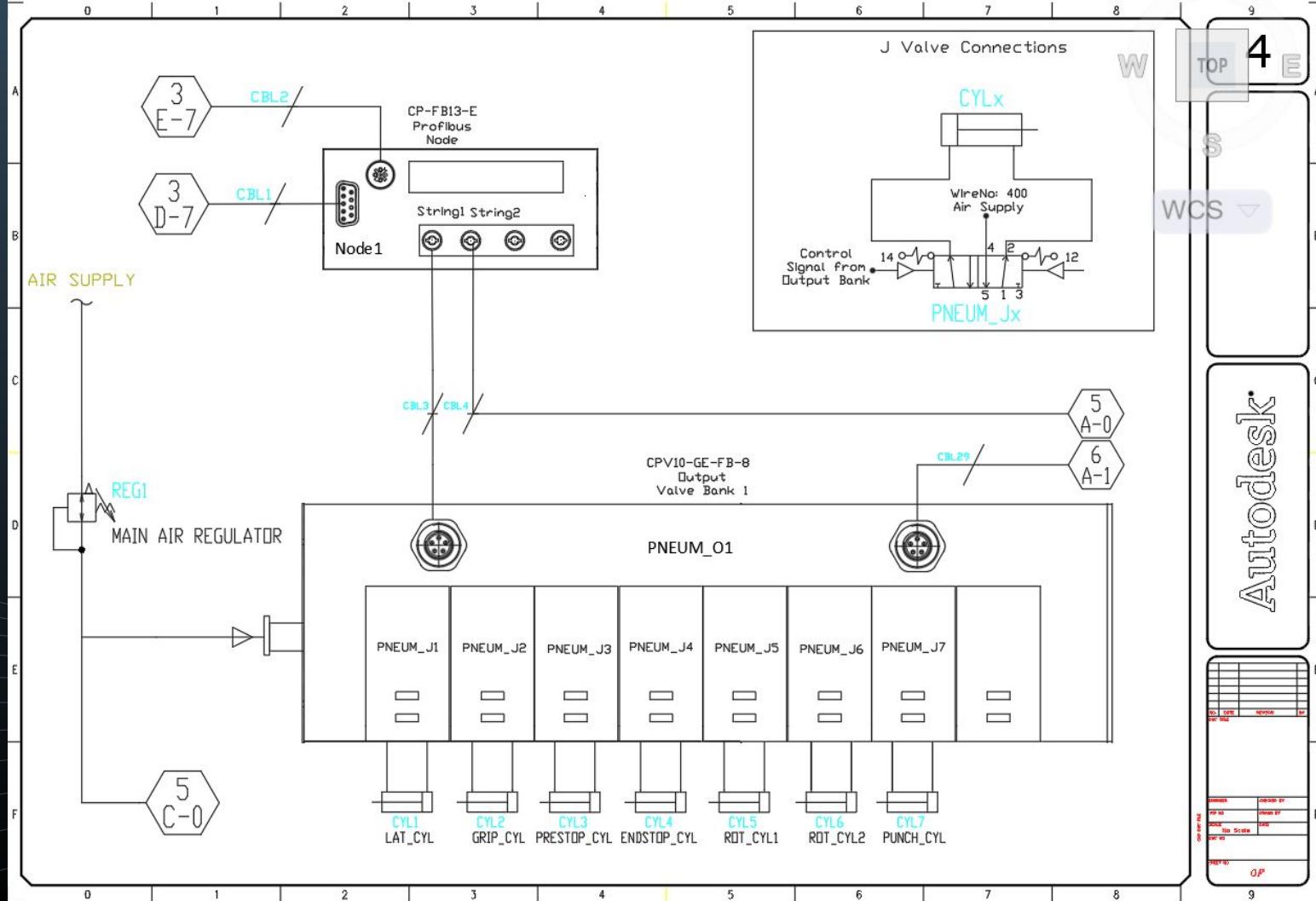




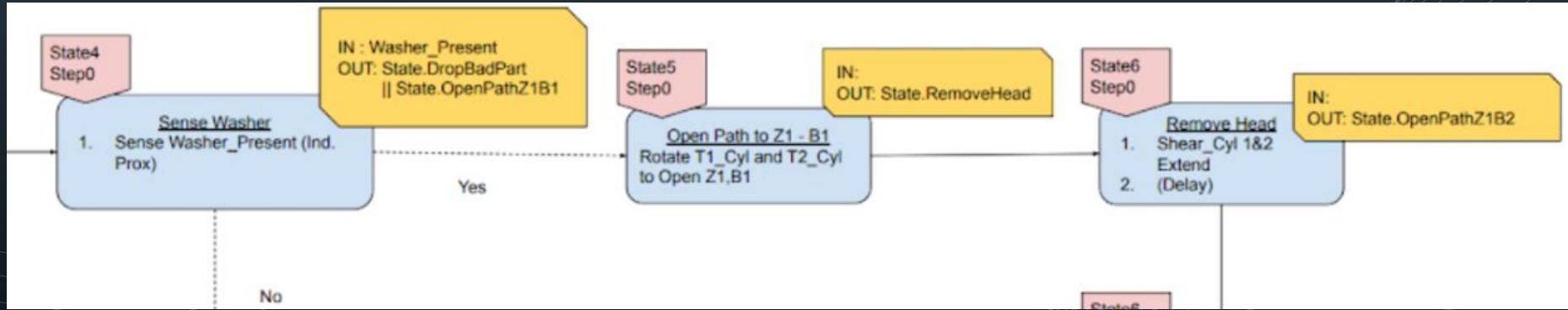
Part Movement



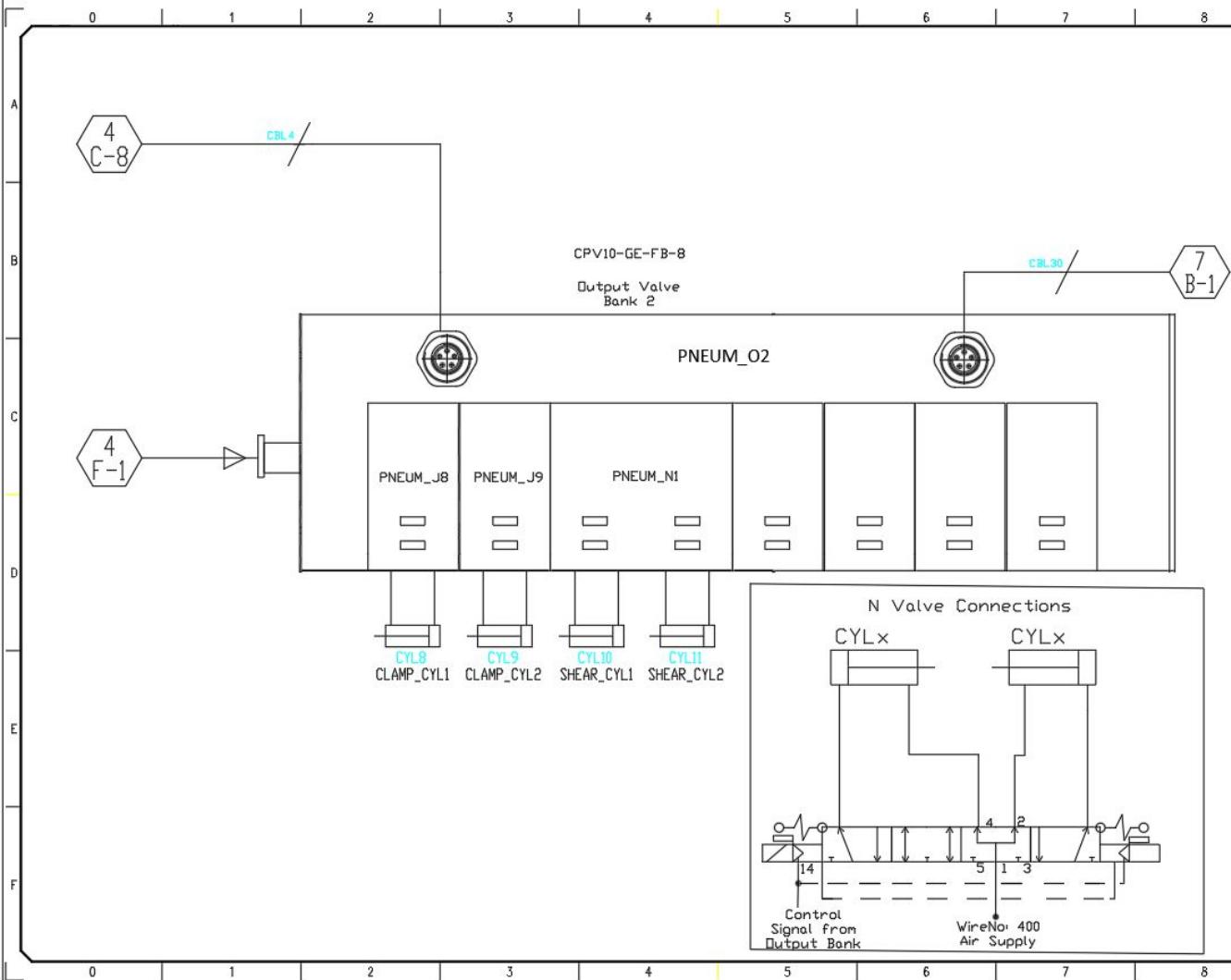
Part Movement



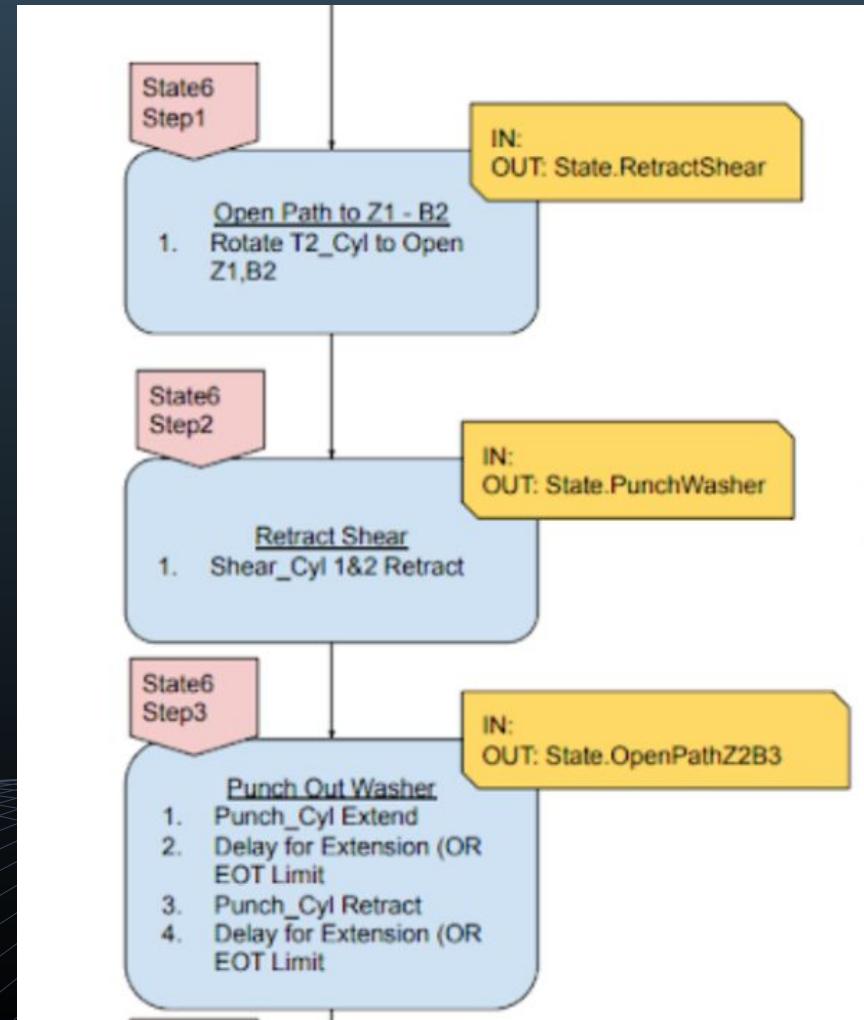
Head Removal



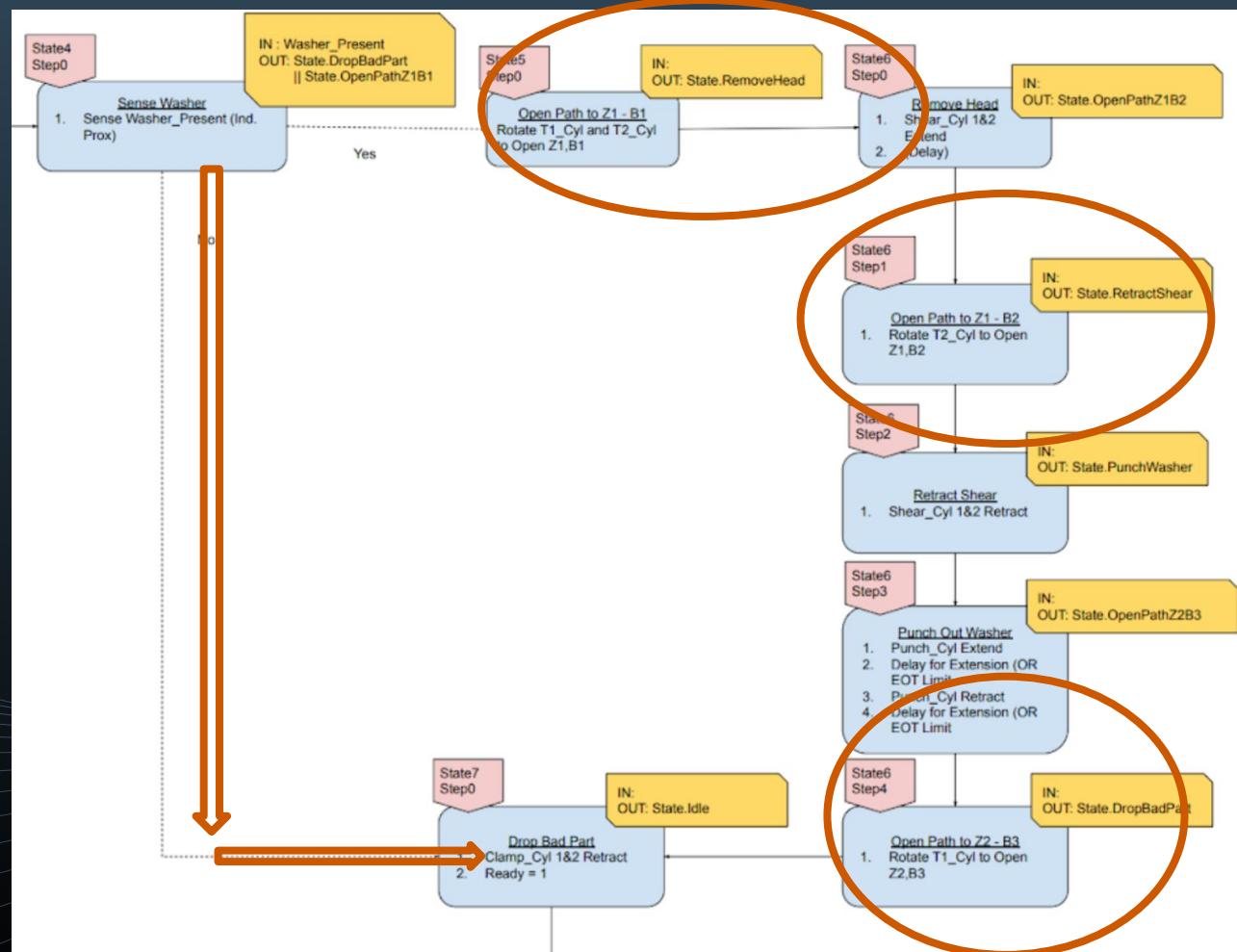
Head Removal



Washer Removal



Sorting



Estimated Cost of Project

Area of Interest	Total Cost
Mechanical Components	\$5,985.26
Pneumatics Components	\$500.00
Electrical Components	\$9,233.69
Transportation	\$200.00
20% Contingency Fee	\$3,184.88
Total Cost	\$19,103.83

Estimated Savings for the Project

If NOT disassembled/current process

- Weight per part = 0.13955 lbs/part
- 0.13955 lbs/part x 8,100,000 parts
 - 1,130,355 lbs
- At the recycled value of \$0.30/lb
 - \$339,107 per 5 years
 - \$67,821 per year
 - \$5,651.78 per month

If the part is disassembled

- Weight per part = 0.10400 lbs/part
- 0.104 lb/part x 8,100,000 parts
 - 842,400 lbs
- At the recycled value of \$1.50/lb
 - \$1,263,600 per 5 years
 - \$252,720 per year
 - \$21,060 per month

Increases Revenue by 272.626%

Specifications Summary

Adherence to Specification	Specification	Required or Optional	Value	Units	Test Method
Yes	Maximum Input Power	Required	110 V	volts	Yes/No
Yes	Maximum Input Air Pressure	Required	7 bar	bar	Yes/No
Yes	Use of hydraulic power not allowed	Required	Yes/No	-	Yes/No
Yes	Portability	Required	>400 kg	kilograms	Mass Scale
Inprocess	Tutorial - written, following attached template	Optional	-	-	Yes/No
Yes	Use metric units	Required	Yes/No	-	Engineer Drawing
Yes	Maximum Size of Machine	Required	Length: 0.9 m Height: 2.2 m Width: 1.0 m	meters	Tape measure

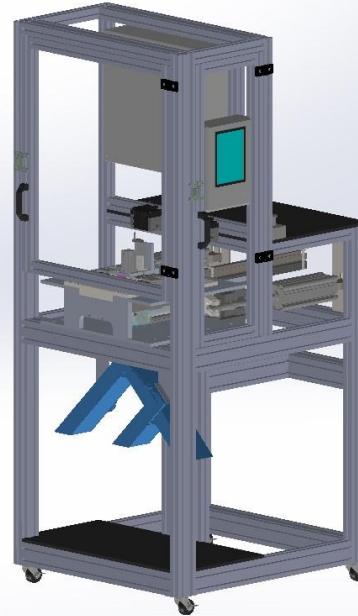
Specifications Summary

Adherence to Specification	Specification	Required or Optional	Value	Units	Test Method
7 s (calculated)	Maximum Cycle Time	Required	10 s	seconds	Run for one hour
17 mins (calculated)	Maximum interaction time with operator/technician per hour of use	Required	15 mins per 1 hour of run time	minutes	Run for one hour
99% (calculated)	Proper separation of Solenoid into 3 components (head, washer, overmolded coil)	Required	99/100 (99%)	parts	Run for one hour
Yes	HMI	Required	-	-	Yes/No
Yes	Maximum Opening Size	Required	38 mm	millimeters	Sphere test

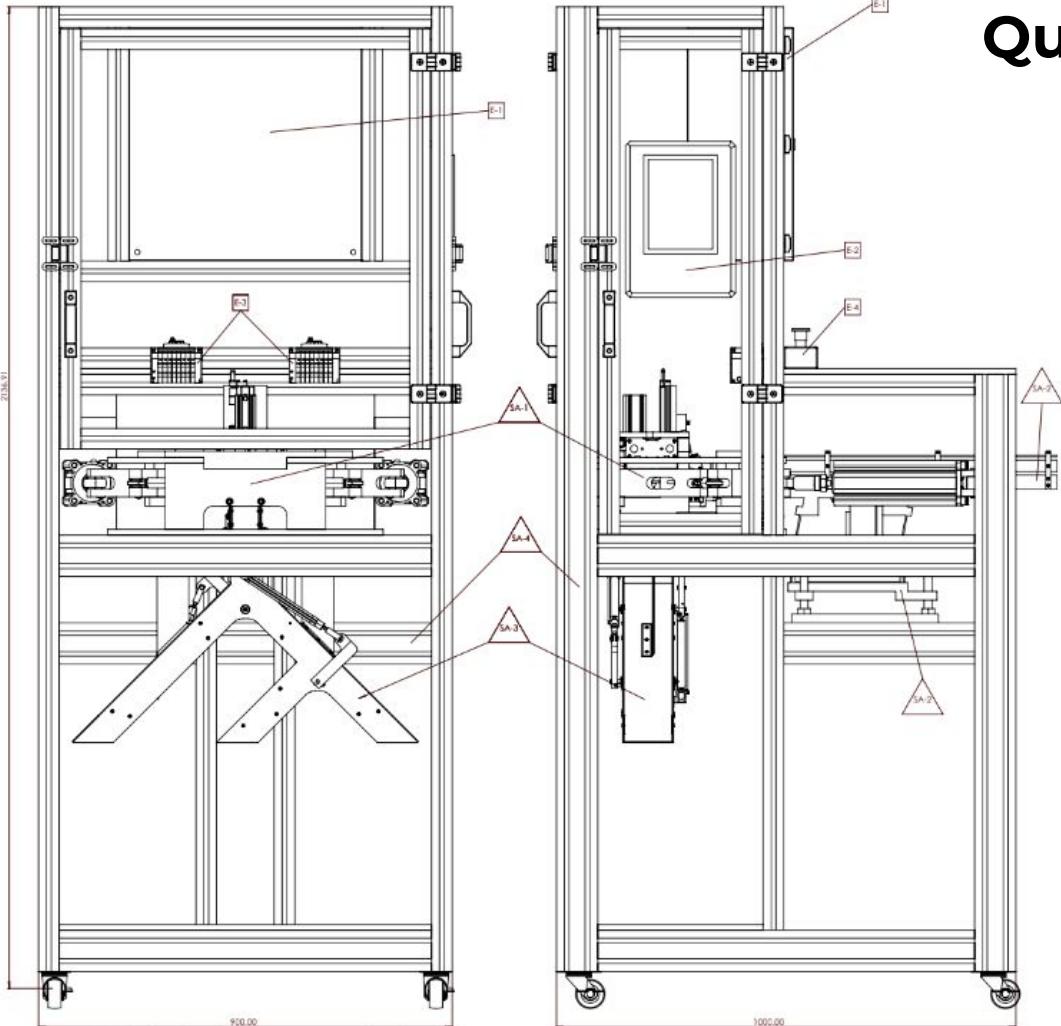
Specifications Summary

Adherence to Specification	Specification	Required or Optional	Value	Units	Test Method
Yes	Machine Safety Equipment Status Indicator	Required	-	-	Yes/No
Yes	Minimum 1 Emergency stop equipped and reachable	Required	-	-	Yes/No
Yes	Communication to I/O and HMI via ProfiBUS	Required	-	-	Yes/No
Yes	I/O achieved with Festo CPI valve banks and input blocks	Required	-	-	Yes/No
Yes	PLC Control	Required	-	-	Yes/No

Questions?



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