GVSU Capstone Project Design Document

Project: Winton Washer Recycler

Sponsor: Swoboda

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1.0 Executive Summary

Swoboda is a tier two automotive manufacturer specializing in precision overmolded plastic casting for wounded coils. Swoboda designs and manufactures one of these devices called the Winton solenoid. Swoboda produces roughly 1.8 million Winton solenoids annually, and they desire a recyclability factor for this production line; therefore, Swoboda has sponsored a Senior Design Project at Grand Valley State.

The Winton solenoid is an overmolded component, containing a copper wound coil, steel washer, and brass plated copper terminals. For recycling purposes, the Winton solenoid can be separated into three pieces: an overmolded coil, a steel washer, and a plastic head. Scrapped parts from the Winton solenoid production line are recycled as a complete assembly, drastically diminishing the value per pound of scrap received by Swoboda from the recycling company – as separating the steel from the plastic and copper isn't an easy task.

Swoboda produces an extraordinary amount of Winton solenoids, yet they have no process for in-house disassembling and recycling of the solenoid. The recyclability of the overmolded coils, steel washer, and the plastic head will decrease third-party processing costs and increase Swoboda's profitability. The current scrap rate for the Winton Solenoid is almost 8%, and a device to increase the value of the scrapped parts will increase the profitability of the Winton solenoid line.

The solution composed for disassembling and recycling the Winton solenoid is by means of shear separation, followed by a step-by-step process for sorting the disassembled components. The solution includes two rotating blades, a vibrating rail delivering mechanism, a trap door sorting mechanism, and any electrical components. The assembly of the device will include a compact casing followed by compliances in the desired specifications.

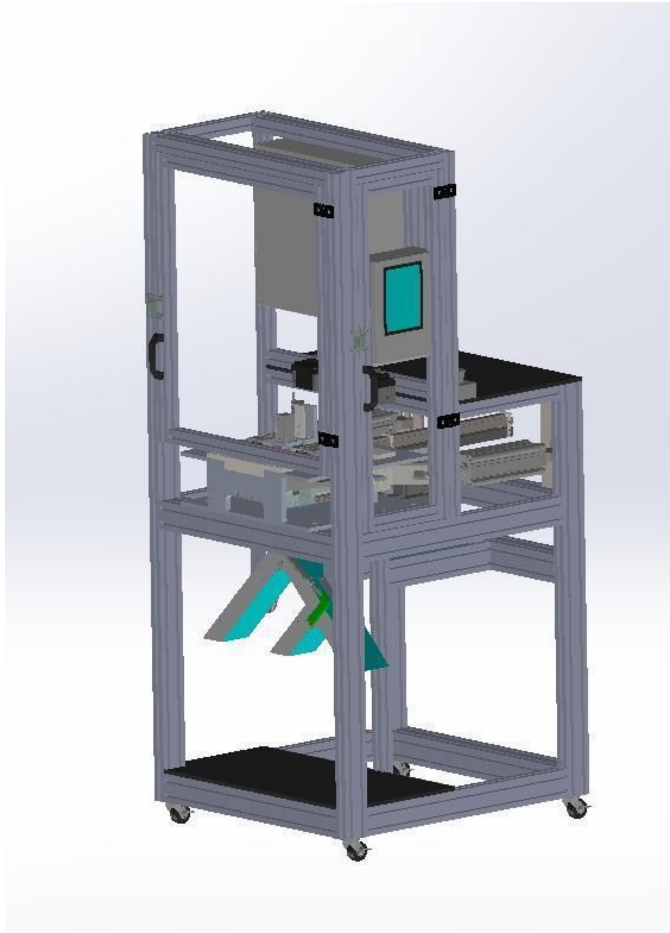


Figure 1.1: Final Concept

Figure 1.1 depicts the finalized concept of the Swoboda Winton Washer Machine. This machine fulfills all the specification requirements first ideated in the design process. Each subassembly of the design will be placed in an aluminum frame in the final construction phase.

Figure 1.1.2: Final Build

Figure 1.1.2 depicts the finalized built Winton Solenoid Recycler Machine.

2.0 Specifications Summary

2.1 Input Energy Specifications

Table 2.1 : Input Energy Specifications

Specification	Required or Optional	Value	Units	Test Method
Maximum Input Power	Required	110 V	volts	DMM
Maximum Input Air Pressure	Required	$6 < x < 8$	bar	Pressure Gauge
Use of hydraulic power is not allowed	Required	Yes/No	-	Visual Inspection

2.2 Functional Specifications

Table 2.2: Specifications (cont.)

Specification	Required or Optional	Value	Units	Test Method
Tutorial - written, following attached template	Required	-	-	Visual Inspection
Use metric units	Required	-	-	Engineer Drawing
Maximum Size of Machine	Required	Width: 0.9 m Height: 2.2 m Length: 1.0 m	meters	Tape measure
Maximum Opening Size	Required	-	-	Sphere test
Maximum Cycle Time	Required	10 s	seconds	1 hr. Trial Test (10 min sub trial)
Machine Safety Equipment Status Indicator	Required	-	-	Yes/No
Minimum 1 Emergency stop equipped and reachable	Required	-	-	Yes/No
Communication to I/0 and HMI via ProfiBUS	Required	-	-	Yes/No

Maximum interaction time with operator/technician per hour of use	Required	15 minutes per 60 minutes (in use)	minutes	1 hr. Trial Test
Proper separation of Solenoid into 3 components (head, washer, overmolded coil)	Required	> 99/100 (99%)	parts	1 hr. Trial Test (100 part sub trial)
HMI	Required	-	-	Visual Inspection
I/0 achieved with Festo CPI valve banks and input blocks	Required	-	-	Visual Inspection
PLC Control	Required	-	-	Visual Inspection
Portability	Required	< 400 kg	kilograms	Mass Scale

In order to outline the design constraints, some of the specifications from Table 2.1 and Table 2.2 need to be defined. The machine is constrained to operate from a 120 V power source and shop pressure of 6 to 8 bar. The machine must be portable – portability is defined by the ability of the operator/technician to move the machine along a level concrete surface with the use of 4 locking and swiveling casters attached to the machine's base. The caster's maximum allowable load will then define the metric of portability. Moreover, the maximum weight should be less than 400kg.

Furthermore, a significant design constraint is the dimensions of the device itself. The required maximum size of the machine is to be defined by the volumetric footprint of [0.8m (width) x 1.0 m (length) x 2.2 m (height)]. Lastly, the required maximum cycle time is 10 seconds. Assuming the loading of the Winton solenoid in que form, the cycle time is defined as time required to load, disassemble, and separate one solenoid.

3.0 Diagrams

3.1 Black Box Diagram

The machine should be a fully functioning automated cell that can separate the Winton solenoid into three components (head, washer, overmolded coil) and place the components into separate bins. The Black Box Diagram in Figure 3.1 shows inputs and outputs predicted to occur within the Winton Recycler.

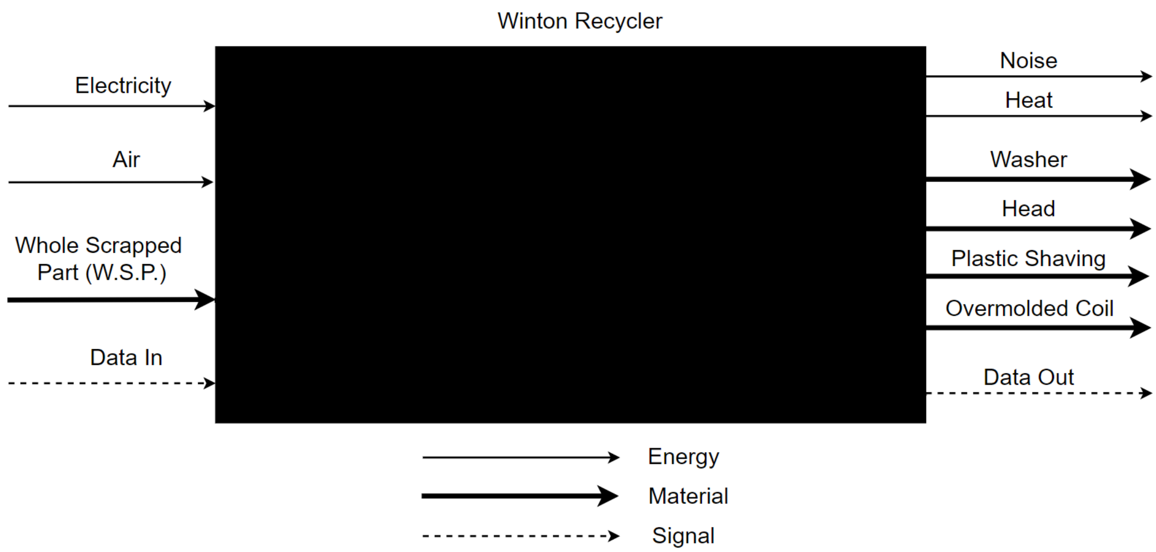


Figure 3.1: Black Box Diagram

3.2 Function Structure Diagram

As seen in Figure 3.2, the Function Structure Diagram (FSD) of the Winton Recycler shows the critical subfunctions present within the machine, as well as how the inputs and outputs are distributed throughout the subfunctions as seen in Figure 3.2.

- Orienting part: All functions dealing with the movement of the Whole Scrap Part (W.S.P.) from the outside world to the first point of contact with the disassembly mechanism. (i.e. feeding mechanism).
- Part Movement: First point of contact between W.S.P. and disassembly mechanism. This includes taking W.S.P. from the feeding mechanism and moving to the disassembly mechanism.
- Head Removal and Washer Removal: Both are part of the disassembly mechanism. But both are conducted separately from each other.
- Sorting: Sorting includes all functions used to properly sort and store the disassembled components.

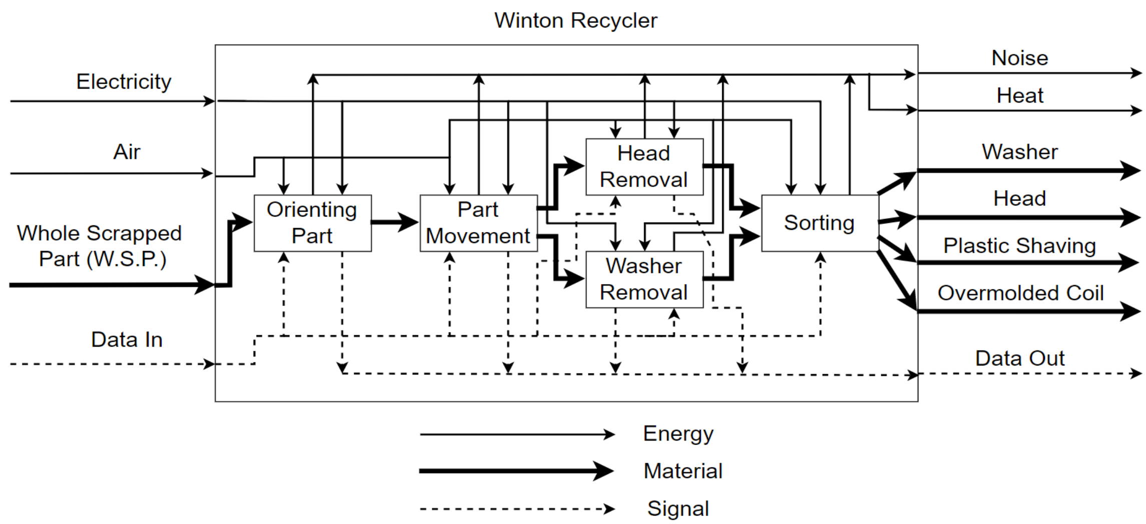


Figure 3.2: Function Structure Diagram

3.3 Electrical System Diagrams

The following diagrams show the general connections between components in the design.

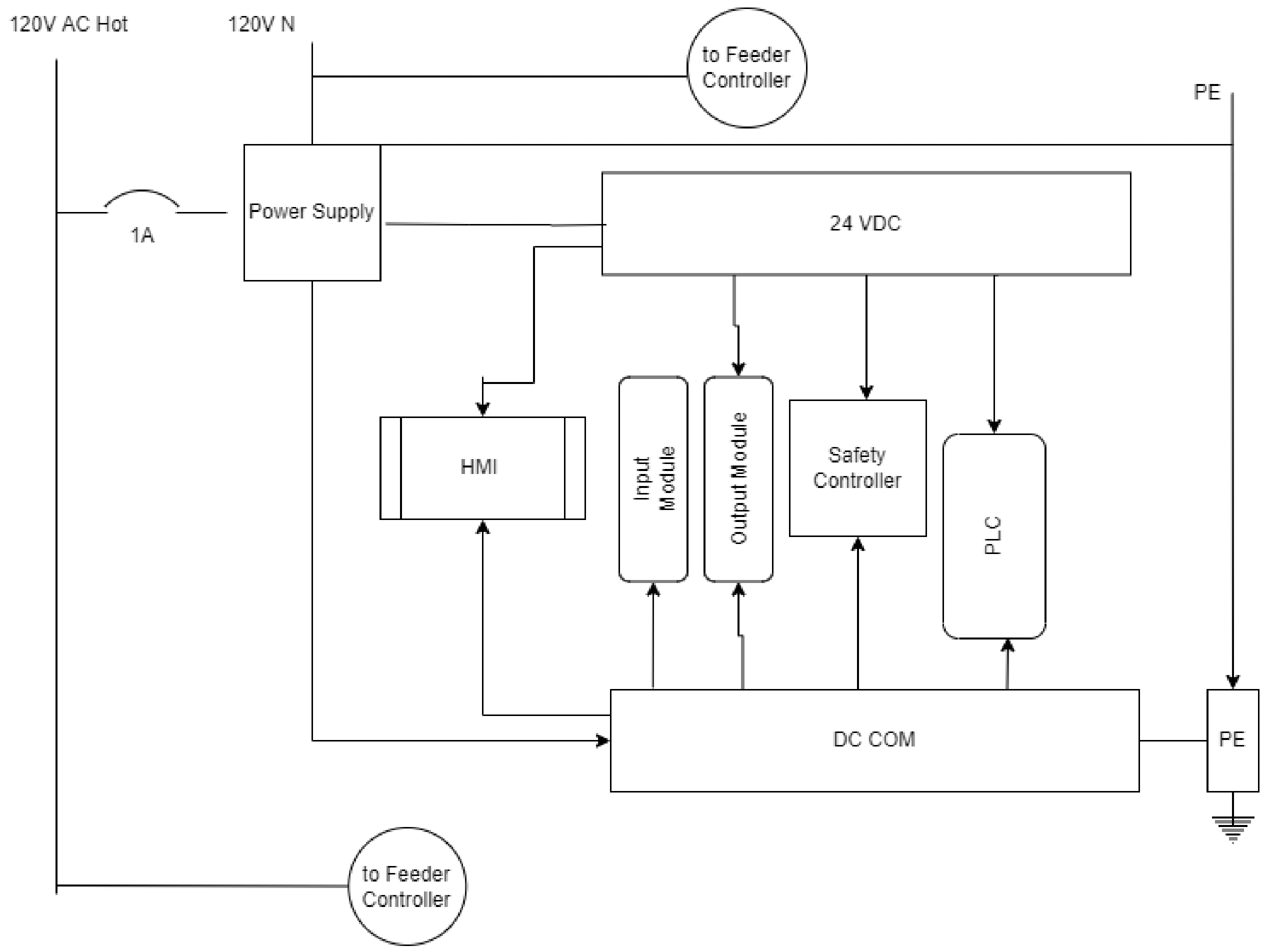


Figure 3.3: Electrical Block Diagram - Power Distribution

The Figure 3.3 shows the general connections for power distribution. 120 V single phase AC is fed into the machine from the building, powering the 24V DC power supply. The power supply will feed a 24V and Common DC terminal blocks. All components besides the Feeder will be powered and controlled using 24V. The HMI requires a 1A fuse. The input module is sourcing, so 24V is fed to the input module. Components that act as inputs to the PLC will receive the sourcing wire from the input module and run to the DC COM. Other modules receive common and power, and the PLC data sheet demands a 2A fuse.

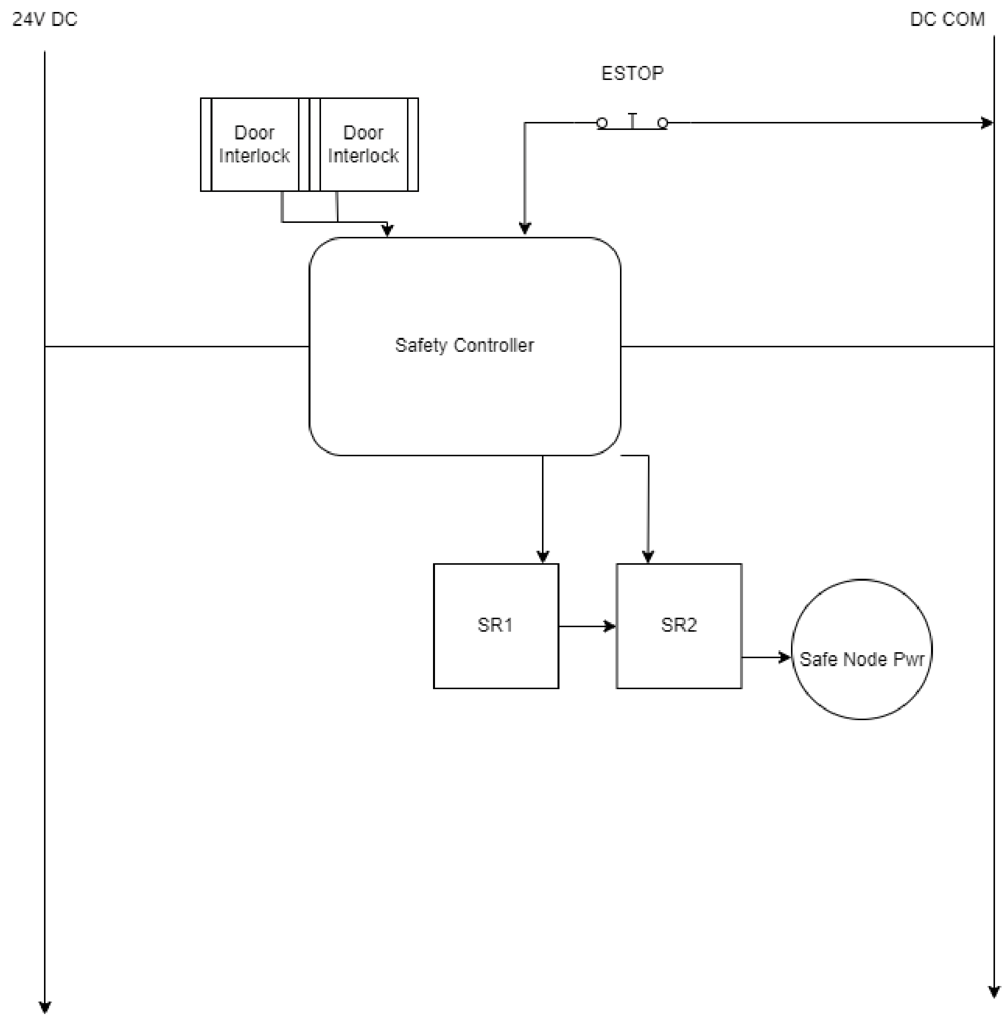


Figure 3.4: Electrical Block Diagram - Safety Controller

The diagram above shows the general connections for the safety controller. The machine has shearing cylinders that must be provided with "safe" DC power, output from the safety controller shown above by confirming the integrity of its safety interlocks. There are two doors on the machine that can be opened to perform maintenance, as well as an ESTOP for emergency stoppage of the machine by operator. Each of these inputs is wired into the controller normally closed. When one of the safety circuits is broken, the Pneumatic and PLC Output Modules lose power and can no longer be actuated.

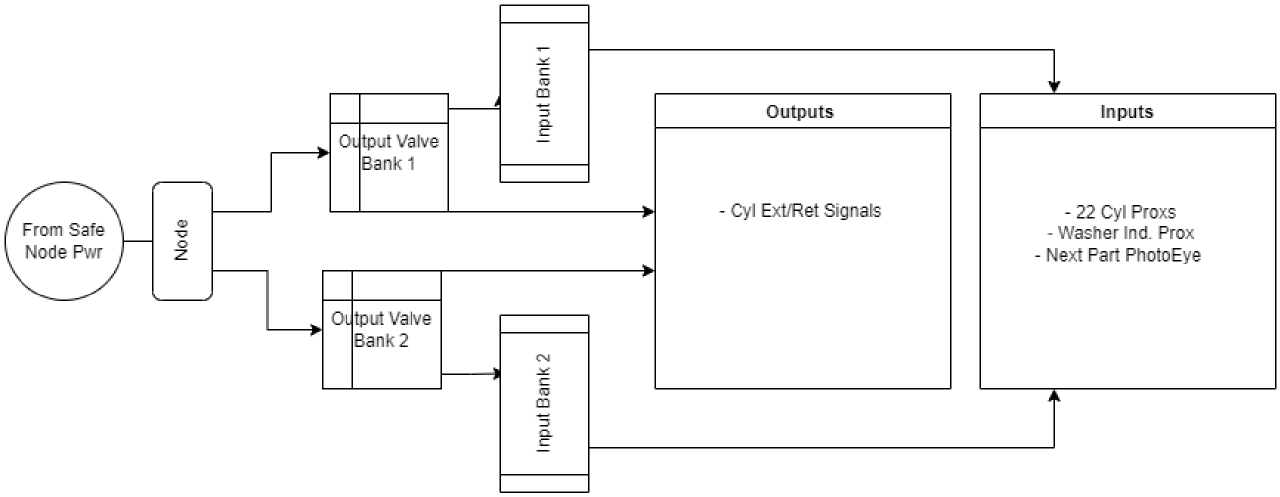


Figure 3.5: Electrical Block Diagram - Pneumatics

Figure 3.5 shows the general connections for the Pneumatics. Power and Profibus signals are sent to the Pneumatic Node from the PLC. Festo Pneumatics works on strings. The node provides power and a data bus to the output bank, and then directly to the input module. The node works with the PLC to communicate input and outputs. The output bank provides air to the extension and retraction signals of the cylinders. The input banks receive input signals from the proximity sensors for extension and retraction EOT limits, as well as for the proximity sensor for whether the washer is in the part, and the photoelectric sensor that tells the machine whether the next part is ready to be processed.

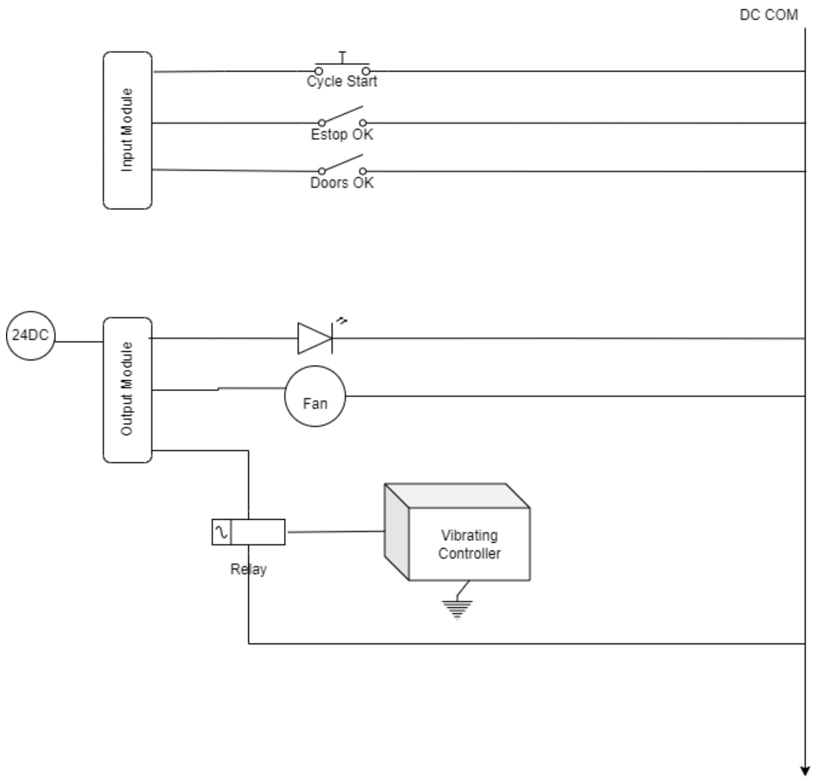


Figure 3.6: Electrical Block Diagram - IO Modules

Figure 3.6 above shows the general connections for the PLC IO modules. Power is provided to the sourcing modules which provide current to the components, attached to DC COM. The machine will have a cycle start and an ESTOP push buttons as input. Outputs are split into two sections, as the PLC Output Module allows for two separate provisions of power. SAFE 24V DC is provided to the first section, which provides the 24V input signal to the Feeder Relay, switching the hot signal out to the Feeder Controller, which controls the provision and frequency of power to the vibrating component of the feeder. Some outputs are kept on as long as power is provided to the machine; these include a fan, which will be installed on a face of the enclosure to dissipate heat, and a lamp to provide light to the inside of the machine.

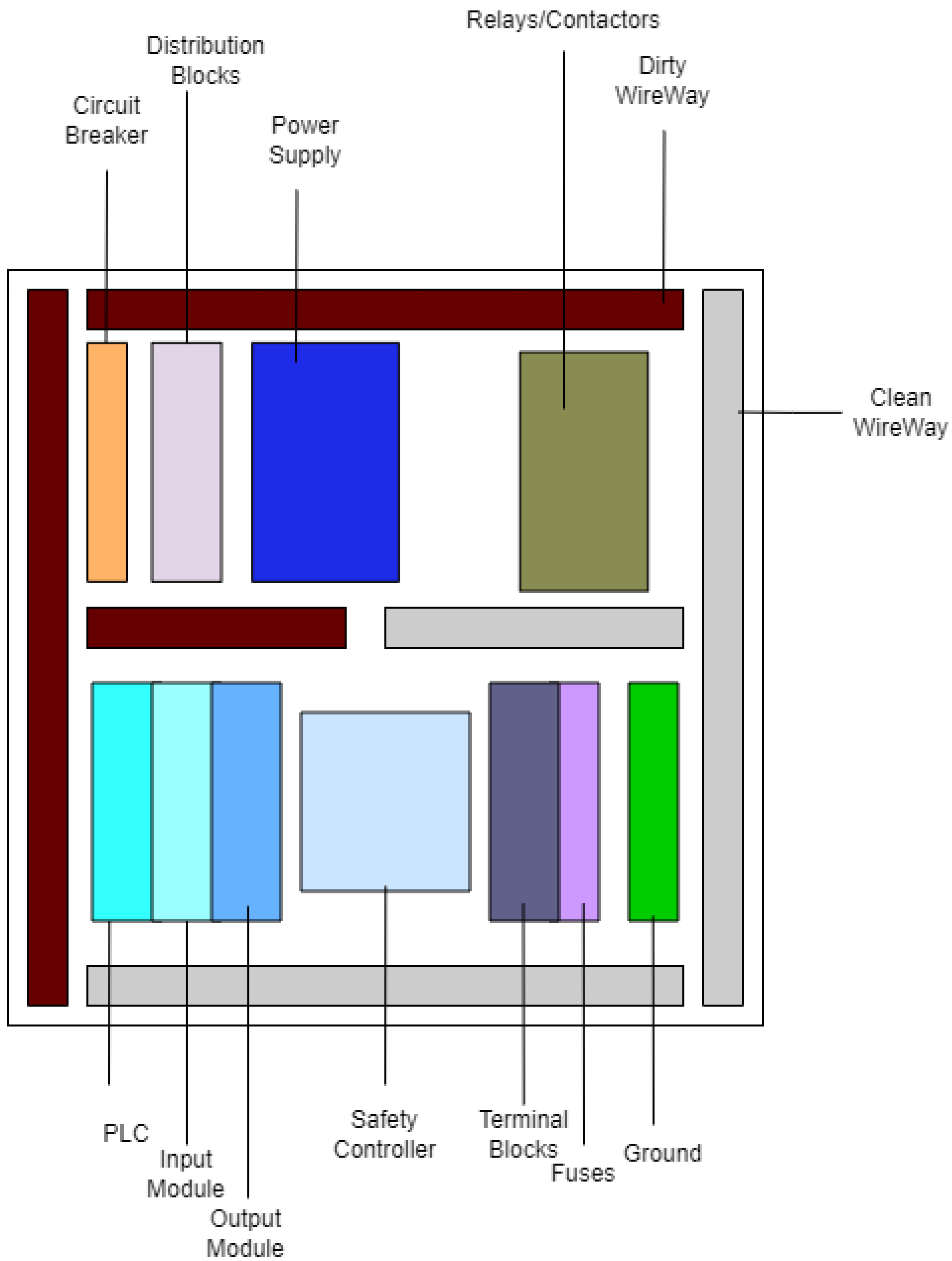


Figure 3.7: PLC Block Diagram

Figure 3.7 above shows a general layout of the components inside the enclosure. The layout provides space for separation of high differential in voltages in devices, as well as wire. There is one circuit breaker for the power supply. Distribution blocks are provided to distribute 120V AC hot and neutral signals to the power supply and the Feeder. The relay is for PLC control of the Feeder. PLC and its module layout, as well as terminal blocks and fuses, was reproduced from the Sonoma Recycler,

3.4 State Diagrams

3.4.1 Signal Planning Table

Table 3.1 : Signal Planning Table

Type	Tag
OUT	LAT_CYL_EXT_SIG
	LAT_CYL_RET_SIG
	GRIP_CYL_EXT_SIG
	GRIP_CYL_RET_SIG
	PRESTOP_CYL_EXT_SIG
	PRESTOP_CYL_RET_SIG
	ENSTOP_CYL_EXT_SIG
	ENSTOP_CYL_RET_SIG
	T1_CYL_EXT_SIG
	T1_CYL_RET_SIG
	T2_CYL_EXT_SIG
	T2_CYL_RET_SIG
	PUNCH_CYL_EXT_SIG
	PUNCH_CYL_RET_SIG
	SHEAR1_CYL_EXT_SIG
	SHEAR1_CYL_RET_SIG
	SHEAR2_CYL_EXT_SIG

	SHEAR2_CYL_RET_SIG
	CLAMP1_CYL_EXT_SIG
	CLAMP1_CYL_RET_SIG
	CLAMP2_CYL_EXT_SIG
	CLAMP2_CYL_EXT_SIG
IN	LAT_CYL_PROX_EXT
	LAT_CYL_PROX_RET
	GRIP_CYL_PROX_EXT
	GRIP_CYL_PROX_RET
	PRESTOP_CYL_PROX_EXT
	PRESTOP_CYL_PROX_RET
	ENSTOP_CYL_PROX_EXT
	ENSTOP_CYL_PROX_RET
	T1_CYL_PROX_EXT
	T1_CYL_PROX_RET
	T2_CYL_PROX_EXT
	T2_CYL_PROX_RET
	PUNCH_CYL_PROX_EXT
	PUNCH_CYL_PROX_RET
	SHEAR1_CYL_PROX_EXT
	SHEAR1_CYL_PROX_EXT
	SHEAR2_CYL_PROX_EXT
	SHEAR2_CYL_PROX_EXT
	CLAMP1_CYL_PROX_EXT
	CLAMP1_CYL_PROX_RET

	CLAMP2_CYL_PROX_EXT
	CLAMP2_CYL_PROX_RET
	WASHER_IN_PART_PROX
	PART_READY_PE
	Cycle_Start
	ESTOP
PV	PV_Reset
	PV_FLT_RESET
	M_Ext Sigs
	M_Ret_Sigs
	PV_Vibrate

System IO was planned out to get an idea of the number of inputs and outputs needed and where they would come from/go to. Outputs listed are the extension and retraction signals for the cylinders, the inputs are the EOT limits, proximity sensor for the washer in the part, and the photoelectric sensor that detects the next part ready to be processed. HMI IO has also been planned out, as a significant amount of functionality is dependant upon a working HMI program and its signals. PV_Reset will set all cylinders to their home positions and set the machine to its idle state. It may also clear faults and production counts. PV_FLT_Reset functions as a fault reset, clearing the machine of faults and operator prompts that would otherwise prohibit function. M_xxx tags are manual control signals for testing and debugging the machine; PV_Vibrate works very similarly, as a maintained manual control button on the HMI.

3.4.2 State/IO Table

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

Figure 3.8: State/IO Diagram

Figure 3.8 details the states and the steps for that state; this includes the step description, whether it is reading an input or setting an output, and defines the physical component corresponding to the input or output. The cylinder states section of the figure details the positioning of each cylinder in each state. The first three rows are green to indicate all cylinders are in their starting state and the machine has not yet begun a process cycle. After activating the prestop, the columns turn green again once it has completed a cycle of movement within the process and has returned to its starting state. In software, the state of all relevant cylinders will be checked before moving to the next state.

3.4.2 Program Flow Diagram

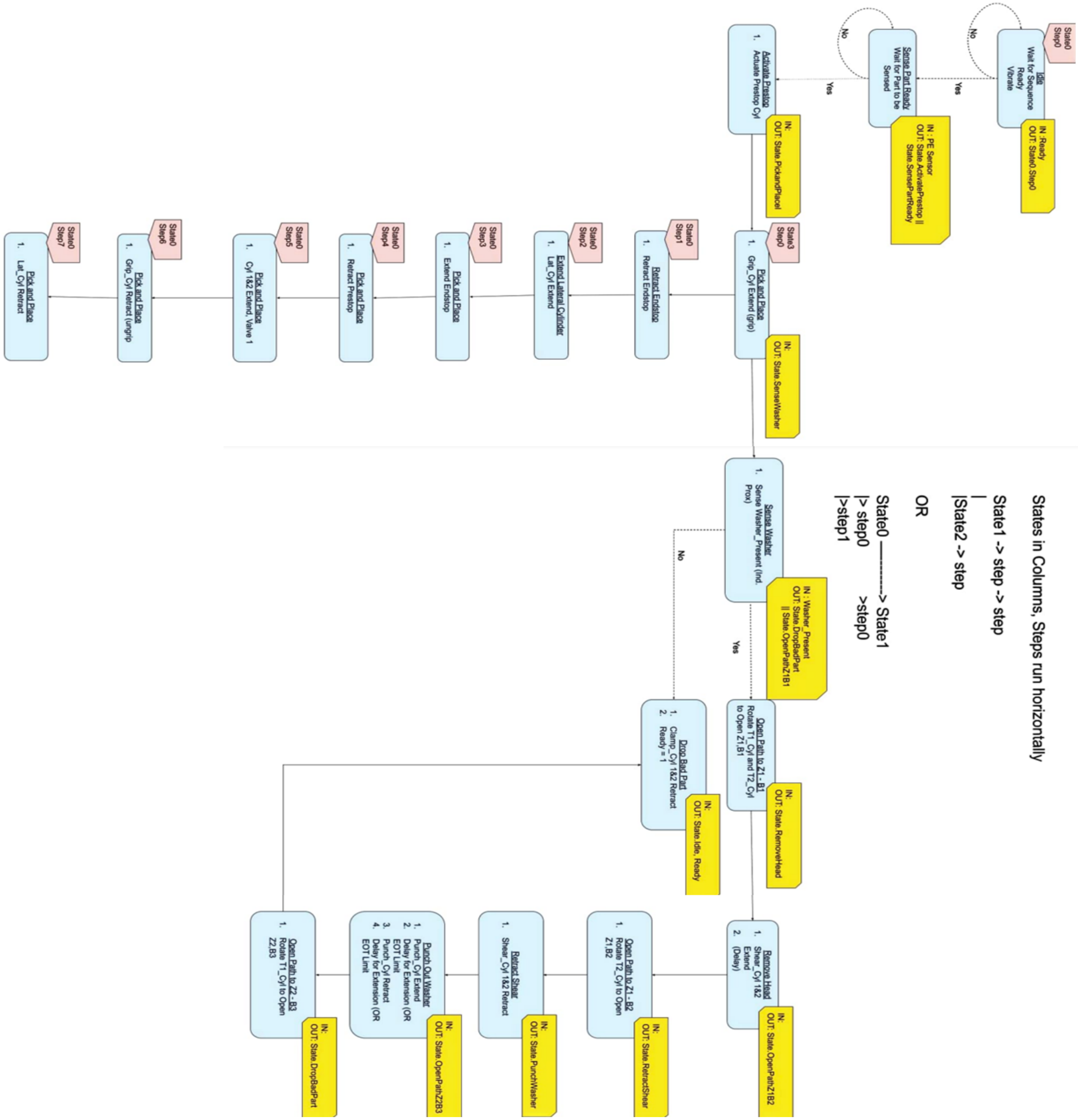


Figure 3.9: Program Flow Diagram

Figure 3.9 details the program flow for the machine as it processes material. Any logical decisions are shown using dotted lines with a 'Yes' or 'No" caption. Red shapes contain the state and step of the process, the blue contains the name and action of the state, and the yellow contains the inputs being evaluated in the state and possible output states.

4.0 Mechanical Sub Assembly Processes

4.1 Sub Assembly One - Head Removal

The head removal process has undergone multiple iterations of design as shown through the Shear Arm Prototype 2. The final design was modified slightly, which includes modifications to adjustability in solenoid height and location for shearing effectiveness.

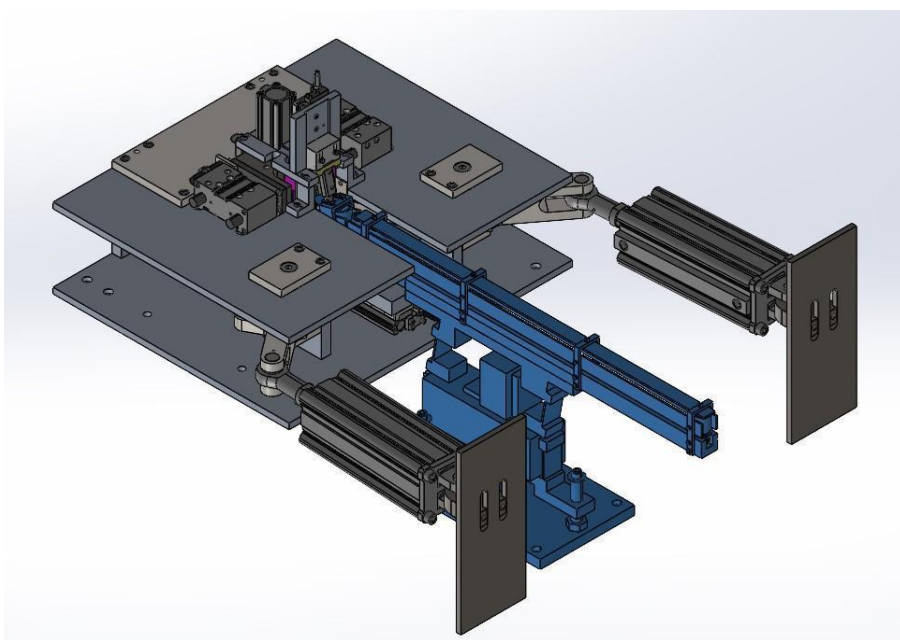


Figure 4.1.1: Sub Assembly One CAD Model

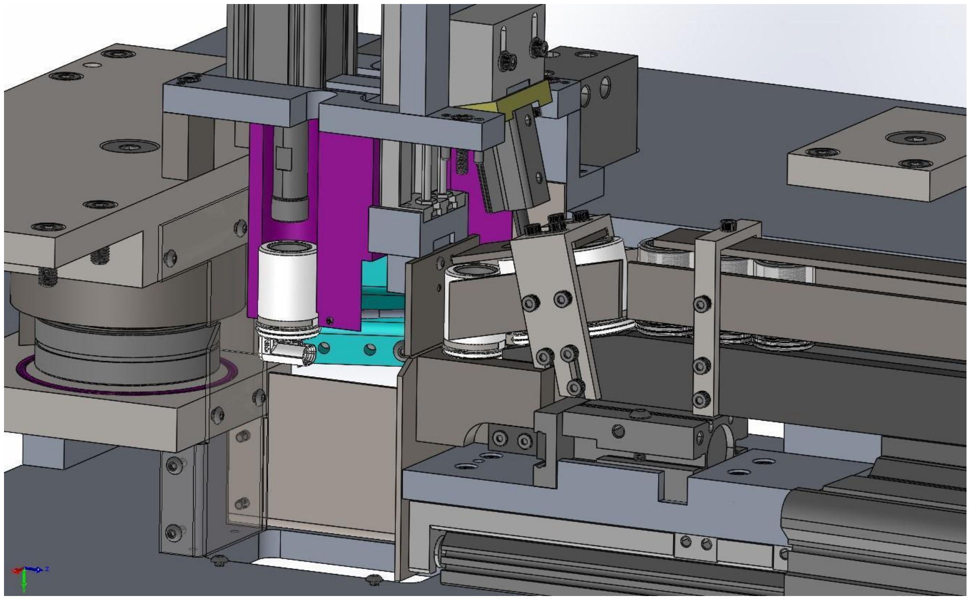


Figure 4.1.2: Sub Assembly One Part Insert

Sub Assembly One is the head removal process of the Winton solenoid. As the part is transferred through a vibrating rail, the part enters a gripper (Figure 4.1.2) and is moved translationally to the clamping mechanism. The portion where the Winton solenoid enters the gripper is slanted. The top, bottom, and side rails ensure that the part does not rotate or tip. A pre-stop and end-stop are mechanical features that utilize a photo-eye sensor and move in place to prevent pieces from entering the shearing chamber. Once seated in the gripper, the blast gate will move up and a pneumatic cylinder will move the part translationally into the clamp. As the clamp closes, the cylinder retreats and the blast gate shuts.

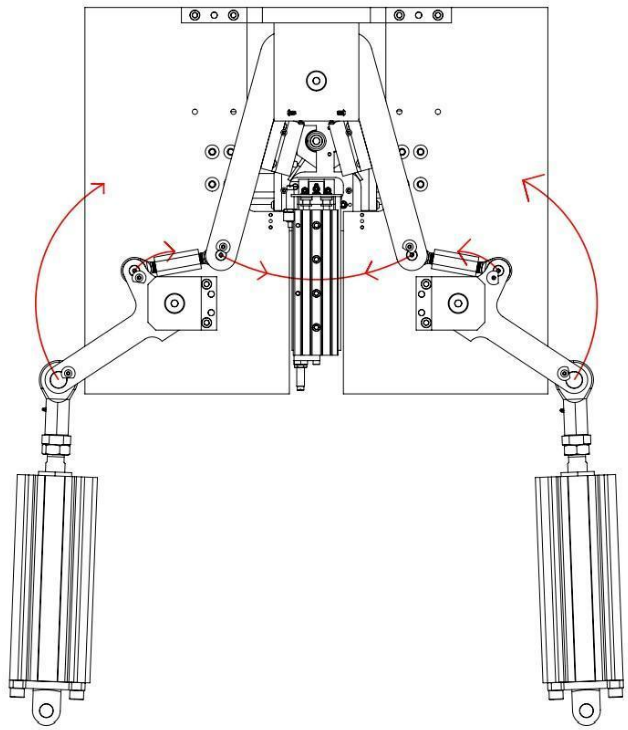


Figure 4.1.3: Shearing Arm Movement

As the Winton solenoid is securely seated in the clamping mechanism, pressure builds in the shearing arm cylinders and then fires to shear off the plastic head. The piece is seated precisely in the clamp to expose the small surface area below the plastic head and above the steel washer. As the cylinders fire, the shearing arms move as depicted in Figure 4.1.3, and make contact with the solenoid until the centerline is reached and the head is fully removed.

The selection process for the correct sheering mechanism was iterated over five times to finally determine the best method. This method, as referenced in the Concept Selection document SAP5, was refined over continuous shearing tests shown in Appendix F. The final and most optimized orientation is displayed in the figures above. This finalized model utilizes a rigid and optimal bearing selection – a double row spherical rolling bearing. The hand calculations show the bearings have a minimal life of 8.1 million cycles with an application factor of 1.

4.2 Sub Assembly Two-Part Transfer

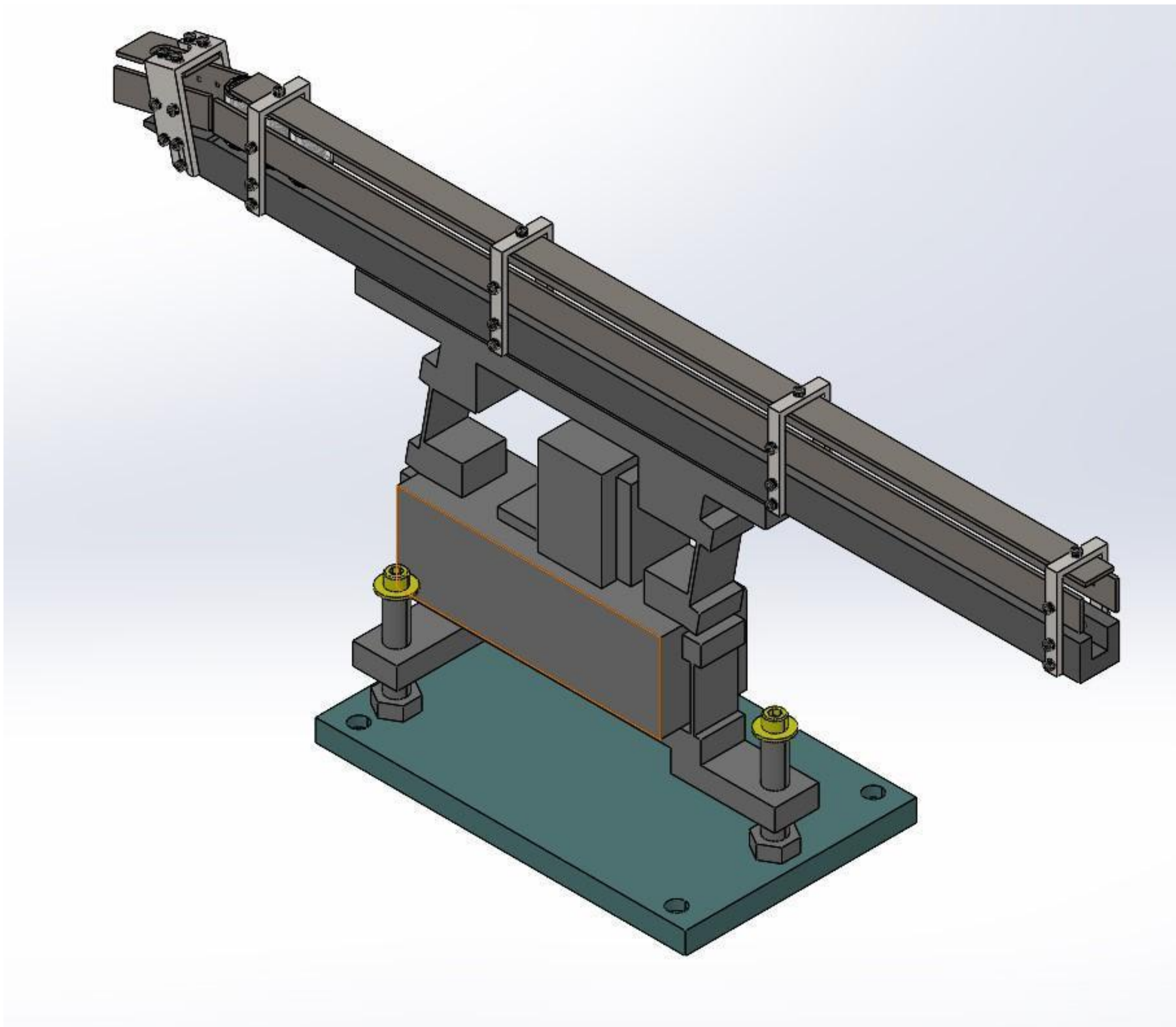


Figure 4.2.1: Sub Assembly Two - Vibrating Rail

Sub Assembly Two is the vibrating rail component of the Winton washer machine. The vibrating rail itself is specifically designed to fit the profile of a Winton solenoid with +/- 0.5mm tolerances. The Winton washer will vibrate down the rail until it reaches the end, where it is slanted. This slanted portion is the beginning of sub assembly one. There are three complete rails in this assembly, held together by U brackets. The top, bottom, and side pieces ensure the Winton solenoid is constrained to one axis and does not rotate or tip in any way.

The gravity rail is the feeding mechanism for the winton washer machine. It's first iteration of design was to utilize gravity, found in B.6 - Gravity Rail Prototype. After it was found that it wouldn't work efficiently and effectively, thus utilizing an already existing method of vibration was undertaken. The vibrating rail ensures proper orientation of the solenoid and maintains tight tolerances to do so. By using the vibrating rail, parts shimmy quickly enough from entrance to exit to satisfy Swoboda cycle time requirements.

4.3 Sub Assembly Three - Sorting

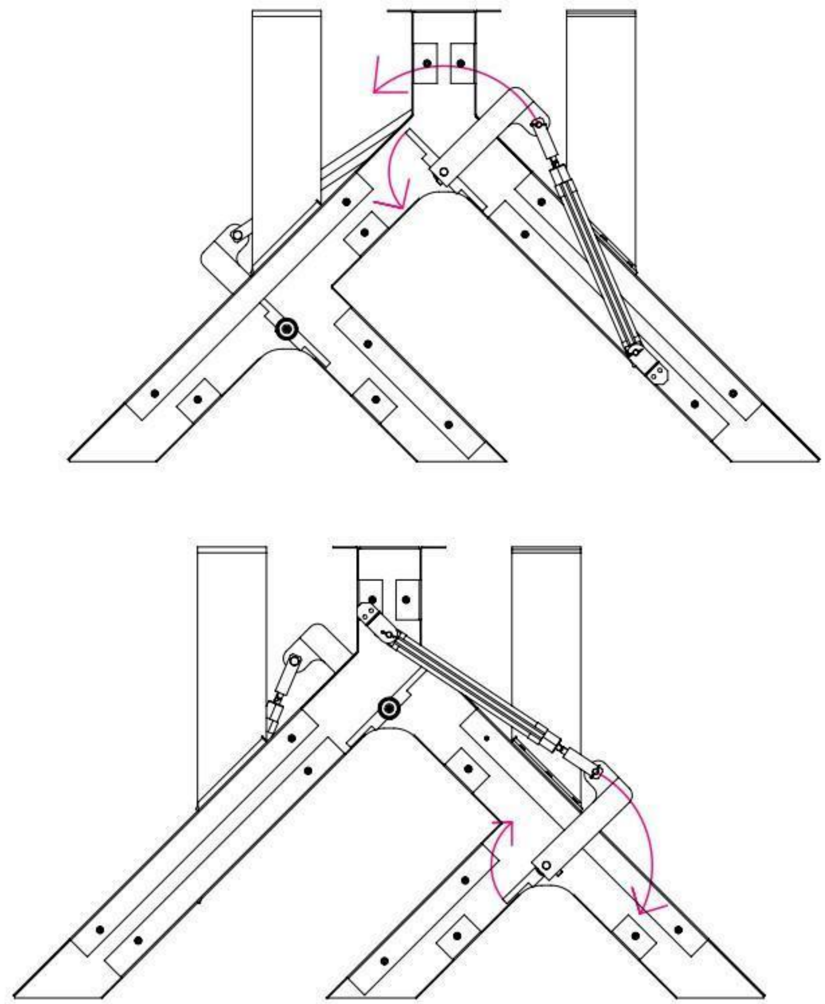


Figure 4.3.1: Sub Assembly Three - Trap Door Sorting

Sub Assembly (Figure 4.3.1) is the trap door sorting mechanism. This sorting mechanism utilizes trap doors rotating at 90 degrees controlled by pneumatic cylinders. When head of the overmolded solenoid is sheared off the trap door will guide the head through guide path via a chute system shown in Figure 4.3.1. The head will free fall through the system and will land in a collection bin. From there, the shears that are still in contact with the Winton washer at the shearing centerline, retract back to the original "home" position. The washer removal from shown in Figure 4.4.1 extends from a pneumatic cylinder to punch the washer from its plastic seating. Before the cylinder extends, the trap doors rotate into a different position to collect the washer in its respective collection bin. As the cylinder retracts, the trap door then rotates to the correct bin for the body of the part to be dropped into. This is then followed by the clamps releasing and the part falls down the correct chute. (figure 4.3.1) rotates and the solenoid will fall down the last path into the last collection bin.

4.4 Sub Assembly Four - Washer Removal

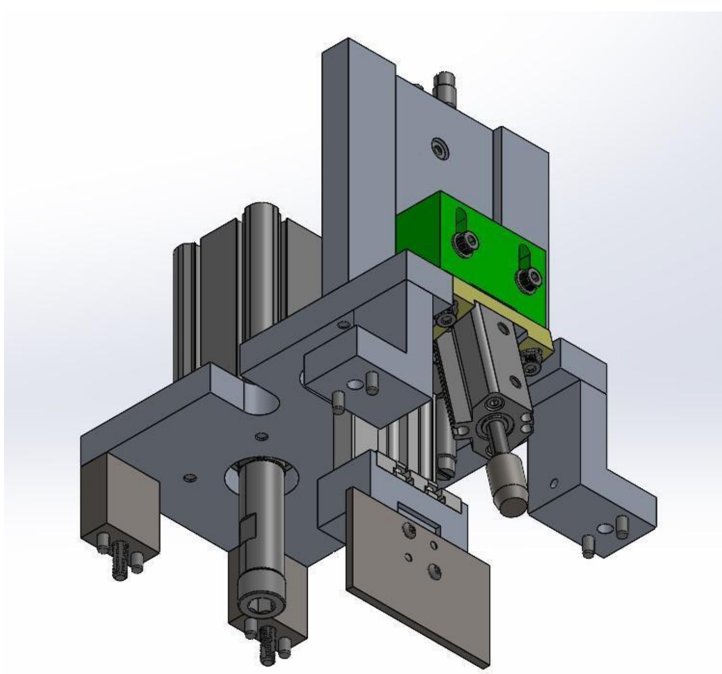


Figure 4.4.1: Sub Assembly Four - Washer Removal

The washer removal stage occurs after the plastic head is removed from the Winton solenoid. The purpose of this machine is to remove the steel washer contained in the Winton solenoid, as the recyclability value increases dramatically. The steel washer is punched out of the headless solenoid. After shearing, the Winton solenoid has plastic debris along the surface area of the plastic connections. This will prevent the washer from freely falling out, so a steel punch attached to a vertical translational cylinder is used to forcefully remove the washer. A photo-eye sensor is used to determine if the washer is in the cylinder at each point in the process. Once the washer is removed, the solenoid can be dropped and the entire process repeated.

5.0 Bill of Materials

5.1 Mechanical

Reference Appendix H.

The mechanical components needed to build the Winton Washer Recycler sum up to be \$2,962.52. It should be mentioned that this price is based on the finalized material list.

5.2 Pneumatic Components

Pneumatic components are listed in Appendix H. The entirety of pneumatic components are held in-house by Swoboda. None of these components need to be purchased, but instead listed as a material list.

5.3 Hydraulic Components

Per Swoboda's design constraints, the use of hydraulic power is not allowed.

5.4 Electrical Components

Reference Appendix I.

The electrical bill of materials includes all the electrical components that are needed in building the Winton washer disassembly device. The total price all the electrical materials is \$1,527.33.

Table 5.4: Cable List

Cable No	Connection	Description
1	Profibus Signals to Node	PROFIBUS FC Standard Cable GP
2	Power to Node	NEBU-M12-W8 5 Pin
3	Power to Output Module 1	NEBU-M12-W8 5 Pin
4	Power to Output Module 2	NEBU-M12-W8 5 Pin
5	PX1	M12, 3-PIN, NEBU-LE
6	PX2	M12, 3-PIN, NEBU-LE
7	PX3	M12, 3-PIN, NEBU-LE
8	PX4	M12, 3-PIN, NEBU-LE
9	PX5	M12, 3-PIN, NEBU-LE
10	PX6	M12, 3-PIN, NEBU-LE
11	PX7	M12, 3-PIN, NEBU-LE
12	PX8	M12, 3-PIN, NEBU-LE
13	PX9	M12, 3-PIN, NEBU-LE
14	PX10	M12, 3-PIN, NEBU-LE
15	PX11	M12, 3-PIN, NEBU-LE
16	PX12	M12, 3-PIN, NEBU-LE
17	PX13	M12, 3-PIN, NEBU-LE
18	PX14	M12, 3-PIN, NEBU-LE
19	PX15	M12, 3-PIN, NEBU-LE
20	PX16	M12, 3-PIN, NEBU-LE
21	PX17	M12, 3-PIN, NEBU-LE
22	PX18	M12, 3-PIN, NEBU-LE
23	PX19	M12, 3-PIN, NEBU-LE
24	PX20	M12, 3-PIN, NEBU-LE
25	PX21	M12, 3-PIN, NEBU-LE
26	PX22	M12, 3-PIN, NEBU-LE
27	PX23	M12, 3-PIN, NEBU-LE
28	PE1	M12, 3-PIN, NEBU-LE
29	Power to Input Module 1	NEBU-M12-W8 5 Pin
30	Power to Input Module 1	NEBU-M12-W8 5 Pin
31	Feeder Contrroller	Standand 120 AC Receptacle
32	Feeder	Standand 120 AC Receptacle
33	PROFIBUS FC Standard Cable GP	PROFIBUS FC Standard Cable GP

Table 5.4 shows all the necessary cable components needed for wiring electrical components. 3-Pin, M12 female cables are held in house at Swoboda so they are not included in the electrical bill of materials.

6.0 Budget

Reference total from above. The original total agreed at the start of this project was $5,000 - $7,000.

The grand total of this project is $4,489.85 which is below the $5,000 - $7,000 budget.

7.0 Validation

7.1 Validation Methods

Table 7.1: Validation Methods

Specification	Method (Testing, Analysis)	Description
Stress within joints	FEA Modeling, Hand calculations	A potential mode of failure is stresses that develop within the components of the structure
Bearing Life	Hand Calculations	In determination of the bearing selection, calculations were done to determine factor of safety and cycle life.
Shear Design	Hand Calculations, testing	The proper shearing mechanism happened over multiple iterations and included hand calculations to determine the resulting shearing forces required.

The validation methods shown in Table 7.1 show the methods used in finalizing the concept design selection. A method of failure was determined to be stress development within joints of the structure. Another method of failure was determined to be the bearing life and the potential for a bearing failure. Lastly, the shearing design was also validated in order to determine if the applied forces are sufficient and if there are any flaws that won't cause failure. All of these specifications were validated using testing methods and hand calculations. The testing methods for the shear design were done over four iterations. Moreover, the bearing life was calculated and verified to be sustainable for the life cycle of this machine. Lastly, the stress developed within the joins of the machine casing was analyzed using FEA Analysis and hand calculations.

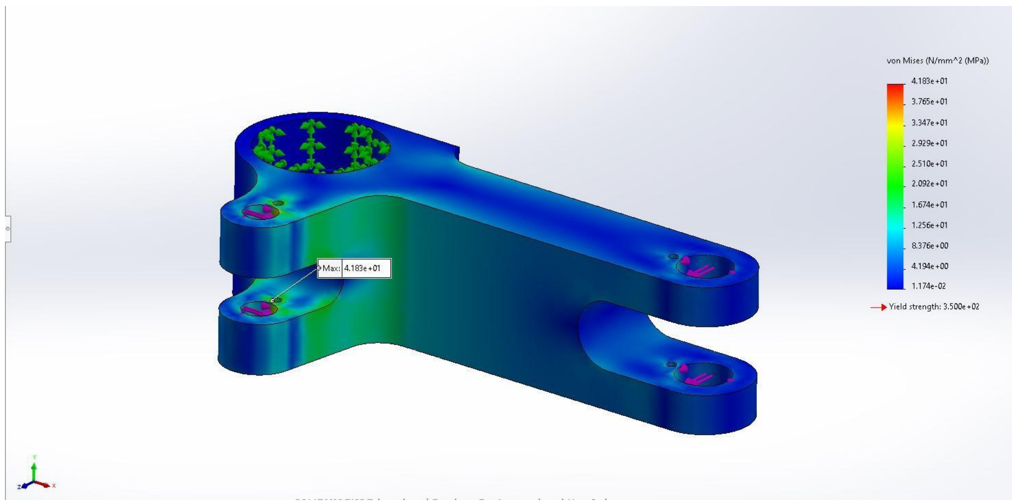


Figure 7.1.1: FEA Analysis of Sub Assembly One Shearing Arm

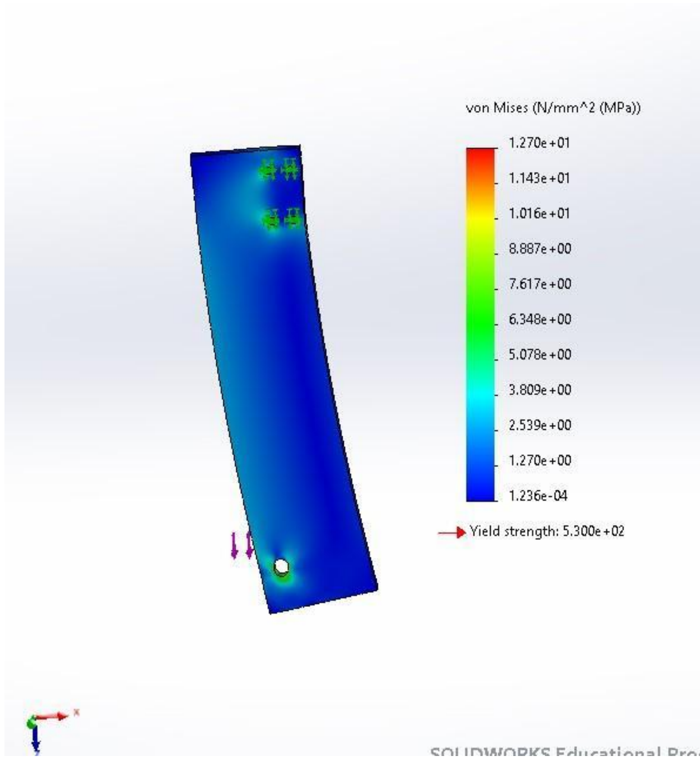


Figure 7.1.2: FEA Analysis of Sub Assembly One Shearing Arm

7.2 System Test Procedure

The different testing methods for the specifications in Table 7.1 were extrapolated in the concept design document. These testing procedures included iterative designs and testing, which included repetitive shearing, vibrating, and orienting of the Winton solenoid. All of these tests were performed sequentially and are recorded in Appendix F.

8.0 Discussion of Engineering Responsibilities

The focal point of this project is centered around efficiency and sustainability. By separating the washer from the overmolded solenoids, the scrap value of the components increases from $0.30/lb to $1.50/lb. Swoboda will continue producing 4000 lbs of this component each month, the machine has the potential to save the company $57,600 annually. The product is being tailored for Swoboda's Grand Rapids facility, which will result in immediate benefits locally. Considering the amount of money saved and the material being recycled, the machine was designed with consideration for the environment and supply chain. For social context, the safety features that have been highlighted in our specifications tables will be beneficial to the company and its production employees. To minimize the risk of any injury, a chassis and cage will be installed around the perimeter of the machine. It was anticipated that the amount of force and tooling needed to shear the solenoid may cause debris to eject outward and possibly injure someone. Therefore, a blast gate was implemented, as well as a shrapnel shroud to protect the operator. An additional safety feature is using the HMI which can prompt warnings, error messages, and force manual control. An Emergency Stop is implemented to comply with OSHA & NFPA 79 standards and will de-energize the safety circuit, stopping all functionality through a Safety Controller. Components are electrically protected where needed using circuit breakers, fuses, and mini-contactors. Conductors with high voltage differential will be separated to reduce noise and avoid other electrical problems. Ferrules will be crimped to the end of all conductors entering components, and plastic covers will be placed over all exposed terminals to hide wires and prevent noise, shorts, and physical discharge.

9. Post-Testing Modifications

In the building process, there were several major and minor changes made to the machine. Some of the major changes include adding notches in the shear blades, replacing the hole punch cylinder, changing the design of the chassis and location of the panel box, and modifications to some of the parts. The minor changes include additions to the trap door exit, the pivot point for the shear arms, trap door shrouds, and end stop size reduction.These changes are depicted below.

Major Changes:

- Notches in Shear Blades
    - The shear blades initial design did not account for the notch that is present in the washer. What was noticed during testing was that the shear blade edge started to develop a rounded indent exactly in place of where the steel notch makes contact with the blade. In order to circumnavigate this issue, slots in the shear blade were machined out to allow the blade to cut over the notch and then up until the notch. This ensured that the notch remained on the washer, which improves the reusibiliy of the washer and longevity of the blade

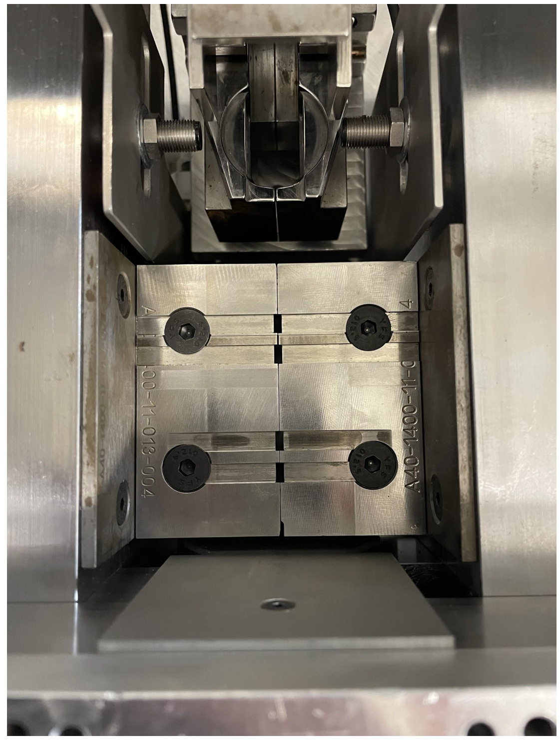


Figure X: Machined Shear Blade.

- Replacing Hole Punch Cylinder
    - Salvaging the washer from the solenoid is among one of the most important things, as the washer can potentially be reused. One of the biggest problems was the fact the first punch was not successfully punching the washer out into it's respective bin. Instead, the washer would follow with the body of the solenoid. This issue was resolved by simply using a bigger cylinder. The first cylinder was significantly smaller, and it was determined that the stroke length of the cylinder was barely making contact with the washer. This meant that any plastic debris that covered the washer would prevent the punch from knocking down the washer. The new cylinder is depicted below, and has a much longer stroke length which ensures the washer is properly hit out every time. The effect of this ensures that each component lands in it's respective bin everytime.
- Design of Chassis
    - The initial chassis design was preliminary, because the first immediate change was to make it smaller in height. This was because it could not fit through a door frame and where it was being built was in a room with a generic door frame. Moreover, it was deemed that the space to view the machine itself was limited by the plastic, head height cover. So, the chassis of the machine was constructed in a box like formation, where each sub

assembly of the machine can be constructed with optimal room and clearly visible.

- Location of Panel Box
    - Since the chassis of the project changed, the panel box was moved so it would be closer to the operator as well as closer to the HMI. Another key aspect is that it is not protruding from the side of the machine and is now sitting flush with the front of the machine out of the way for the operator.

<u>Minor Changes:</u>

- Trap Door Exit
    - To prevent parts from falling out of the bins upon exiting of the trap door, two pieces were welded on to the head and the body bins. With this new change, the parts have been able to fall within the perspective bins and were made so that an operator does not have to pick up loose parts laying on the floor.
- Pivot Point for Shear Arm
    - The pivot point for the shear arms was relocated due to the contact points and the redesign of the tertiary links. Moreover, there wasn’t a lot of room for the machine to move as the shear arms closed. Do to the rotation along the rotation of the tertiary link, the front was constructed slightly. Lastly, the most significant contribution to the pivot point of the shear arms is due to the redesign of hte machined components. This is seen in the figures below.
- Trap Door Shrouds
    - The initial design had a small gap in between the door and the side of the trap door shells, to fix this a very small part was made to attach to the sides of the doors themselves.
- End Stop Size Reduction
    - The end stop was reduced in size by 0.5mm. The reason for this is because the end stop was getting in the way of the shrouds and would not be able to come down properly.

10. Programming Development

The software is written in the STL language of Siemens TIA Portal, more commonly known as Instruction List. The first step is to determine the inputs and outputs of the system.

Input Tag Table

Name	Path	Data Type	Logical Address	Comment	Hmi Visible	Hmi Accessible	Hmi Writeable
Ix Prestop Ext PX	Input Tag Table	Bool	%I10.2		True	True	True
Ix Prestop Ret PX	Input Tag Table	Bool	%I10.3		True	True	True
Ix Endstop Ext PX	Input Tag Table	Bool	%I10.4		True	True	True
Ix Endstop Ret PX	Input Tag Table	Bool	%I10.5		True	True	True
Ix Punch Ext PX	Input Tag Table	Bool	%I10.6		True	True	True
Ix Punch Ret PX	Input Tag Table	Bool	%I10.7		True	True	True
Ix Washer Present PX	Input Tag Table	Bool	%I11.0		True	True	True
Ix Left Clamp Ext PX	Input Tag Table	Bool	%I11.2		True	True	True
Ix Left Clamp Ret PX	Input Tag Table	Bool	%I11.3		True	True	True
Ix Right Clamp Ext PX	Input Tag Table	Bool	%I11.4		True	True	True

Ix Right Clamp Ret PX	Input Tag Table	Bool	%I11.5	True	True	True
Ix Left Shear Ext PX	Input Tag Table	Bool	%I11.6	True	True	True
Ix Left Shear Ret PX	Input Tag Table	Bool	%I11.7	True	True	True
Backup Washer Present PX	Input Tag Table	Bool	%I11.1	True	True	True
Ix Gripper Ext PX	Input Tag Table	Bool	%I12.0	True	True	True
Ix Gripper Ret PX	Input Tag Table	Bool	%I12.1	True	True	True
Ix Lat Ext PX	Input Tag Table	Bool	%I12.2	True	True	True
Ix Lat Ret PX	Input Tag Table	Bool	%I12.3	True	True	True
Ix T2 Ext PX	Input Tag Table	Bool	%I12.4	True	True	True
Ix T2 Ret PX	Input Tag Table	Bool	%I12.5	True	True	True
Ix T1 Ext PX	Input Tag Table	Bool	%I12.6	True	True	True
Ix T1 Ret PX	Input Tag Table	Bool	%I12.7	True	True	True
Ix Sense Part Ready PE	Input Tag Table	Bool	%I13.4	True	True	True

Ix Right Shear Ext PX	Input Tag Table	Bool	%I13.6		True	True	True
Ix Right Shear Ret PX	Input Tag Table	Bool	%I13.7		True	True	True
Ix Cycle Start PB	Input Tag Table	Bool	%I1.0		True	True	True
Ix ESTOP Not Pressed	Input Tag Table	Bool	%I1.1		True	True	True
Ix Doors Are Closed	Input Tag Table	Bool	%I1.2		True	True	True

Output Tag Table

Name	Path	Data Type	Logical Address	Comment	Hmi Visible	Hmi Accessible	Hmi Writeable
Qx Shear Cyl Ret	**Ouput Tag Table**	**Bool**	**%Q10.0**		**True**	**True**	**True**
Qx Shear Cyl Ext	**Ouput Tag Table**	**Bool**	**%Q10.1**	**lateral must be ret, punch must be ret**	**True**	**True**	**True**
Qx Prestop Cyl Ret	**Ouput Tag Table**	**Bool**	**%Q10.2**	**RET lets part through**	**True**	**True**	**True**
Qx Prestop	**Ouput Tag Table**	**Bool**	**%Q10.3**		**True**	**True**	**True**

Cyl Ext							
Qx Endstop Cyl Ret	Ouput Tag Table	Bool	%Q10.4	prestop must be ext,	True	True	True
Qx Endstop Cyl Ext	Ouput Tag Table	Bool	%Q10.5		True	True	True
Qx Clamp Cyl Ret	Ouput Tag Table	Bool	%Q10.6		True	True	True
Qx Clamp Cyl Ext	Ouput Tag Table	Bool	%Q10.7		True	True	True
Qx Punch Cyl Ret	Ouput Tag Table	Bool	%Q11.0		True	True	True
Qx Punch Cyl Ext	Ouput Tag Table	Bool	%Q11.1		True	True	True
Qx Gripper Cyl Ret	Ouput Tag Table	Bool	%Q12.0		True	True	True
Qx Gripper Cyl Ext	Ouput Tag Table	Bool	%Q12.1		True	True	True
Qx Lat Cyl Ret	Ouput Tag Table	Bool	%Q12.2		True	True	True
Qx Lat Cyl Ext	Ouput Tag Table	Bool	%Q12.3	Prestop must be EXT, gripper ret, endstop must be RET, punch ret, shear ret,	True	True	True

				clamps ret			
Qx T2 Cyl Ret	Ouput Tag Table	Bool	%Q12.4		True	True	True
Qx T2 Cyl Ext	Ouput Tag Table	Bool	%Q12.5		True	True	True
Qx T1 Cyl Ret	Ouput Tag Table	Bool	%Q12.6		True	True	True
Qx T1 Cyl Ext	Ouput Tag Table	Bool	%Q12.7		True	True	True
Qx Cycle Start PL	Ouput Tag Table	Bool	%Q5.0		True	True	True
Qx Feeder OFF	Ouput Tag Table	Bool	%Q5.1	Logic is Reversed!	True	True	True
Qx Overhead Light ON	Ouput Tag Table	Bool	%Q5.2		True	True	True
Qx Fan ON	Ouput Tag Table	Bool	%Q5.3		True	True	True
Qx Auxiliary Lights ON	Ouput Tag Table	Bool	%Q5.4		True	True	True

The program was then structured for Tia Portal.

The OB1 (Organization Block 1) is the main block, and on;y exists to call the function call shown below.

Microsoft

WintonWasher_Recycler / PLC_1 [CPU 315-2 PN/DP] / Program blocks

Main [OB1]

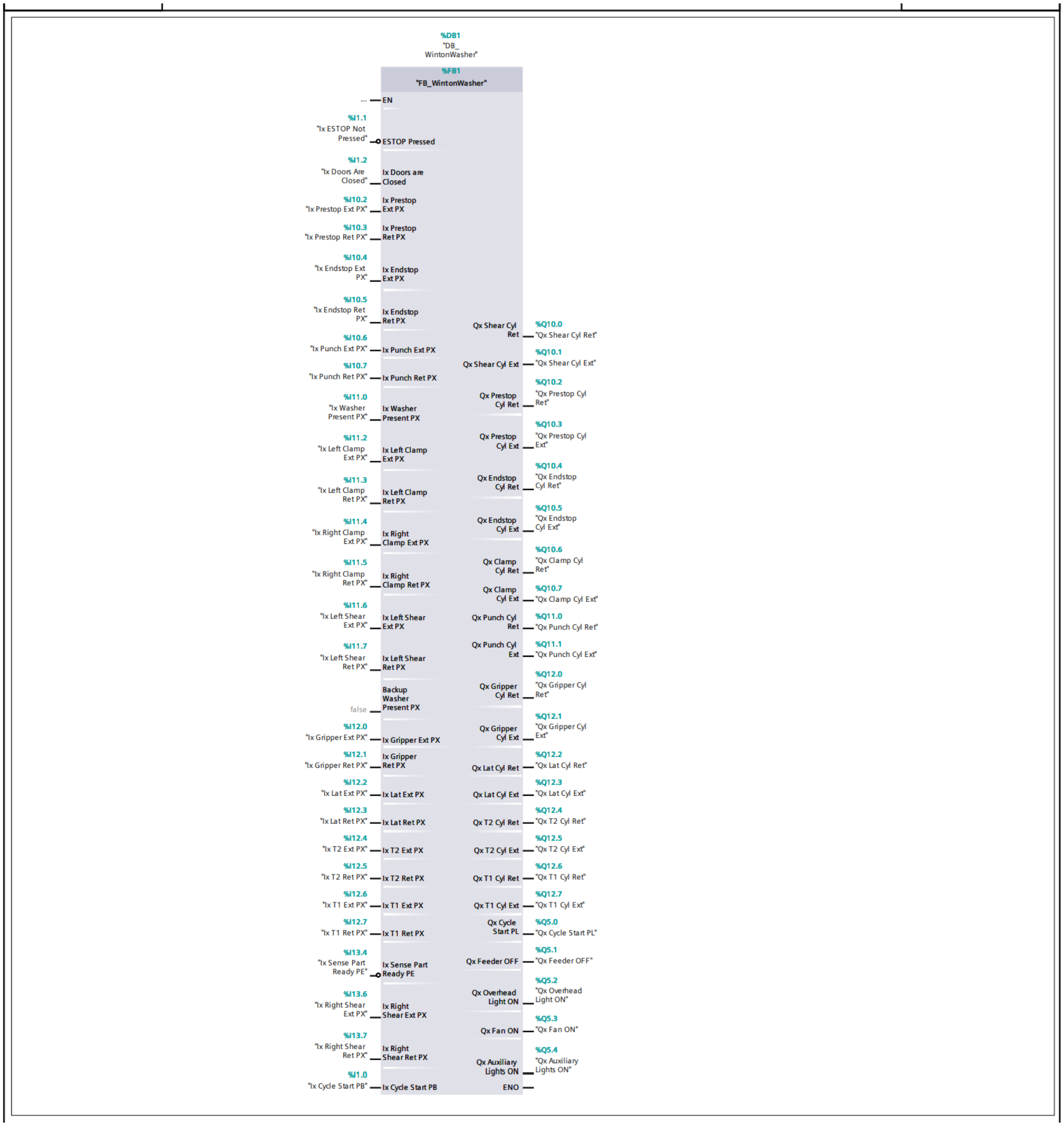
Main Properties							
General							
Name	Main	**Number**	1	**Type**	OB	**Language**	STL
Numbering	Manual						
Information							
Title	"Main Program Sweep (Cy-cle)"	**Author**		**Comment**		**Family**	
Version	0.1	**User-defined ID**					

Main				
Name	**Data type**	**Offset**	**Default value**	**Comment**
Temp				
OB1_EV_CLASS	Byte	0.0		Bits 0-3 = 1 (Coming event), Bits 4-7 = 1 (Event class 1)
OB1_SCAN_1	Byte	1.0		1 (Cold restart scan 1 of OB 1), 3 (Scan 2-n of OB 1)
OB1_PRIORITY	Byte	2.0		Priority of OB Execution
OB1_OB_NUMBR	Byte	3.0		1 (Organization block 1, OB1)
OB1_RESERVED_1	Byte	4.0		Reserved for system
OB1_RESERVED_2	Byte	5.0		Reserved for system
OB1_PREV_CYCLE	Int	6.0		Cycle time of previous OB1 scan (milliseconds)
OB1_MIN_CYCLE	Int	8.0		Minimum cycle time of OB1 (milliseconds)
OB1_MAX_CYCLE	Int	10.0		Maximum cycle time of OB1 (milliseconds)
OB1_DATE_TIME	Date_And_Time	12.0		Date and time OB1 started
Constant				

Network 1:

```
0001       CALL   "FC_WintonWasher"
0002
0003
```

The FC (Function Call) exists to populate an FB (Function Block) with actual inputs and outputs.



A DB (Data Block) holds the static values for the machine's logic inside the FB. One was created for the WintonWasherDB. The WintonWasher FB contains the logic for the system. These are shown in the appendix for project code.

The HMI was also designed and developed during validation and testing. The HMI variables had to be created and assigned as well.

Name	Path	Connection	PLC tag	DataType	Length	Coding	Access Method	Address
HMI_MasterReset	HMI Tag Table	HMI_Connection	HMI_DB.MasterReset	Bool	1	Binary	Absolute access	%DB7.DBX0.0
HMI Prestop Ext	HMI Tag Table	HMI_Connection	HMI_DB."Prestop Ext"	Bool	1	Binary	Absolute access	%DB7.DBX0.7
HMI Prestop Ret	HMI Tag Table	HMI_Connection	HMI_DB."Prestop Ret"	Bool	1	Binary	Absolute access	%DB7.DBX1.0
HMI Endstop Ext	HMI Tag Table	HMI_Connection	HMI_DB."Endstop Ext"	Bool	1	Binary	Absolute access	%DB7.DBX1.1
HMI Endstop Ret	HMI Tag Table	HMI_Connection	HMI_DB."Endstop Ret"	Bool	1	Binary	Absolute access	%DB7.DBX1.2
HMI Lat Ext	HMI Tag Table	HMI_Connection	HMI_DB."Lat Ext"	Bool	1	Binary	Absolute access	%DB7.DBX1.7
HMI Lat Ret	HMI Tag Table	HMI_Connection	HMI_DB."Lat Ret"	Bool	1	Binary	Absolute access	%DB7.DBX2.0
HMI Punch Ret	HMI Tag Table	HMI_Connection	HMI_DB."Punch Ret"	Bool	1	Binary	Absolute access	%DB7.DBX0.4
HMI Gripper Ext	HMI Tag Table	HMI_Connection	HMI_DB."Gripper Ext"	Bool	1	Binary	Absolute access	%DB7.DBX1.5
HMI Gripper Ret	HMI Tag Table	HMI_Connection	HMI_DB."Gripper Ret"	Bool	1	Binary	Absolute access	%DB7.DBX1.6

HMI T1 Ext	HMI Tag Table	HMI_ Conne ction	HMI_DB."T1 Ext"	Bool	1	Binar y	Absolute access	%DB7.DBX2.1
HMI T1 Ret	HMI Tag Table	HMI_ Conne ction	HMI_DB."T1 Ret"	Bool	1	Binar y	Absolute access	%DB7.DBX2.2
HMI T2 Ext	HMI Tag Table	HMI_ Conne ction	HMI_DB."T2 Ext"	Bool	1	Binar y	Absolute access	%DB7.DBX2.3
HMI T2 Ret	HMI Tag Table	HMI_ Conne ction	HMI_DB."T2 Ret"	Bool	1	Binar y	Absolute access	%DB7.DBX2.4
HMI Shear Ext	HMI Tag Table	HMI_ Conne ction	HMI_DB."Shear Ext"	Bool	1	Binar y	Absolute access	%DB7.DBX0.5
HMI Shear Ret	HMI Tag Table	HMI_ Conne ction	HMI_DB."Shear Ret"	Bool	1	Binar y	Absolute access	%DB7.DBX0.6
HMI Clamp Ext	HMI Tag Table	HMI_ Conne ction	HMI_DB."Clamp Ext"	Bool	1	Binar y	Absolute access	%DB7.DBX1.3
HMI Clamp Ret	HMI Tag Table	HMI_ Conne ction	HMI_DB."Clamp Ret"	Bool	1	Binar y	Absolute access	%DB7.DBX1.4
HMI Auto ON	HMI Tag Table	HMI_ Conne ction	HMI_DB."Auto On"	Bool	1	Binar y	Absolute access	%DB7.DBX0.2
Ix Prestop Ext PX	HMI Tag Table	HMI_ Conne ction	"Ix Prestop Ext PX"	Bool	1	Binar y	Absolute access	%I10.2
Ix Prestop Ret PX	HMI Tag Table	HMI_ Conne ction	"Ix Prestop Ret PX"	Bool	1	Binary	Absolute access	%I10.3
Ix T1 Ext PX	HMI Tag Table	HMI_ Conne ction	"Ix T1 Ext PX"	Bool	1	Binary	Absolute access	%I12.6

Ix T1 Ret PX	HMI Tag Table	HMI_ Conne ction	"Ix T1 Ret PX"	Bool	1	Binary	Absolute access	%I12.7
Ix T2 Ext PX	HMI Tag Table	HMI_ Conne ction	"Ix T2 Ext PX"	Bool	1	Binary	Absolute access	%I12.4
Ix T2 Ret PX	HMI Tag Table	HMI_ Conne ction	"Ix T2 Ret PX"	Bool	1	Binary	Absolute access	%I12.5
Ix Lat Ext PX	HMI Tag Table	HMI_ Conne ction	"Ix Lat Ext PX"	Bool	1	Binary	Absolute access	%I12.2
Ix Lat Ret PX	HMI Tag Table	HMI_ Conne ction	"Ix Lat Ret PX"	Bool	1	Binary	Absolute access	%I12.3
Ix Doors Are Closed	HMI Tag Table	HMI_ Conne ction	"Ix Doors Are Closed"	Bool	1	Binary	Absolute access	%I1.2
Ix Punch Ext PX	HMI Tag Table	HMI_ Conne ction	"Ix Punch Ext PX"	Bool	1	Binary	Absolute access	%I10.6
Ix Punch Ret PX	HMI Tag Table	HMI_ Conne ction	"Ix Punch Ret PX"	Bool	1	Binary	Absolute access	%I10.7
Ix Left Clamp Ext PX	HMI Tag Table	HMI_ Conne ction	"Ix Left Clamp Ext PX"	Bool	1	Binary	Absolute access	%I11.2
Ix Left Clamp Ret PX	HMI Tag Table	HMI_ Conne ction	"Ix Left Clamp Ret PX"	Bool	1	Binary	Absolute access	%I11.3
Ix Right Clamp Ext PX	HMI Tag Table	HMI_ Conne ction	"Ix Right Clamp Ext PX"	Bool	1	Binary	Absolute access	%I11.4
Ix Right Clamp Ret PX	HMI Tag Table	HMI_ Conne ction	"Ix Right Clamp Ret PX"	Bool	1	Binary	Absolute access	%I11.5

Ix Right Shear Ext PX	HMI Tag Table	HMI_Connection	"Ix Right Shear Ext PX"	Bool	1	Binary	Absolute access	%I13.6
Ix Right Shear Ret PX	HMI Tag Table	HMI_Connection	"Ix Right Shear Ret PX"	Bool	1	Binary	Absolute access	%I13.7
Ix ESTOP Not Pressed	HMI Tag Table	HMI_Connection	"Ix ESTOP Not Pressed"	Bool	1	Binary	Absolute access	%I1.1
Ix Sense Part Ready PE	HMI Tag Table	HMI_Connection	"Ix Sense Part Ready PE"	Bool	1	Binary	Absolute access	%I13.4
Ix Washer Present PX	HMI Tag Table	HMI_Connection	"Ix Washer Present PX"	Bool	1	Binary	Absolute access	%I11.0
Ix Endstop Ext PX	HMI Tag Table	HMI_Connection	"Ix Endstop Ext PX"	Bool	1	Binary	Absolute access	%I10.4
Ix Endstop Ret PX	HMI Tag Table	HMI_Connection	"Ix Endstop Ret PX"	Bool	1	Binary	Absolute access	%I10.5
Ix Gripper Ext PX	HMI Tag Table	HMI_Connection	"Ix Gripper Ext PX"	Bool	1	Binary	Absolute access	%I12.0
Ix Gripper Ret PX	HMI Tag Table	HMI_Connection	"Ix Gripper Ret PX"	Bool	1	Binary	Absolute access	%I12.1
Ix Cycle Start PB	HMI Tag Table	HMI_Connection	"Ix Cycle Start PB"	Bool	1	Binary	Absolute access	%I1.0
HMI Punch Ext	HMI Tag Table	HMI_Connection	HMI_DB."Punch Ext"	Bool	1	Binary	Absolute access	%DB7.DBX0.3
HMI Aux Lights	HMI Tag Table	HMI_Connection	HMI_DB."Auxiliary Lights"	Bool	1	Binary	Absolute access	%DB7.DBX2.7

HMI Overhead Lights	HMI Tag Table	HMI_ Conne ction	HMI_DB."Overhead Lights"	Bool	1	Binary	Absolute access	%DB7.DBX2.6
Ix Part Present	HMI Tag Table	HMI_ Conne ction	"Ix Sense Part Ready PE"	Bool	1	Binary	Absolute access	%I13.4
HMI_Pause	HMI Tag Table	HMI_ Conne ction	HMI_DB.Pause	Bool	1	Binary	Absolute access	%DB7.DBX0.1
Ix Left Shear Ret PX	HMI Tag Table	HMI_ Conne ction	"Ix Left Shear Ret PX"	Bool	1	Binary	Absolute access	%I11.7
Ix Left Shear Ext PX	HMI Tag Table	HMI_ Conne ction	"Ix Left Shear Ext PX"	Bool	1	Binary	Absolute access	%I11.6
Qx Vibrate OFF	HMI Tag Table	HMI_ Conne ction	"Qx Feeder OFF"	Bool	1	Binary	Absolute access	%Q5.1
HMI Vibrate	HMI Tag Table	HMI_ Conne ction	HMI_DB.Vibrate	Bool	1	Binary	Absolute access	%DB7.DBX2.5
Bin_Count	HMI Tag Table	HMI_ Conne ction	HMI_DB.Bin_Count	Int	2	Binary	Absolute access	%DB7.DBW4
HMI Fan	HMI Tag Table	HMI_ Conne ction	HMI_DB.Fan	Bool	1	Binary	Absolute access	%DB7.DBX3.0
Reset_Bin_Count	HMI Tag Table	HMI_ Conne ction	HMI_DB.Reset_Bin_Count	Bool	1	Binary	Absolute access	%DB7.DBX6.0
Cycle_Count	HMI Tag Table	HMI_ Conne ction	HMI_DB.Cycle_Count	Int	2	Binary	Absolute access	%DB7.DBW8
Alarms	HMI Tag Table	HMI_ Conne ction	Alarms_DB.Alarms	Word	2	Binary	Absolute access	%DB11.DBW0

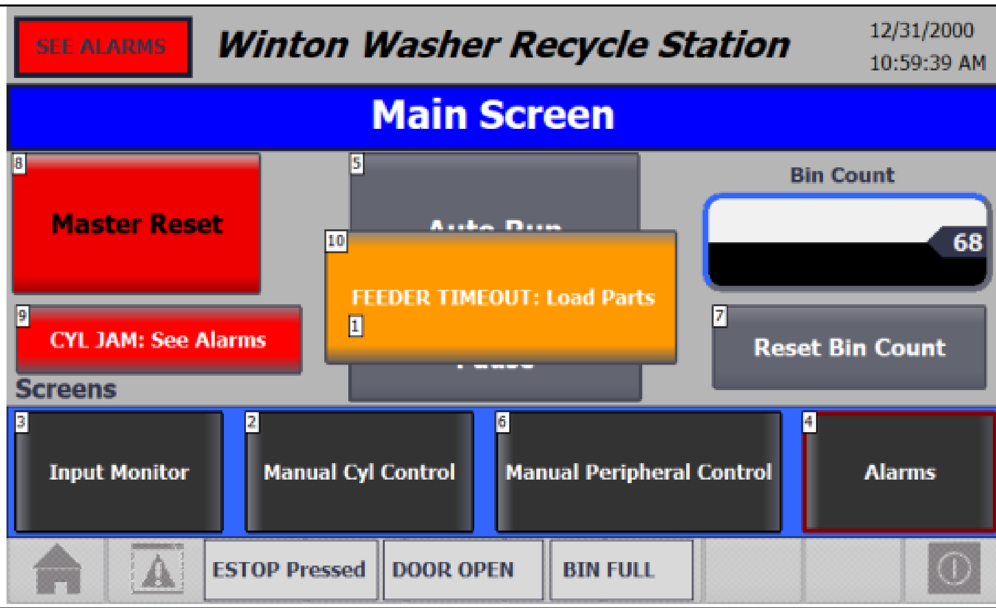
The Main Screen is shown below. A table references the button functions. The "SEE ALARMS" indicator is only visible and flashes when there is an error.

Totally Integrated
Automation Portal

WintonWasher_Recycler / HMI_1 [TP700 Comfort] / Screens

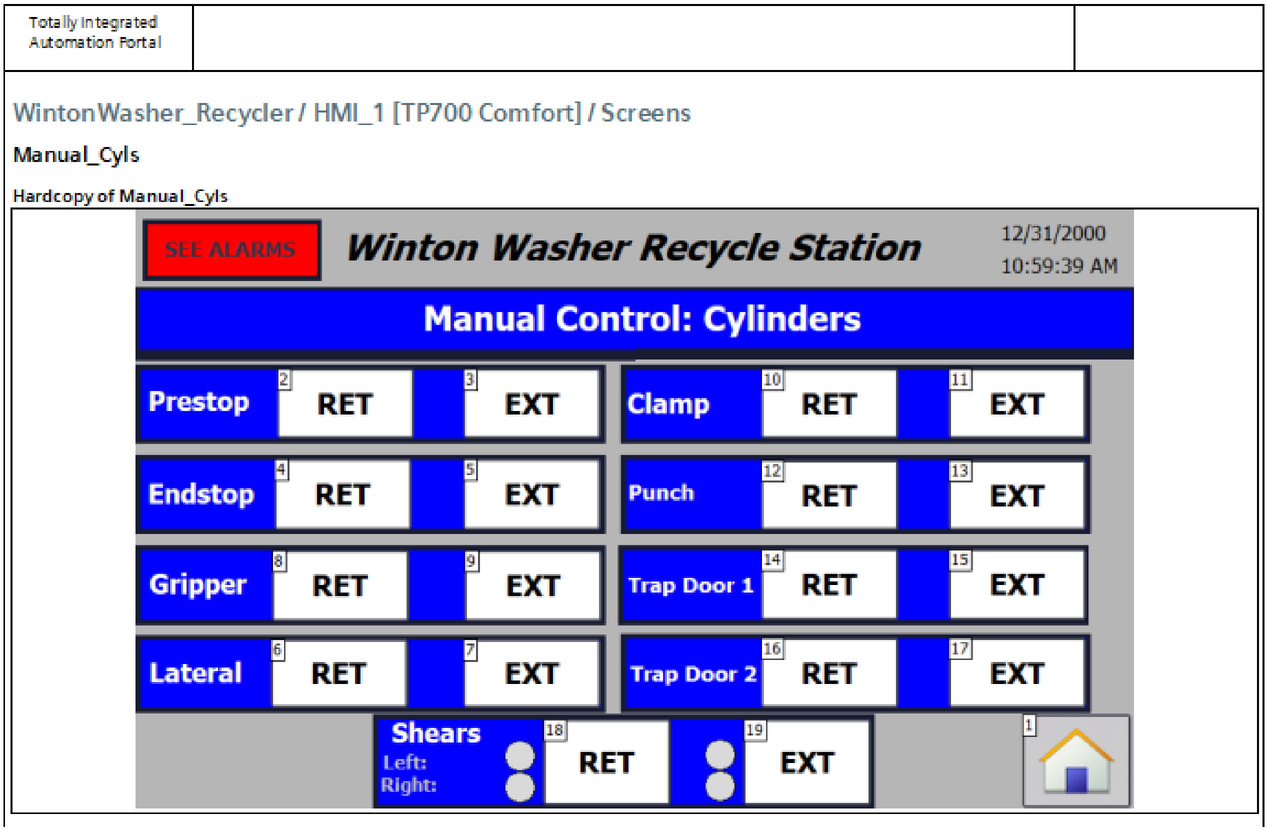
Main Screen

Hardcopy of Main Screen

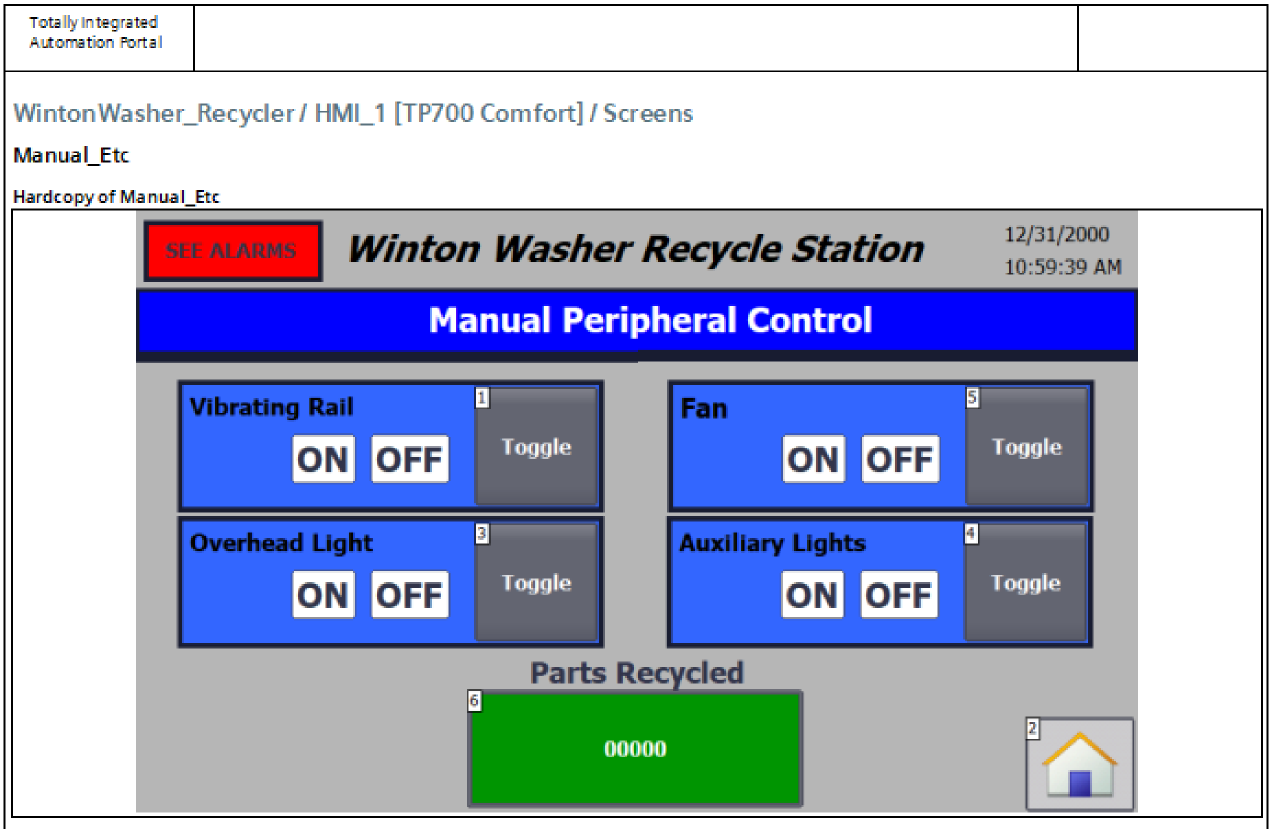


Label No.	Function	HMI Tag
1	Pauses the machine	HMI_Pause
2	Transitions to Manual Cyl Control Screen	NA
3	Transitions to Input Monitor Screen	NA
4	Transition to Alarms Screen	NA
5	Auto Run button, sets the machine in Auto	HMI_Auto ON
6	Transitions screen to Manual Peripheral Control	NA
7	Resets the Bin Count	Bin_Count
8	Master Reset. Will Reset Cylinders to home position in auto to clear jams or reset machine. Without auto, machine resets to auto	HMI_MasterReset
9	Cyl Jam Indicator, is visible only if there is a pending cylinder jam	Alarm
10	Feeder Timeout, only visible when timed out. Acknowledge, resets the error	NA

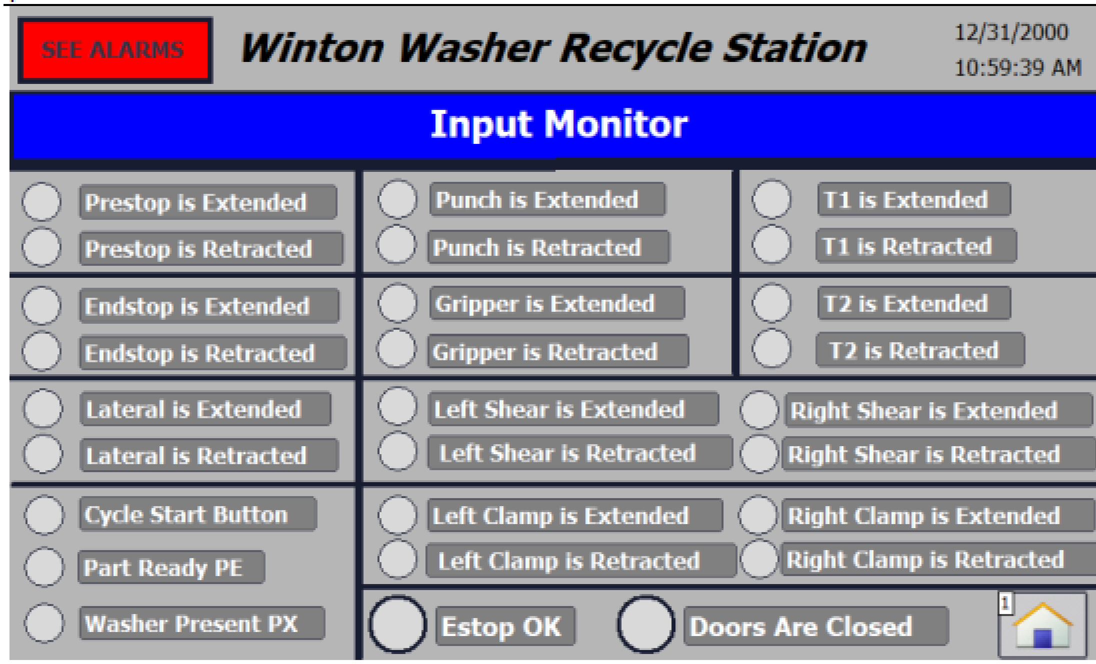
The Manual Cyl Control Screen is shown below. Its function is to manually extend or retract cylinders when not in auto. Ret and Ext buttons change indicator color dependent on the state of the cylinder.



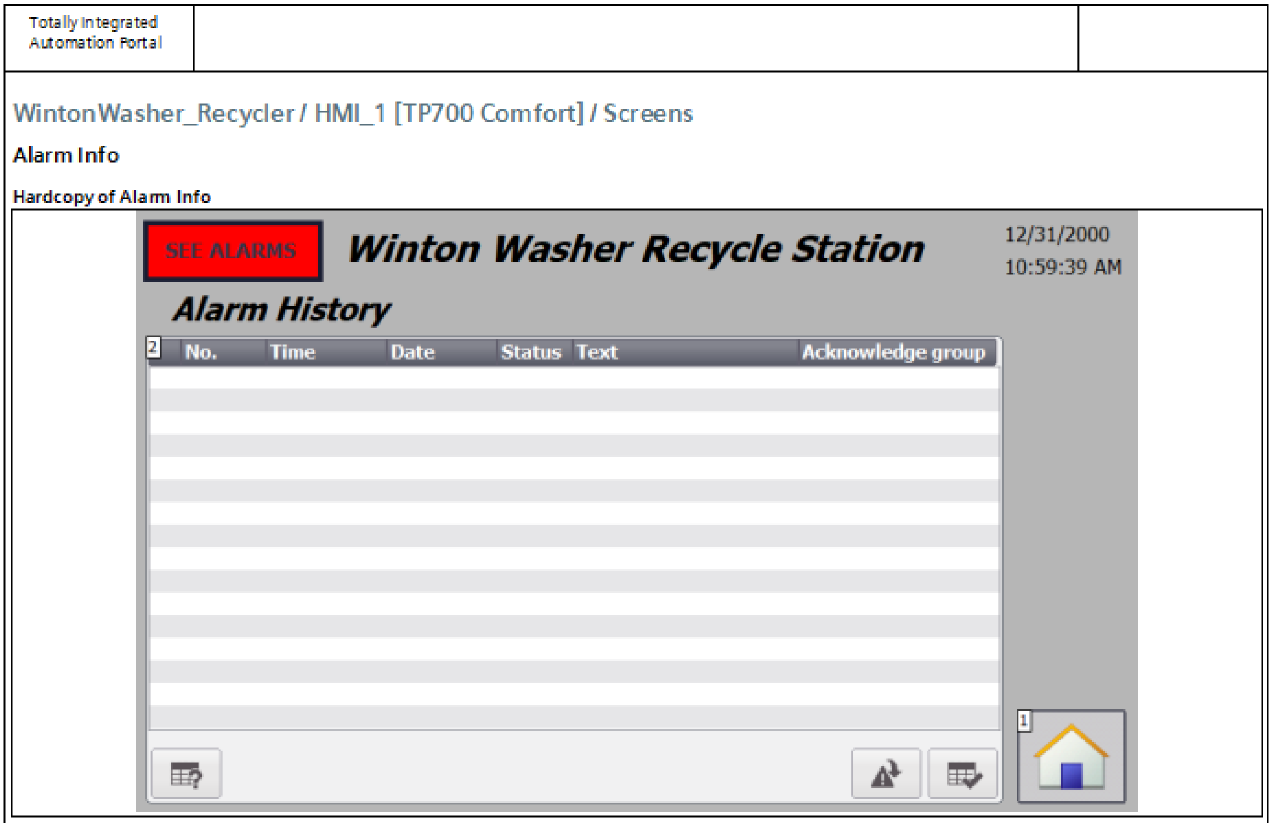
The Peripheral Control Screen allows control of lighting, feeding, and panel fan functions.



The Input Monitor screen shows the status of system inputs.



The Alarms screen will show info for any pending or current alarm in the system. It will diagnose any cylinder jam, bin overflows, ESTOP, Doors, ect and notify the operator.



11. Final Design

The Winton Washer Recycler was constructed from ground up, where a component made by Swoboda was found to be profitable by recycling it. However, the main issue with recycling this component is that it contains a steel washer encased in a plastic overmold. Through the engineering design process, we first started by ideating what needed to be done and simplifying the problem into small tasks. The project was divided into four sub assemblies, where the first sub assembly would be the mode of transportation for the solenoid from the operator to disassembly. The second sub assembly was the means of shearing off the plastic head of the solenoid. The third sub assembly was punching out the steel washer of the solenoid. The last, fourth, sub assembly was correctly sorting each component every time. Each sub assembly underwent rigorous testing and prototyping, which can be seen in Appendix G. After the prototyping was done, each idea and model was developed into a real physical model. This was done by machining, milling, and assembling the made and ordered components. At first, the machine seemed to be working brilliantly, but after some testing it was deemed that there needed to be some simple minor and major changes. Those changes are tabulated in section 9. Some of the common errors we saw occurring were improper separation of the steel washer with the head and body of the solenoid. At about a 7.5% rate, we saw solenoids not being properly separated. This encouraged us to further change some of the specific components of the machine, which effectively reduced the defected part rate to a mere 0.7%. Moreover, one of the most important specifications of the project were completed towards the end of the build. These were, first and foremost, ensuring the whole scrapped part is disassembled into 3 parts and the cycle time were to be less than ten seconds. With the modifications created after the ideation phase, the steel washer, head, and body of the solenoid were at consistent levels with producing defective parts. Furthermore, the pneumatic cylinders used were more than capable of withstanding the speed we wanted to disassemble parts at. In fact, the cylinders would fire faster than we could manage with the speed of the part. This proved to us early on that we would be at or under that level of 10 seconds. After refinement of the code and the machine, we achieved a cycle time of approximately 10 seconds, which placed the machine at a production rate of 360 parts per hour, which is also almost $90/hr! Overall, the Winton Solenoid Recycler works extremely effectively per the project statement, and safely secures the separation of one whole scrapped part into three. The further recycling of the parts produced by this machine will increase the production of the Winton Solenoid line by efficiently recycling the scrapped parts.

Appendix A – Drawings

Reference Winton Washer Machine Technical Details Drawing Sheet

Reference Winton Washer Machine Eletrical Details Drawing Sheet

Winton Washer Machine Technical Details

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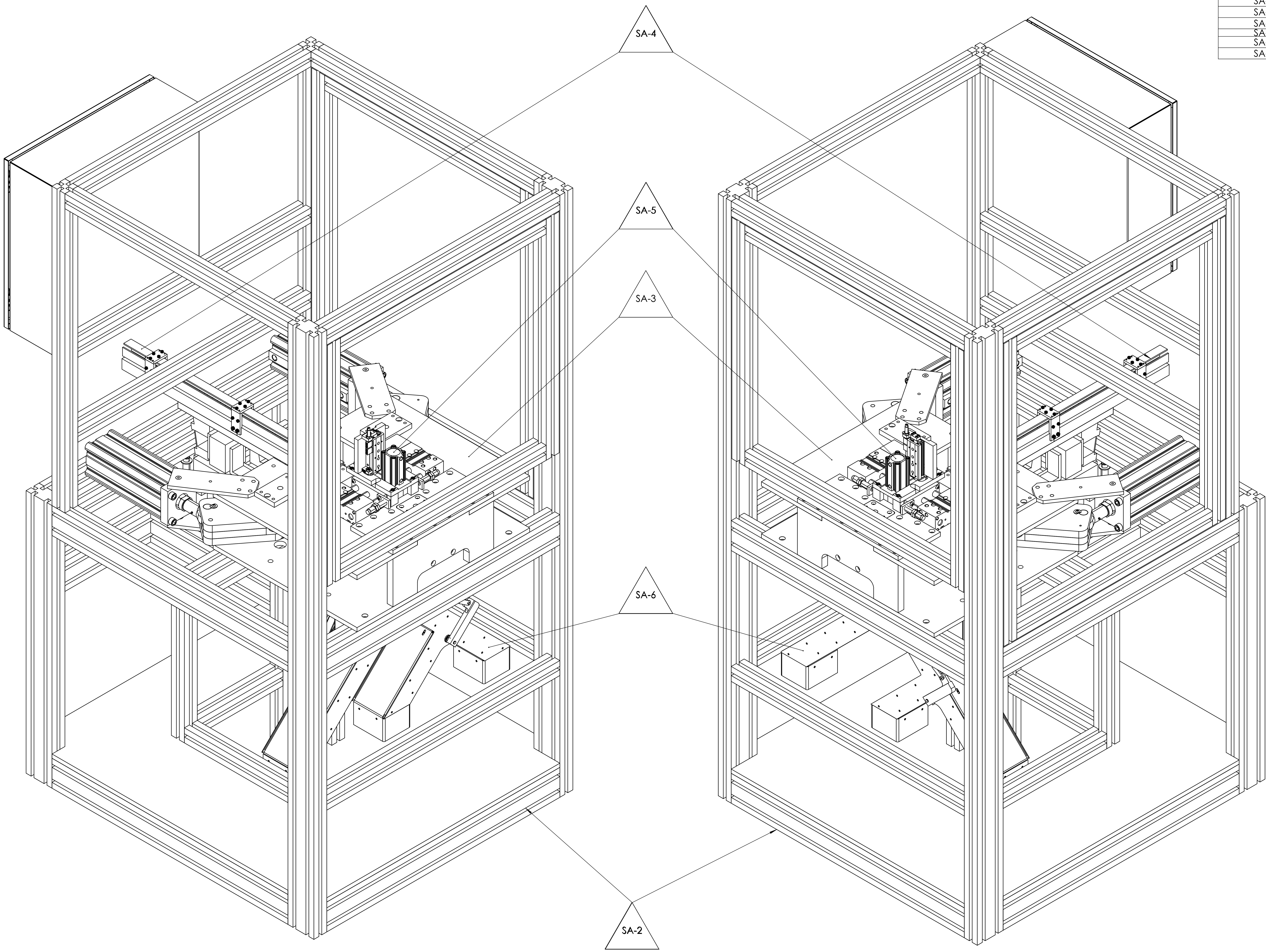
SUB-ASSEMBLY	DESCRIPTION	PAGE NUMBER
SA-1	MACHINE	
SA-2	CHASSIS	
SA-3	HEAD REMOVAL/PART TRANSFER	
SA-4	VIBRATING RAIL	
SA-5	WASHER REMOVAL	
SA-6	SORTING MECHANISM	



Swoboda, Inc.
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Fax 616-554-9093

3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER	
	GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM SW	
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING NO		REV 0	
QTY: 1	PART NUMBER SA-1	PART NAME		
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:5	SHEET 1 OF 11

SIZE A1

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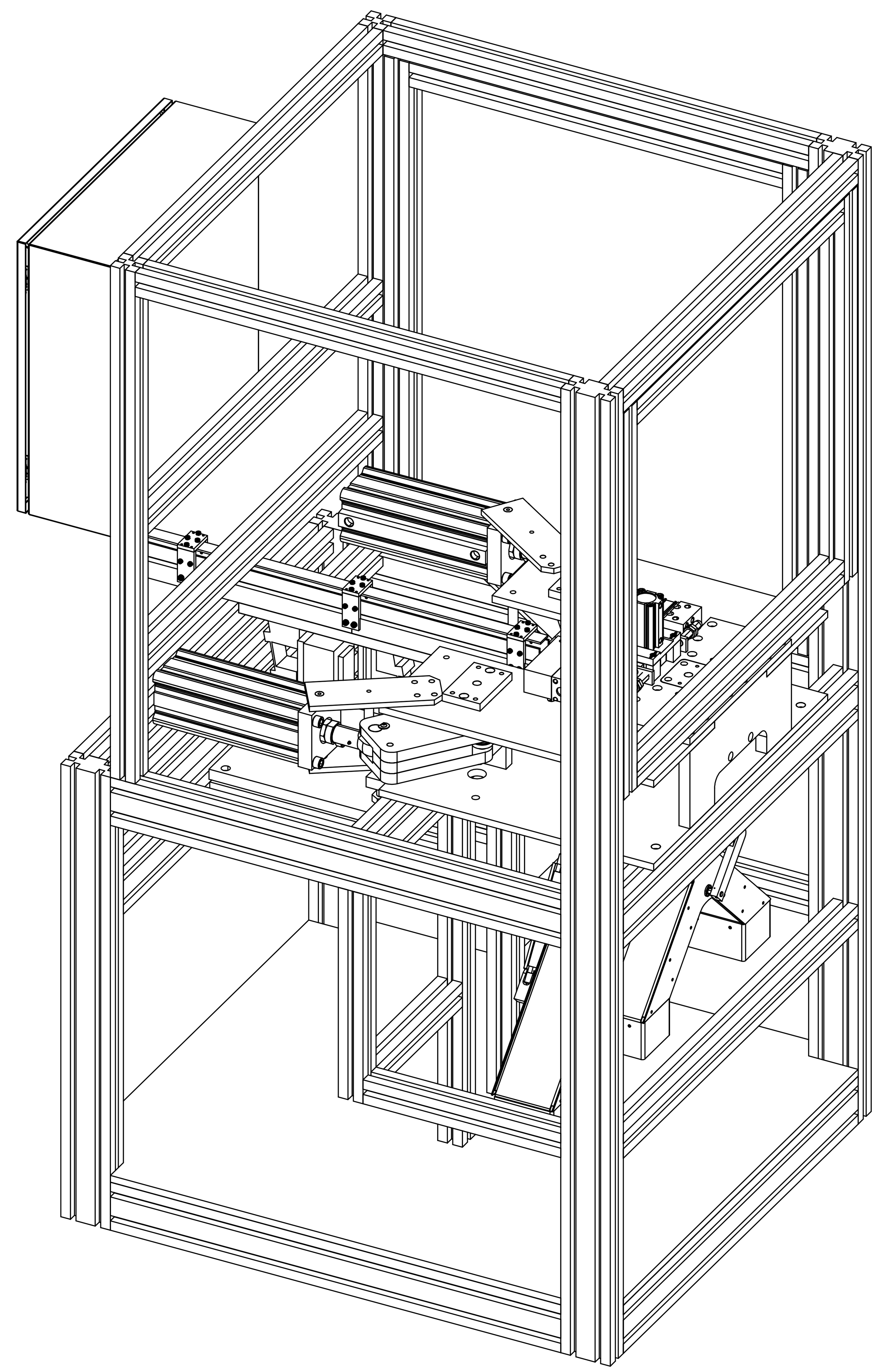
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	45X90X810		5
2	45X90X850		2
3	45X90X820		4
4	45X90X1810.5		2
5	45X45X810		8
6	FLOOR_PLASTIC		1
7	45X45X657.3		2
8	45X90X415		2
9	45X45X297.9		2
10	45X45X393.7		2
11	45X45X360		2
12	45X45X960.5		2
13	45X45X775		2
14	TAMPER-RESISTANT WASHDOWN ENCLOSURE	TAMPER-RESISTANT WASHDOWN ENCLOSURE	1
15	45X45X715		2
16	45X45X725.5		2
17	45X45X910.5		2
18	45X45X680		2
19	A40-1400-11-011-004 BASE MID		1
20	A40-1400-11-011-007 SHEAR TOP		1
21	A40-1400-11-011-005 ACCESS PORT		1
22	A40-1400-11-011-001 BASE		1
23	A40-1400-11-011-003 BASE RIGHT		1
24	A40-1400-11-011-002 BASE LEFT		1
25	A40-1400-11-011-018 BASE PIN		2
26	A40-1400-11-011-006 BASE UPRIGHT		1
27	A40-1400-11-011-008 SHEAR BOTTOM		1
28	A40-1400-11-011-009 TERT UPRIGHT		2
29	A40-1400-11-011-010 TERT TOP		2
30	A40-1400-11-011-011 TERT BOTTOM		2
31	A40-1400-11-011-013 CYL. BOTTOM		2
32	A40-1400-11-011-012 CYL. TOP		2
33	A40-1400-11-011-019 CYL. PIN		2
34	MXQ16_100_0_0__5		1
35	A40-1400-11-011-015 SHROUD MIDDLE		1
36	A40-1400-11-011-016 SHROUD LEFT		1
37	A40-1400-11-011-014 SHROUD RIGHT		1
38	MGPL32_25Z_BODY		2
39	A40-1400-11-013-001 UPPER RIGHT SHEAR ARM		1
40	A40-1400-11-013-002 UPPER RIGHT BEARING INSERT		1
41	91595A643	DOWEL PIN	4
42	91290A528	BLACK-OXIDE ALLOY STEEL SOCKET HEAD SCREW	2
43	DOWEL_M5_X_20	91595A356	4
44	FPSFJBA_D14_L60_M5(MISUMI)	14 X 60 SHAFT	4
45	OVERSIZE_CLIP_WASH_M5_X_18	93409A133	10
46	BUTT_HD_SCR_M5_X_10	91239A224	10
47	A40-1400-11-013-005 BLADE BOTTOM		2
48	A40-1400-11-013-004 BLADE		2
49	A40-1400-11-013-003 BLADE BACK		2
50	NSK 22208CDE4C3	ID:40 OD:80 SPEHERICAL ROLLER BEARING	2
51	1161N86_DOUBLE X-PROFILE OIL-RESISTANT BUNA-N O-RING	1161N86	3
52	A40-1400-11-014-001 LOWER LEFT SHEAR ARM		1
53	A40-1400-11-014-002 LOWER LEFT BEARING INSERT		1
54	CLBPB40_49_10(MISUMI)	ID:40 OD:49 L:10 SHEAR SHAFT SPACER	1
55	CLBPB40_49_12(MISUMI)	ID:40 OD:49 L:12 SHEAR SHAFT SPACER	1
56	NSFRBE_D48_L31_5_M12_T68_Q40_N12(MISUMI) SHEAR SHAFT		1
57	A40-1400-11-012-002 MIDDLE LINK		2
58	A40-1400-11-012-003 TOP LINK		2
59	A40-1400-11-012-001 BOTTOM LINK		2
60	SFR22_60(MISUMI)	22 X 60 SHAFT	2
61	1161N74_DOUBLE X-PROFILE OIL-RESISTANT BUNA-N O-RING	1161N74	4
62	CLBUB25_31_20(MISUMI)	ID:25 OD:31 L:20 TERT SHAFT SPACER	2
63	NSK 22205CE4C3	ID:25 OD:52 SPHEREICAL ROLLER BEARING	4
64	CLBPB25_31_12(MISUMI)	ID:25 OD:31 L:12 TERT SHAFT SPACER	2
65	NSFRBE_D30_L31_5_M12_T68_Q25_N12 (MISUMI)	TERT SHAFT	2
66	DW-AD-501-04.STEP	INDUCTIVE PROXIMITY SENSOR	2
67	MGPL32_25Z_0_0_0__6		2
68	SET_SCR_M4_X_10	91390A114	2
69	A40-1400-11-016-004 CLAMP STOP		2
70	BUTT_HD_HEX_SCR_M6_X_30	91239A328	4
71	BUTT_HD_HEX_SCR_M6_X_20	91239A326	4
72	RB1412_RB-BODY		2
73	1412		2
74	14		4
75	A40-1400-11-016-003 CLAMP BACK		2
76	A40-1400-11-016-002 CLAMP MID		2
77	A40-1400-11-016-001 CLAMP BOTTOM RIGHT		1
78	PCF_8_BS_3		4
79	PCF_8_BS_5		4
80	A40-1400-11-015-001 CLAMP BOTTOM LEFT		1
81	A40-1400-11-017-001 TURN BUCKLE	8416N25	2
82	A40-1400-11-017-003 HEIM JOINT RH	60645K981	2
83	A40-1400-11-017-002 HEIM JOINT LF	60645K982	2
84	A40-1400-11-018-001 WASHER BASE		1
85	CDQ2B32_50DZ_0_1_0__5		1
86	A40-1400-11-018-002 WASHER UPRIGHT		2
87	A40-1400-11-018-006 CYL. SUPPORT		1
88	MXS8_50B_0_0__20		1
89	MXS8_50B_0_0__18		1
90	A40-1400-11-018-009 ENDSTOP BASE		1
91	A40-1400-11-018-008 PRESTOP IN OUT		1
92	A40-1400-11-018-007 PRESTOP UP DOWN		1
93	A40-1400-11-018-010 ENDSTOP IN OUT		1
94	A40-1400-11-018-011 ENDSTOP		1
95	CDQ2B32_50DZ_0_1_0__3		1
96	THRD_ROD_M8_X_25	93675A250	1
97	MXS_BT8_X12	SHOCK ABSORBER	1
98	MXS_BS8	EXTENSION END	1
99	MXS_8	TABLE MOUNT	1
100	MXS_8_2	TABLE MOUNT	1
101	MXS_B8_NUT	NUT	2
102	MXS_BS8_X12	SHOCK ABSORBER	1
103	MXS_BT8	RETRACTION END	1
104	HEX_SOC_CAP_SCR_M4_X_12	91290A148	4
105	DOWEL_M3_X_8	91595A104	2
106	HEX_SOC_CAP_SCR_M5_X_85	91290A105	4
107	HEX_SOC_CAP_SCR_M5_X_25	91290A252	4
108	DOWEL_M4_X_20	91595A167	18
109	HEX_SOC_CAP_SCR_M5_X_20	91290A242	2
110	HEX_SOC_CAP_SCR_M5_X_50	91290A262	2
111	HEX_SOC_CAP_SCR_M4_X_15	91290A306	2
112	BUTT_HD_SCR_M3_X_15	91239A811	2
113	DOWEL_M3_X_14	91595A114	2
114	CDQ2B12_15DCZ_0_1_0__8		1
115	HEX_SOC_CAP_SCR_M3_X_45	91290A079	2
116	CDQ2B12_15DCZ_0_1_0__6		1
117	FPSFJTB_D12_L20_N3_J5 (MISUMI)	12 X 20 PRE STOP PLUG	1
118	THRD_ROD_M3_X_12	93805A629	1
119	PSFGZ15_45_M8_N10_SC22(MISUMI)	15 X 45 WASHER REMOVAL SHAFT	1
120	HEX_SOC_CAP_SCR_M10_X_14	91290A127	1
121	A40-1400-11-018-003 STOP BLOCK LEFT		1
122	A40-1400-11-018-005 STOP PIN		2
123	A40-1400-11-018-004 STOP BLOCK RIGHT		1
124	91290A238	ALLOY STEEL SOCKET HEAD SCREW	5
125	98687A110	GENERAL PURPOSE STEEL WASHER	5
126	A40-1400-11-011-017 CYL. BRACKET		2
127	90128A298	ZINC-PLATED ALLOY STEEL SOCKET HEAD SCREW	8
128	2867T132	CORROSION-RESISTANT SLEEVE BEARING	4
129	2872T48	CORROSION-RESISTANT THRUST BEARING	4
130	A40-1400-11-011-024 CYL.PIVOT SHAFT		4
131	PHS22_3		2
132	PHS22_5		2
133	CDQ2A80_200DCMZ_BODY		2
134	CDQ2A80_200DCMZ_NUT		2
135	CDQ2A80_200DCMZ_SHAFT		2
136	MXQ16_100_0_0__3		1
137	A40-1400-11-011-020 PART TRANSFER	CONFIG 4	1
138	MHZ2_25D_33_3_0__6		1
139	MHZ2_25D_33_3_0__3		2
140	A40-1400-11-011-023 GRIPPER RIGHT		1
141	A40-1400-11-011-022 GRIPPER LEFT		1
142	BUTT_HD_ HEX_ SCR_M5_X_45	91239A244	2
143	HEX_SOC_CAP_SCR_M5_X_14	91290A230	2
144	LOW_PROF_HEX_SOC_CAP_SCR_M4_X_18	90358A129	4
145	DOWEL_M5_X_14	91595A348	2
146	A40-1400-11-011-021 TRANSFER GAURD		1
147	A40-1400-11-019-002 RAIL BASE BACK		1
148	A40-1400-11-019-001 RAIL BASE FRONT		1
149	A40-1400-11-019-003 SRT BRACKET SIDE		6
150	91595A108	DOWEL PIN	16
151	A40-1400-11-019-004 SRT BRACKET TOP		3
152	91290A148	ALLOY STEEL SOCKET HEAD SCREW	8
153	91290A228	ALLOY STEEL SOCKET HEAD SCREW	16
154	91290A144	ALLOY STEEL SOCKET HEAD SCREW	24
155	A40-1400-11-019-007 RAIL SIDE		2
156	A40-1400-11-019-008 RAIL TOP		1
157	A40-1400-11-019-005 ANGLE BRACKET SIDE		2
158	A40-1400-11-019-006 ANGELED BRACKET TOP		1
159	A40-1400-11-019-0010 TOP ANGLE RAIL		1
160	A40-1400-11-019-009 SIDE ANGLE RAIL		2
161	A40-1400-11-019-011 VIBE_TOP_CONNECTOR		1
162	A40-1600-04-030-001 VIBE BASE.STP.STEP		1
163	PLAIN_WASHER_M10_R.STP.STEP		3
164	HEX_SOC_CAP_SCR_M10_X_110.STP.STEP		3
165	HEX_SOC_CAP_SCR_M5_X_25.STP.STEP		3
166	DOWEL 5X10.STP.STEP		2
167	WASH 15OD-5.3ID-T3.STP.STEP		3
168	A40-1600-04-030-008 VIBE GEN.STP.STEP		1
169	A40-1400-11-030-001 BACK PANEL		1
170	A40-1400-11-030-002 OUTSIDE PANEL		1
171	A40-1400-11-030-005 SHORT STRAIGHT PANEL		2
172	SFLC698ZZ	ID:8 OD19 FLANGED BEARING	2
173	A40-1400-11-030-007 FRONT PANEL		1
174	SFLC626ZZ	ID:6 OD19: FLANGED BEARING	2
175	A40-1400-11-030-016 TRAP DOOR SHAFT	PSFGG8-135-F6-P6-M3	2
176	A40-1400-11-030-006 TRAP DOOR		2
177	92981A142	ALLOY STEEL SHOULDER SCREWS	4
178	A40-1400-11-030-010 LEVER ARM		2
179	92981A743	ALLOY STEEL SHOULDER SCREWS	1
180	92981A143	ALLOY STEEL SHOULDER SCREWS	1
181	A40-1400-11-030-003 NINETY DEGREE PANEL		1
182	A40-1400-11-030-012 CHUTE EXTENSION		4
183	A40-1400-11-030-004 LONG STRAIGHT PANEL		1
184	A40-1400-11-030-013 DOOR SHROUD		4
185	91294A128	BLACK-OXIDE ALLOY STEEL HEX DRIVE FLAT HEAD SCREW	24
186	A40-1400-11-030-014 OUTSIDE PANEL		1
187	A40-1400-11-030-011 VERTICAL SUPPORT		2
188	FNTS6_1_0_D6_B6_U20 (CLEVIS)		2
189	CD85N16_125_A(SHAFT)		2
190	CD85N16_125_A		2
191	HCLGN6_12		2
192	HCLGN6_22		2
193	A40-1400-11-030-008 CYL CLEVIS		2
194	A40-1400-11-030-009 CYL CLEVIS SUPPORT		2
195	91290A138	ALLOY STEEL SOCKET HEAD SCREW	80
196	91116A120	18-8 STAINLESS STEEL OVERSIZED WASHER	2
197	91290A115	BLACK-OXIDE ALLOY STEEL SOCKET HEAD SCREW	2
198	91239A136	BUTTON HEAD HEX DRIVE SCREW	8
199	A40-1400-11-030-015 CHUTE BOTTOM		3
200	91290A140	ALLOY STEEL SOCKET HEAD SCREW	8



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3RD ANGLE PROJECTION
METRIC All Dimensions in MM
IN ACCORDANCE WITH ASME Y14.5M-1994
CAD DATA IS MASTER
GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°
CAD SYSTEM SW

DRAWN LD
DATE (MM/DD/YY) 8/9/2022
MATERIAL N/A
HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED
SURFACE COATING NO
REV 0

QTY: 1

PART NUMBER SA-1
PART NAME

MOD N
VENDOR PART# N/A
DO NOT SCALE
SCALE 1:7
SHEET 2 OF 11
SIZE A1

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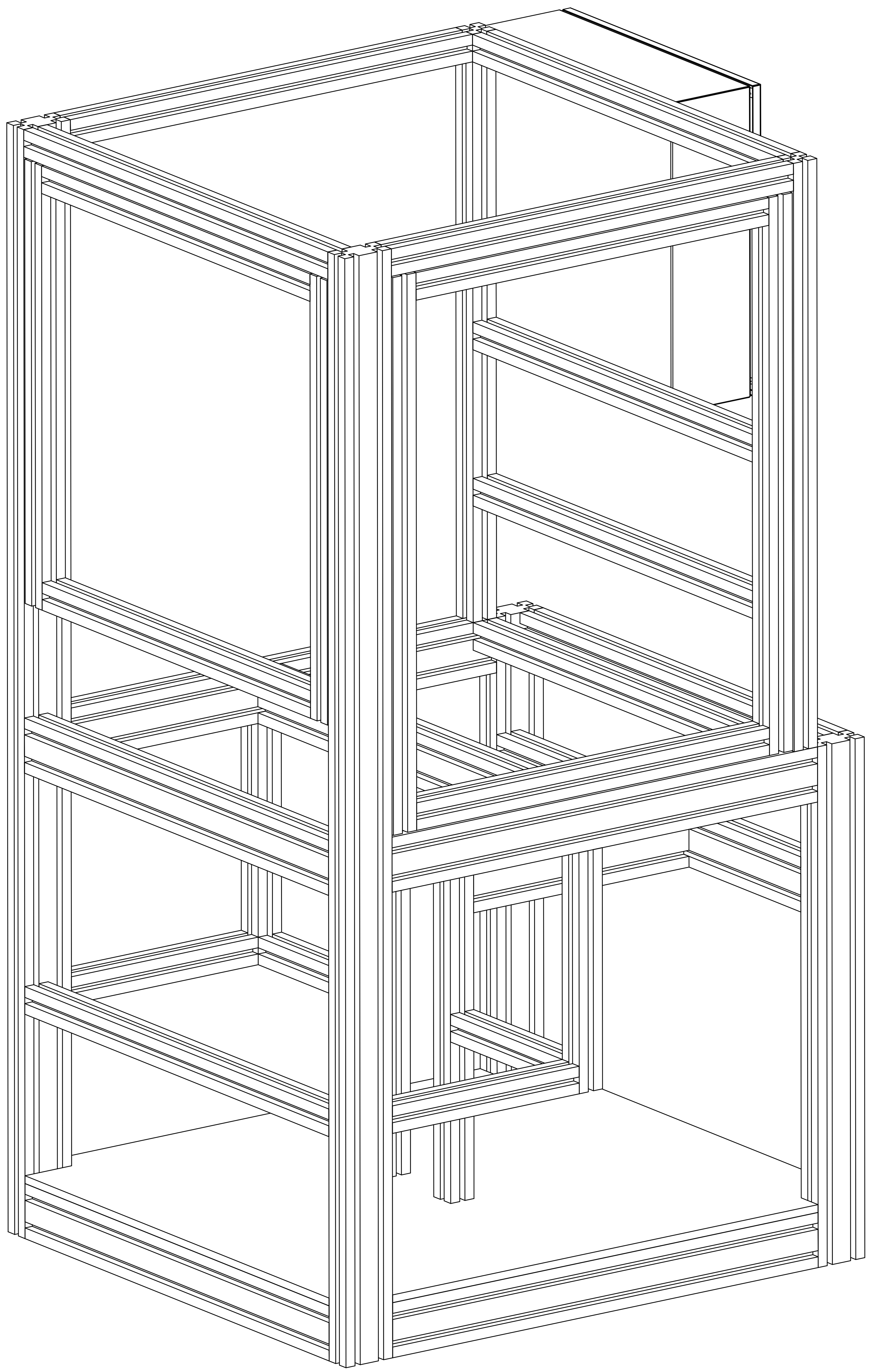

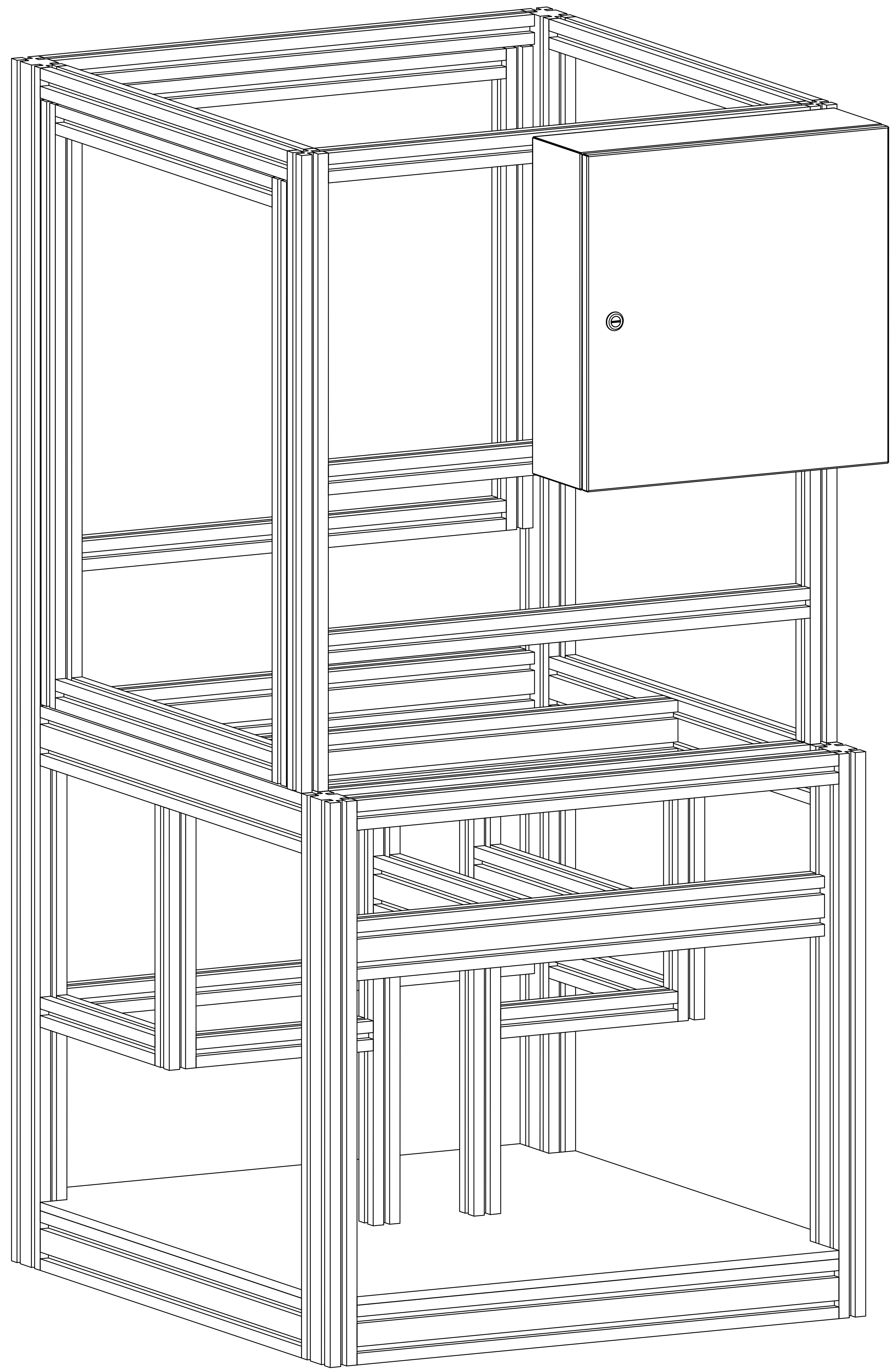

Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER SA-2	PART NAME	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:5	SHEET 3 OF 11

SIZE A1

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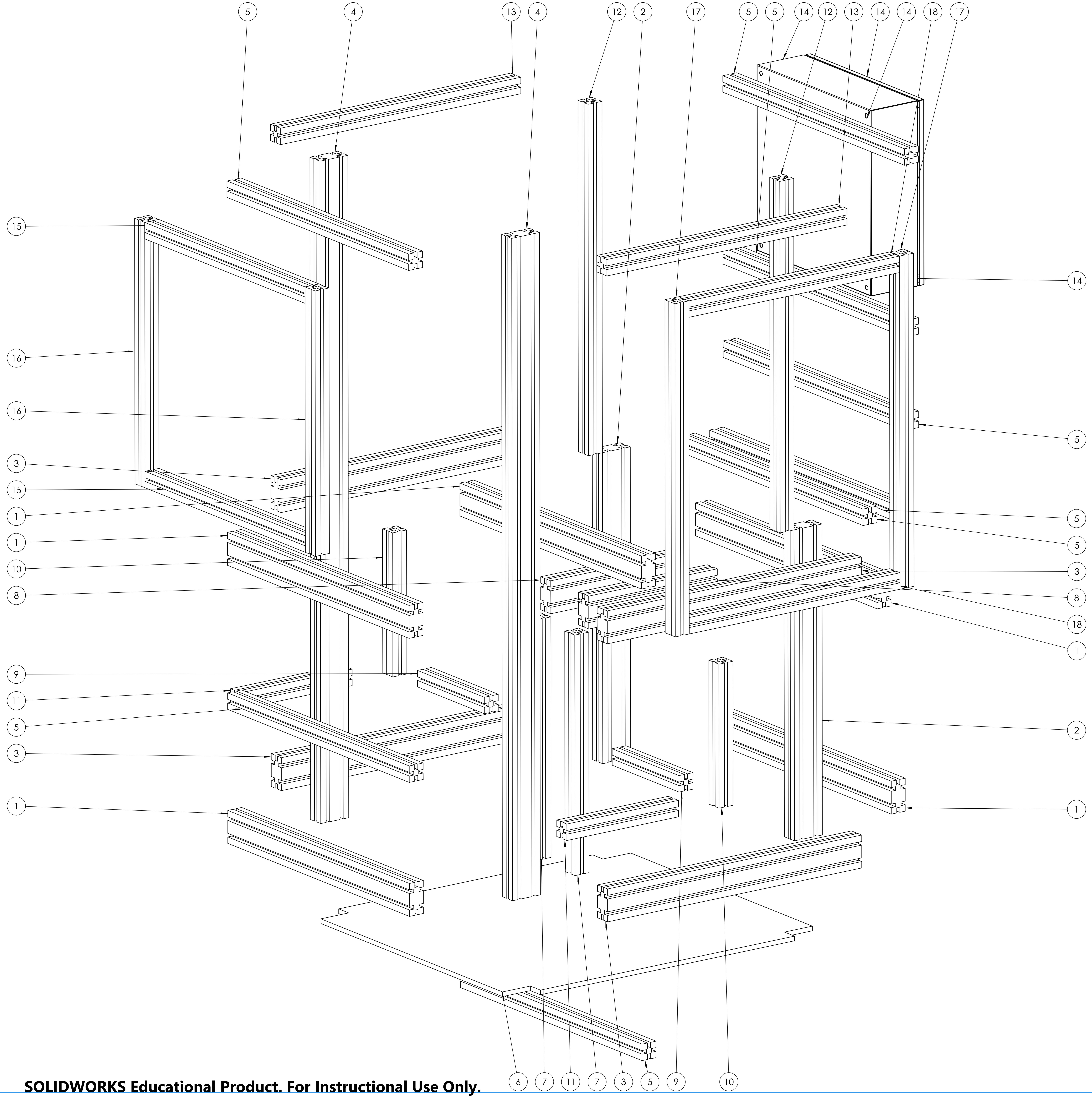
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	45x90x810		5
2	45x90x850		2
3	45x90x820		4
4	45x90x1810.5		2
5	45x45x810		8
6	Floor_plastic		1
7	45x45x657.3		2
8	45x90x415		2
9	45x45x297.9		2
10	45x45x393.7		2
11	45x45x360		2
12	45x45x960.5		2
13	45x45x775		2
14	Tamper-Resistant Washdown Enclosure	Tamper-Resistant Washdown Enclosure	1
15	45x45x715		2
16	45x45x725.5		2
17	45x45x910.5		2
18	45x45x680		2



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3RD ANGLE PROJECTION | METRIC All Dimensions in MM | IN ACCORDANCE WITH ASME Y14.5M-1994 | CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1° | CAD SYSTEM SW

DRAWN LD | DATE (MM/DD/YY) 8/9/2022 | MATERIAL N/A | HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED | SURFACE COATING NO | REV 0

QTY: 1 | PART NUMBER SA-2 | PART NAME

MOD N | VENDOR PART# N/A | DO NOT SCALE | SCALE 1:5 | SHEET 4 OF 11

SIZE A1

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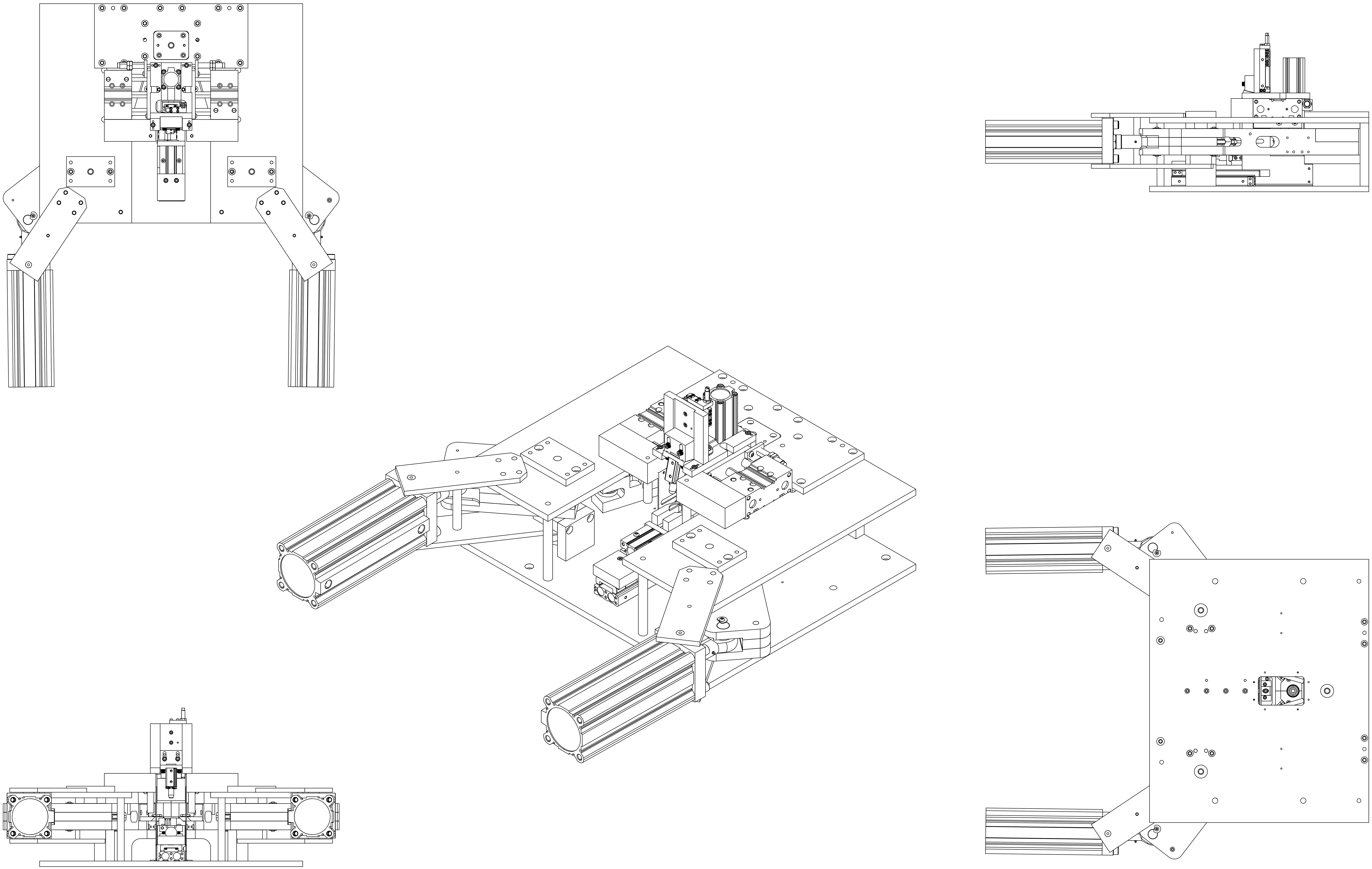

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER SA-3	PART NAME	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:3	SHEET 5 OF 11

SIZE A1

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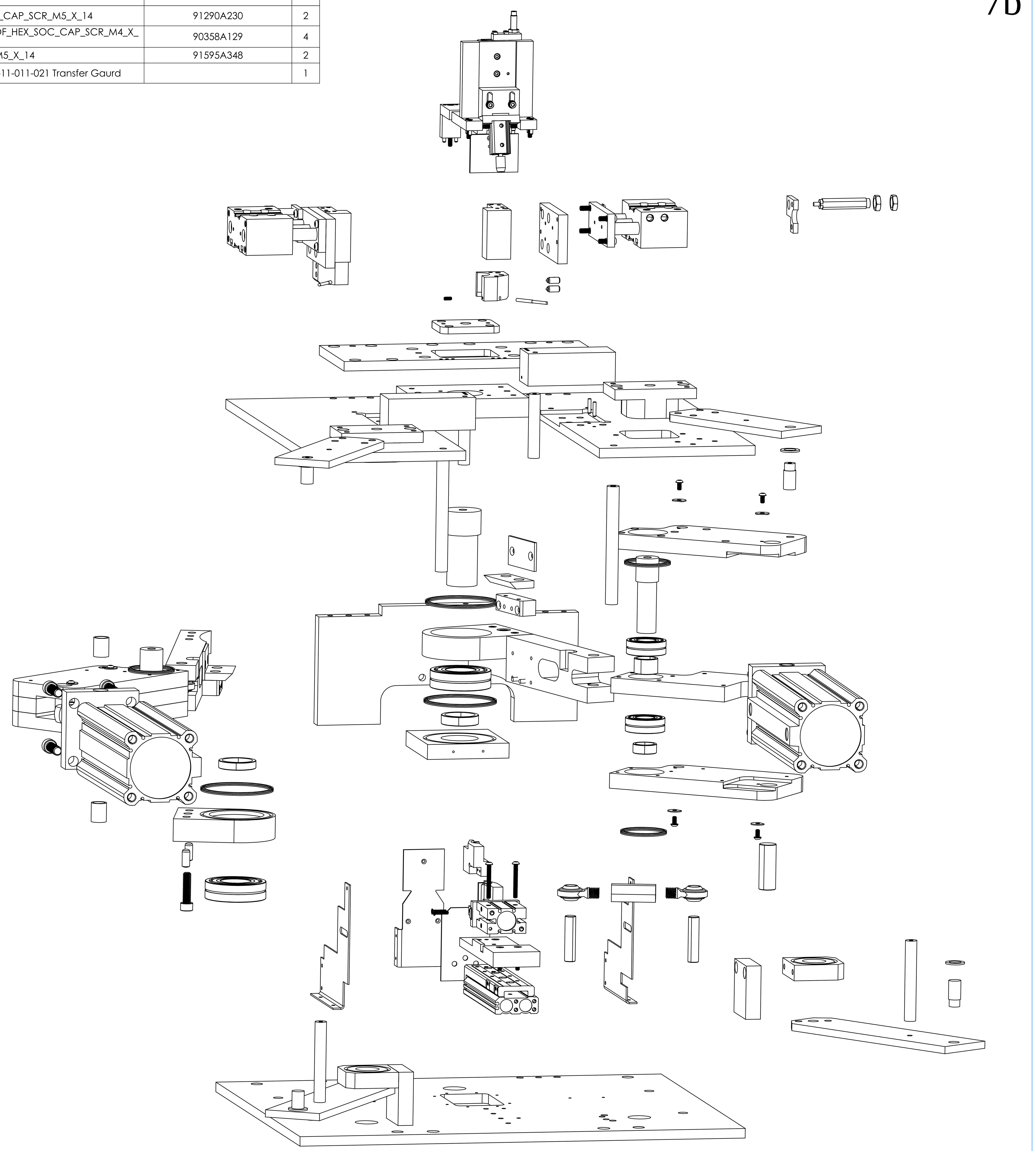
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
19	A40-1400-11-011-004 Base Mid		1
20	A40-1400-11-011-007 Shear Top		1
21	A40-1400-11-011-005 Access Port		1
22	A40-1400-11-011-001 Base		1
23	A40-1400-11-011-003 Base Right		1
24	A40-1400-11-011-002 Base Left		1
25	A40-1400-11-011-018 Base Pin		2
26	A40-1400-11-011-006 Base Upright		1
27	A40-1400-11-011-008 Shear Bottom		1
28	A40-1400-11-011-009 Tert Upright		2
29	A40-1400-11-011-010 Tert Top		2
30	A40-1400-11-011-011 Tert Bottom		2
31	A40-1400-11-011-013 Cyl. Bottom		2
32	A40-1400-11-011-012 Cyl. Top		2
33	A40-1400-11-011-019 Cyl. Pin		2
34	MXQ16_100_0_0__5		1
35	A40-1400-11-011-015 Shroud Middle		1
36	A40-1400-11-011-016 Shroud Left		1
37	A40-1400-11-011-014 Shroud Right		1
38	MGPL32_25Z_body		2
39	A40-1400-11-013-001 Upper Right Shear Arm		1
40	A40-1400-11-013-002 Upper Right Bearing Insert		1
41	91595A643	Dowel Pin	4
42	91290A528	Black-Oxide Alloy Steel Socket Head Screw	2
43	DOWEL_M5_X_20	91595A356	4
44	FPSFJBA_D14_L60_M5(misumi)	14 x 60 shaft	4
45	OVERSIZE_CLIP_WASH_M5_x_18	93409A133	10
46	BUTT_HD_SCR_M5_X_10	91239A224	10
47	A40-1400-11-013-005 Blade Bottom		2
48	A40-1400-11-013-004 Blade		2
49	A40-1400-11-013-003 Blade Back		2
50	NSK 22208CDE4C3	ID:40 OD:80 Speherical Roller Bearing	2
51	1161N86_Double X-Profile Oil-Resistant Buna-N O-Ring	1161N86	3
52	A40-1400-11-014-001 Lower Left Shear Arm		1
53	A40-1400-11-014-002 Lower Left Bearing Insert		1
54	CLBPB40_49_10(misumi)	ID:40 OD:49 L:10 Shear Shaft Spacer	1
55	CLBPB40_49_12(misumi)	ID:40 OD:49 L:12 Shear Shaft Spacer	1
56	NSFRBE_D48_L31_5_M12_T68_Q40_N12(misumi) Shear Shaft		1
57	A40-1400-11-012-002 Middle Link		2
58	A40-1400-11-012-003 Top Link		2
59	A40-1400-11-012-001 Bottom Link		2
60	SFR22_60(misumi)	22 x 60 Shaft	2
61	1161N74_Double X-Profile Oil-Resistant Buna-N O-Ring	1161N74	4
62	CLBUB25_31_20(misumi)	ID:25 OD:31 L:20 Tert Shaft Spacer	2
63	NSK 22205CE4C3	ID:25 OD:52 Sphereical Roller Bearing	4
64	CLBPB25_31_12(misumi)	ID:25 OD:31 L:12 Tert Shaft Spacer	2
65	NSFRBE_D30_L31_5_M12_T68_Q25_N12 (misumi)	Tert Shaft	2
66	DW-AD-501-04.step	Inductive Proximity Sensor	2
67	MGPL32_25Z_0_0_0__6		2
68	SET_SCR_M4_X_10	91390A114	2
69	A40-1400-11-016-004 Clamp Stop		2
70	BUTT_HD_HEX_SCR_M6_X_30	91239A328	4
71	BUTT_HD_HEX_SCR_M6_X_20	91239A326	4
72	RB1412_Rb-Body		2
73	1412		2
74	14		4
75	A40-1400-11-016-003 Clamp Back		2
76	A40-1400-11-016-002 Clamp Mid		2
77	A40-1400-11-016-001 Clamp Bottom Right		1
78	PCF_8_BS_3		4
79	PCF_8_BS_5		4
80	A40-1400-11-015-001 Clamp Bottom Left		1
81	A40-1400-11-017-001 Turn Buckle	8416N25	2
82	A40-1400-11-017-003 Heim Joint RH	60645K981	2
83	A40-1400-11-017-002 Heim Joint LF	60645K982	2
84	A40-1400-11-018-001 Washer Base		1
85	CDQ2B32_50DZ_0_1_0__5		1
86	A40-1400-11-018-002 Washer Upright		2
87	A40-1400-11-018-006 Cyl. Support		1
88	MXS8_50B_0_0__20		1
89	MXS8_50B_0_0__18		1
90	A40-1400-11-018-009 EndStop Base		1
91	A40-1400-11-018-008 PreStop In Out		1
92	A40-1400-11-018-007 PreStop Up Down		1
93	A40-1400-11-018-010 EndStop In Out		1
94	A40-1400-11-018-011 EndStop		1
95	CDQ2B32_50DZ_0_1_0__3		1
96	THRD_ROD_M8_x_25	93675A250	1
97	MXS_BT8_X12	Shock Absorber	1
98	MXS_BS8	Extension End	1
99	MXS_8	Table Mount	1
100	MXS_8_2	Table Mount	1
101	MXS_B8_NUT	Nut	2
102	MXS_BS8_X12	Shock Absorber	1
103	MXS_BT8	Retraction End	1
104	HEX_SOC_CAP_SCR_M4_X_12	91290A148	4
105	DOWEL_M3_X_8	91595A104	2
106	HEX_SOC_CAP_SCR_M5_X_85	91290A105	4
107	HEX_SOC_CAP_SCR_M5_X_25	91290A252	4
108	DOWEL_M4_X_20	91595A167	18
109	HEX_SOC_CAP_SCR_M5_X_20	91290A242	2
110	HEX_SOC_CAP_SCR_M5_X_50	91290A262	2
111	HEX_SOC_CAP_SCR_M4_X_15	91290A306	2
112	BUTT_HD_SCR_M3_X_15	91239A811	2
113	DOWEL_M3_X_14	91595A114	2
114	CDQ2B12_15DCZ_0_1_0__8		1
115	HEX_SOC_CAP_SCR_M3_X_45	91290A079	2
116	CDQ2B12_15DCZ_0_1_0__6		1
117	FPSFJTB_D12_L20_N3_J5 (Misumi)	12 x 20 Pre Stop Plug	1
118	THRD_ROD_M3_x_12	93805A629	1
119	PSFGZ15_45_M8_N10_SC22(Misumi)	15 x 45 Washer Removal Shaft	1
120	HEX_SOC_CAP_SCR_M10_X_14	91290A127	1
121	A40-1400-11-018-003 Stop Block Left		1
122	A40-1400-11-018-005 Stop Pin		2
123	A40-1400-11-018-004 Stop Block Right		1
124	91290A238	Alloy Steel Socket Head Screw	5
125	98687A110	General Purpose Steel Washer	5
126	A40-1400-11-011-017 Cyl. Bracket		2
127	90128A298	Zinc-Plated Alloy Steel Socket Head Screw	8
128	2867T132	Corrosion-Resistant Sleeve Bearing	4
129	2872T48	Corrosion-Resistant Thrust Bearing	4
130	A40-1400-11-011-024 Cyl.Pivot Shaft		4
131	PHS22_3		2
132	PHS22_5		2
133	CDQ2A80_200DCMZ_BODY		2
134	CDQ2A80_200DCMZ_NUT		2
135	CDQ2A80_200DCMZ_SHAFT		2
136	MXQ16_100_0_0__3		1
137	A40-1400-11-011-020 Part Transfer	config 4	1
138	MHZ2_25D_33_3_0__6		1
139	MHZ2_25D_33_3_0__3		2
140	A40-1400-11-011-023 Gripper Right		1
141	A40-1400-11-011-022 Gripper Left		1
142	BUTT_HD_ HEX_ SCR_M5_X_45	91239A244	2
143	HEX_SOC_CAP_SCR_M5_X_14	91290A230	2
144	LOW_PROF_HEX_SOC_CAP_SCR_M4_X_18	90358A129	4
145	DOWEL_M5_X_14	91595A348	2
146	A40-1400-11-011-021 Transfer Gaurd		1



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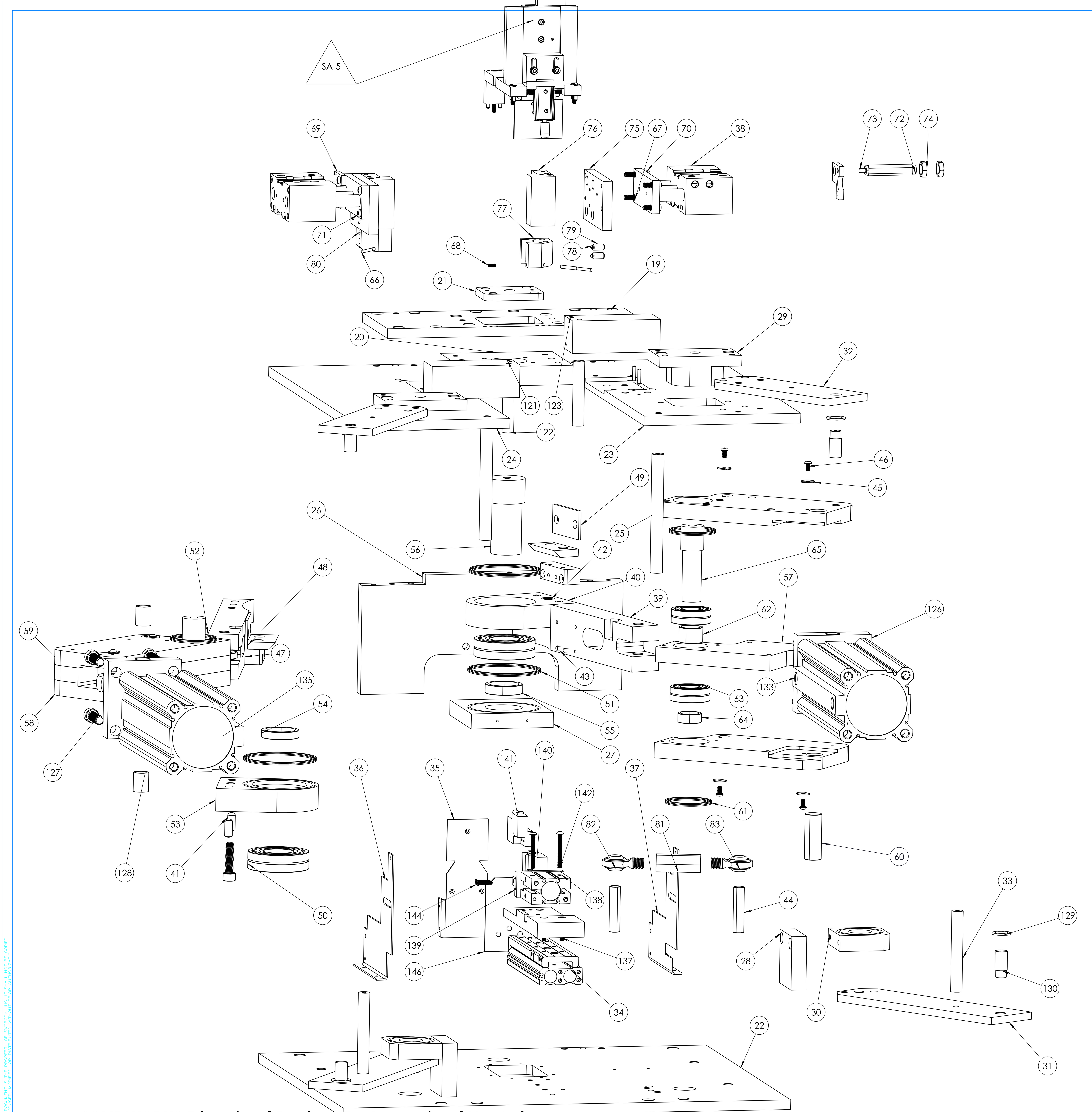
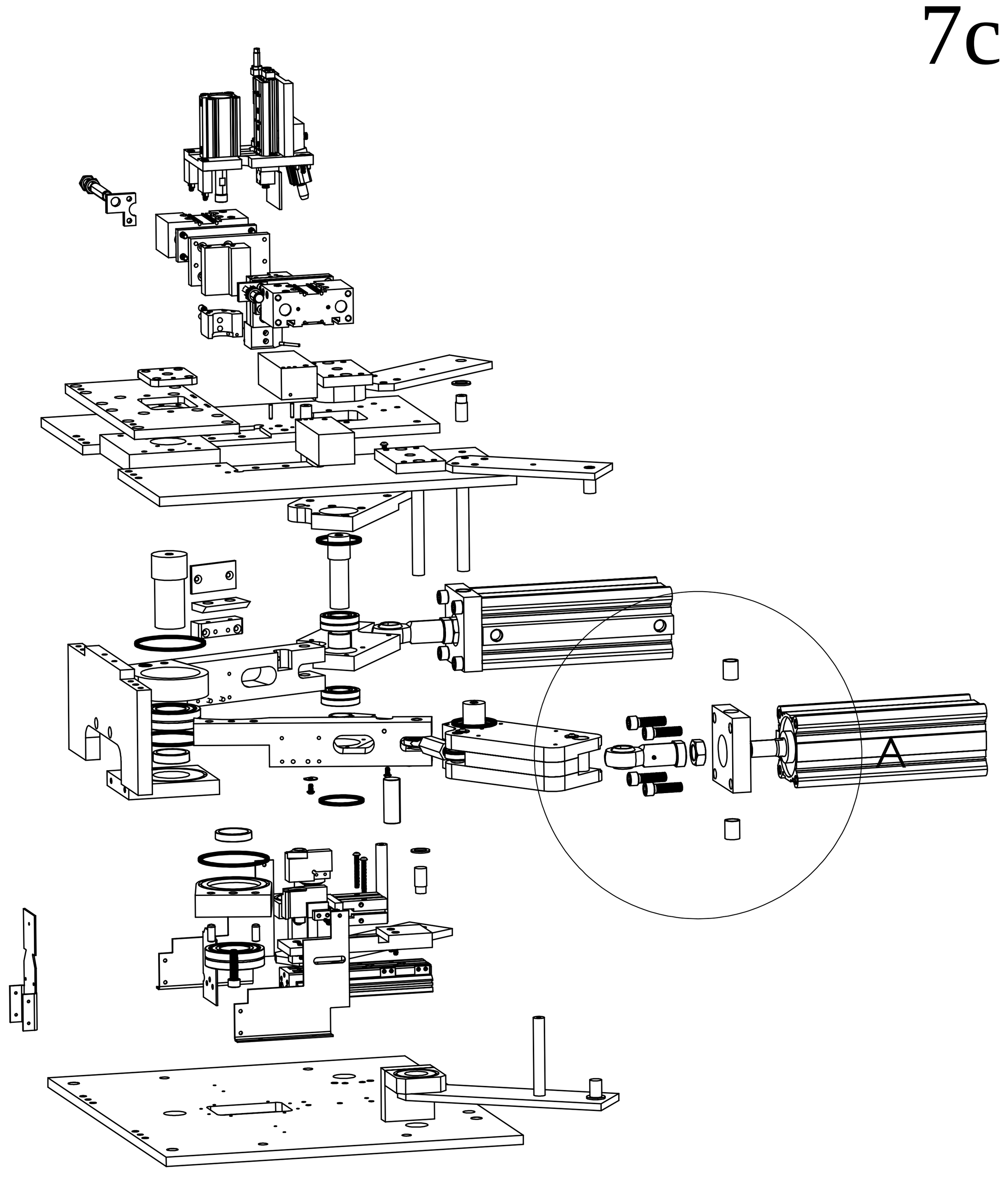
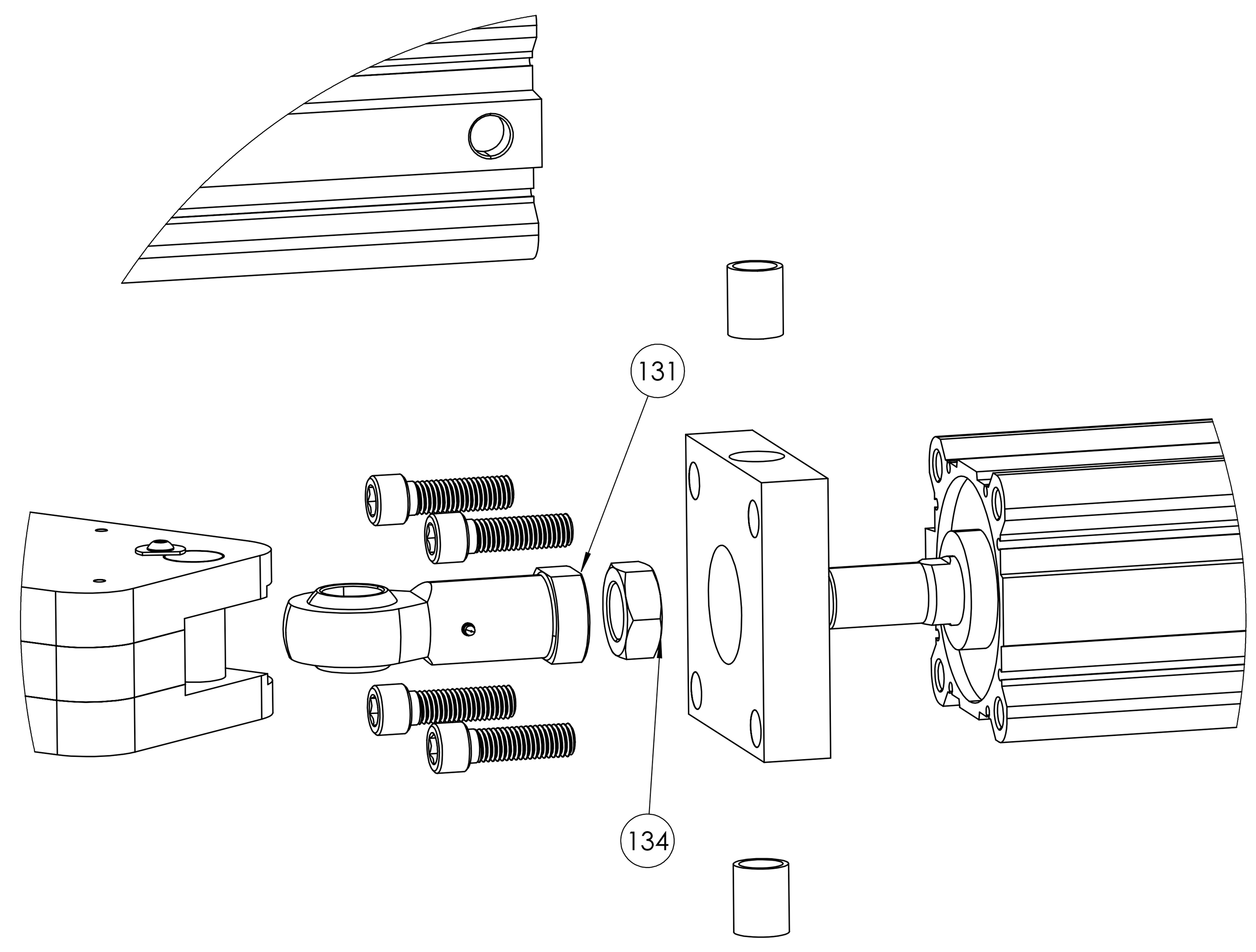
Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994 / CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO	REV 0
QTY: 1		PART NUMBER SA-3	PART NAME
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:3 / SHEET 6 OF 11

SIZE A1







DETAIL A
SCALE 1 : 2

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER SA-3	PART NAME	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:2.5	SHEET 7 OF 11

SIZE A1

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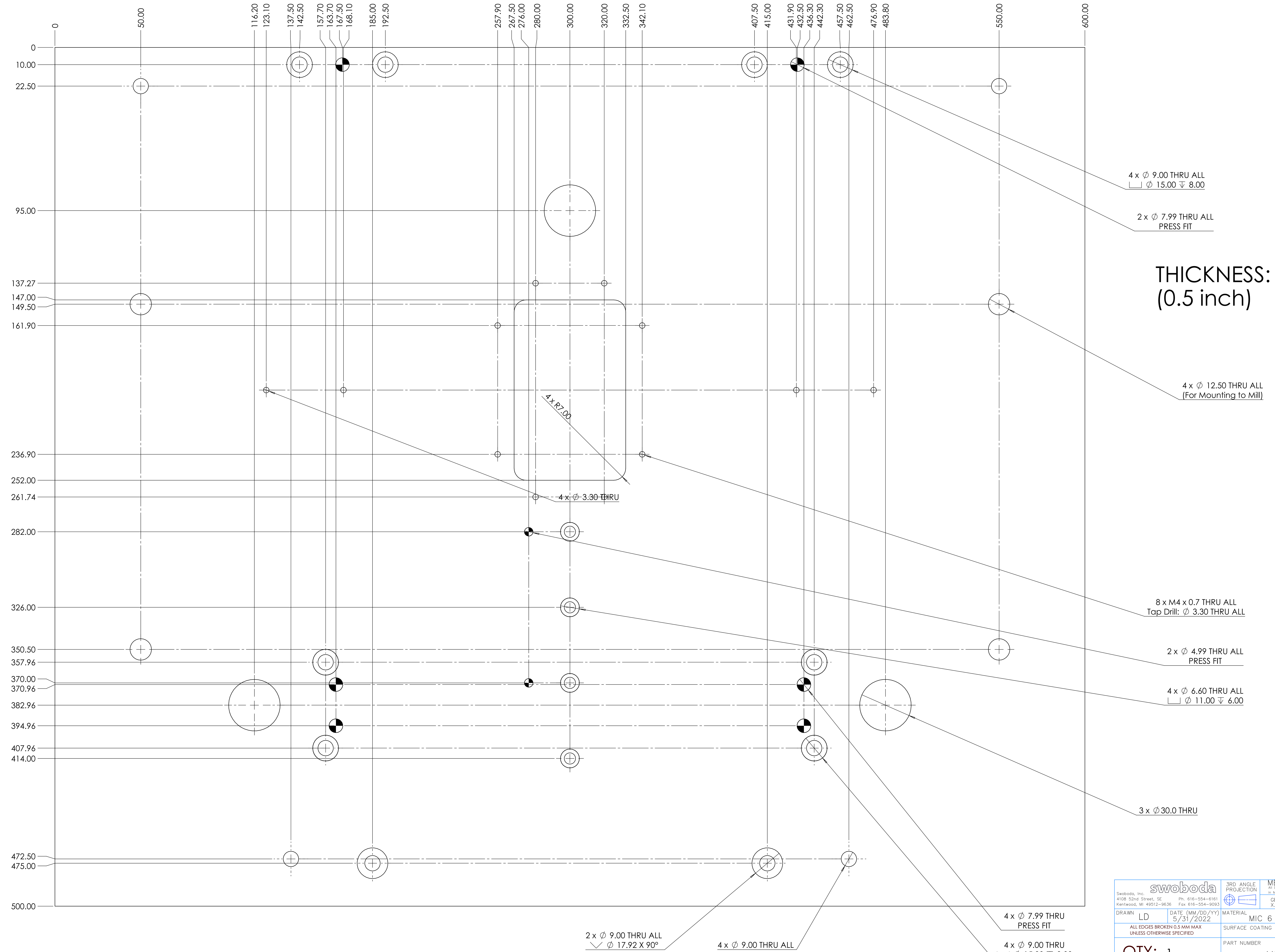

THICKNESS: 12.7mm
(0.5 inch)

swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL MIC 6	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-011-001	PART NAME Base	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 2

SIZE A1

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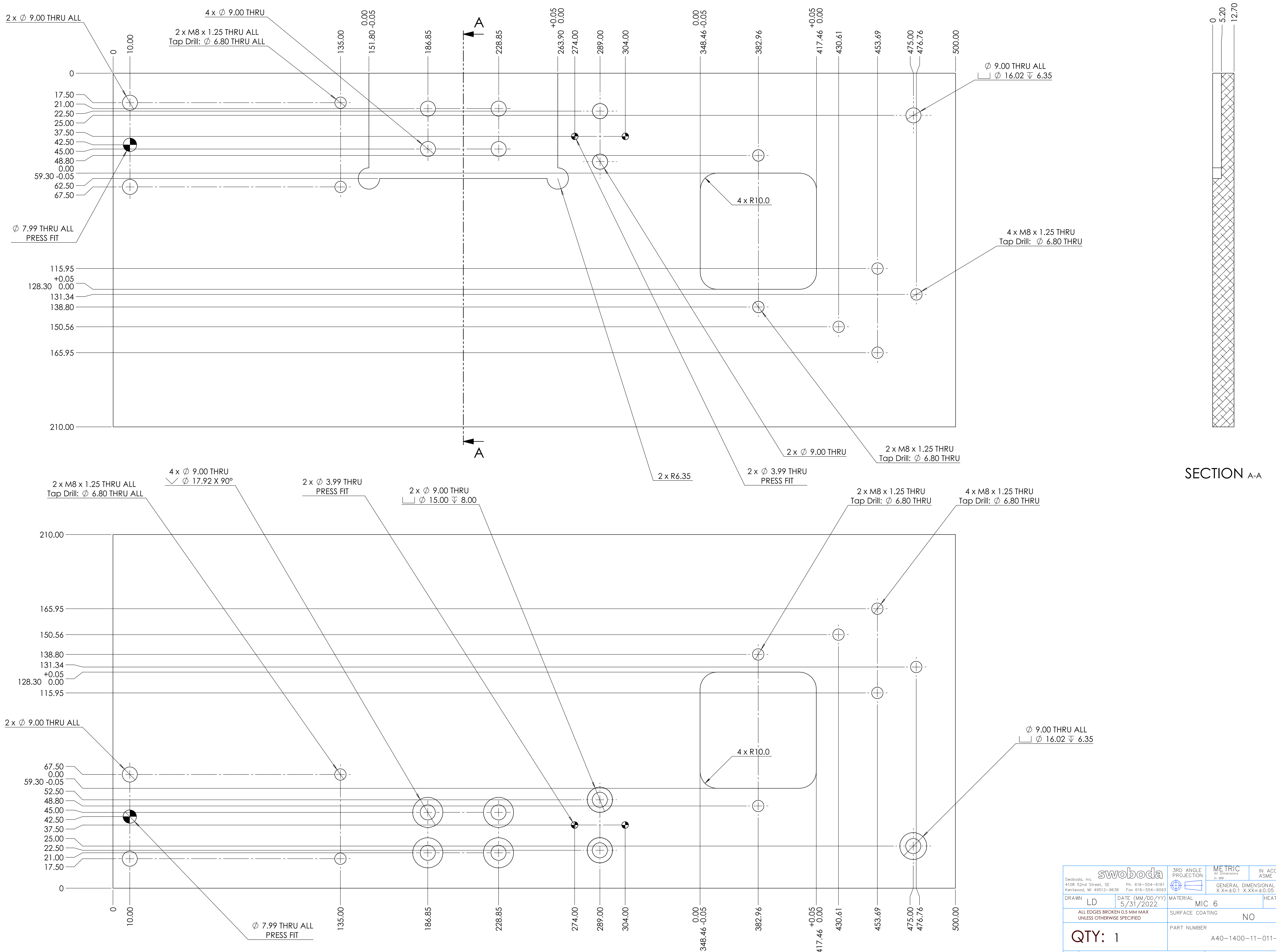

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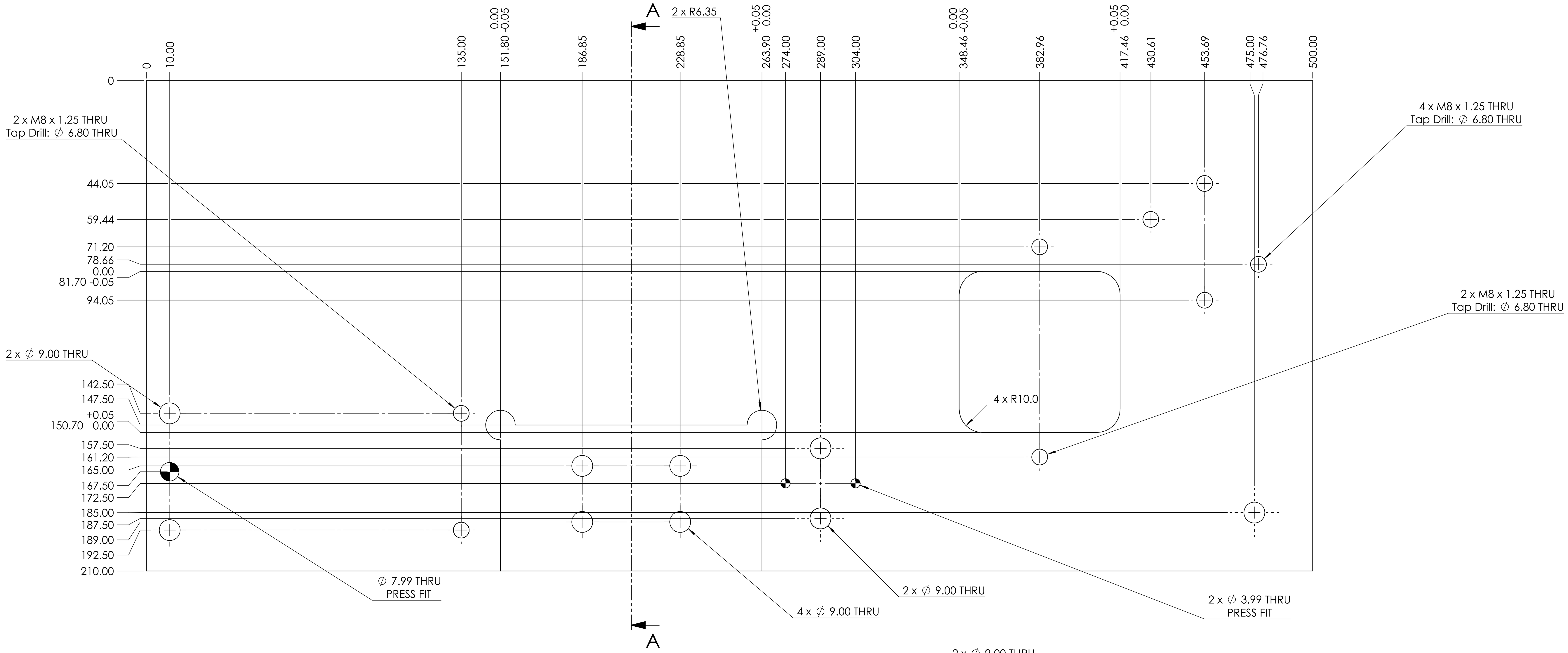
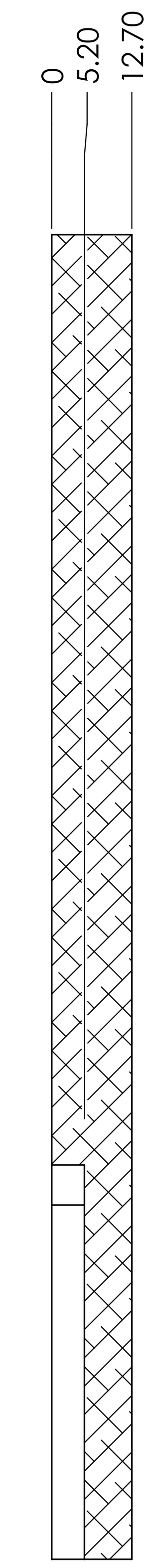
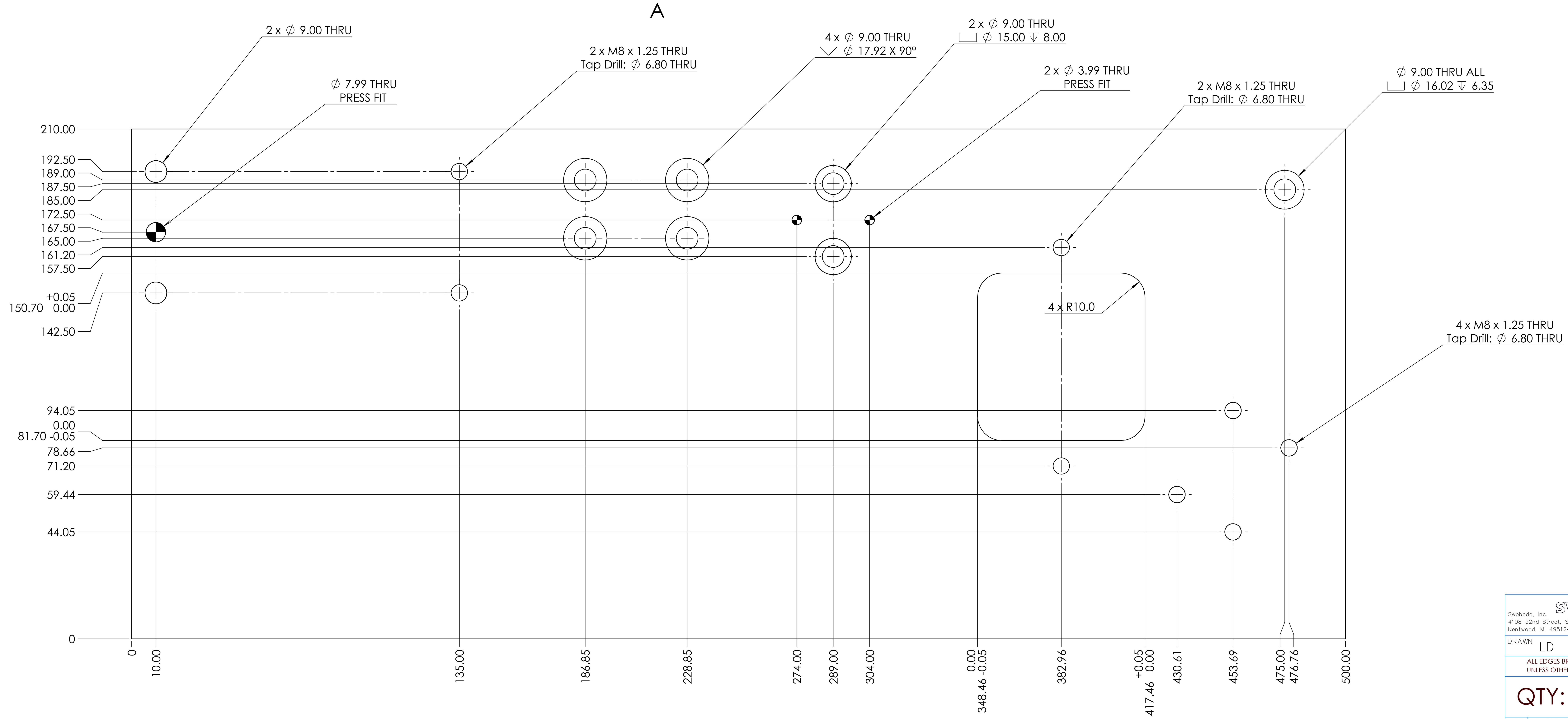
swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL MIC 6	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-011-002	PART NAME Base Left	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 1

SIZE A1





SECTION A-A



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Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093

3RD ANGLE PROJECTION | METRIC All Dimensions in MM | IN ACCORDANCE WITH ASME Y14.5M-1994 | CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1° | CAD SYSTEM SW

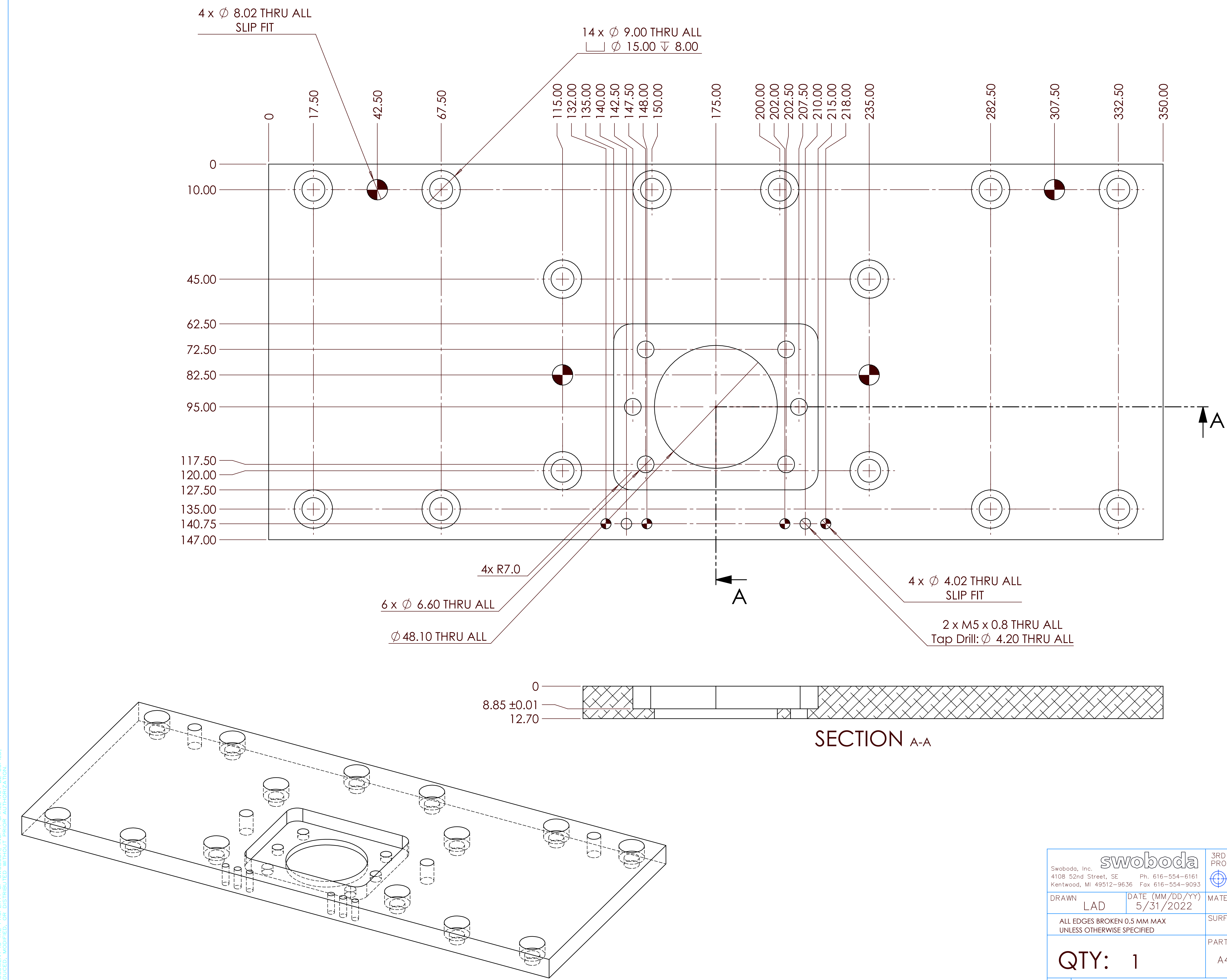
DRAWN LD | DATE (MM/DD/YY) 5/31/2022 | MATERIAL MIC 6 | HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED | SURFACE COATING NO | REV 0

QTY: 1 | PART NUMBER A40-1400-11-011-003 | PART NAME Base Right

MOD N | VENDOR PART# N/A | DO NOT SCALE | SCALE 1:1 | SHEET 1 OF 1

SIZE A1



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4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD ANGLE PROJECTION

METRIC
ALL DIMENSION IN MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM SW

DRAWN LAD

DATE (MM/DD/YY) 5/31/2022

MATERIAL MIC 6

HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING NO

REV 0

PART NUMBER A40-1400-11-011-004

PART NAME Base Mid

QTY: 1

MOD N

VENDOR PART# N/A

DO NOT SCALE

SCALE 1:1

SHEET 1 OF 1

SIZE A2

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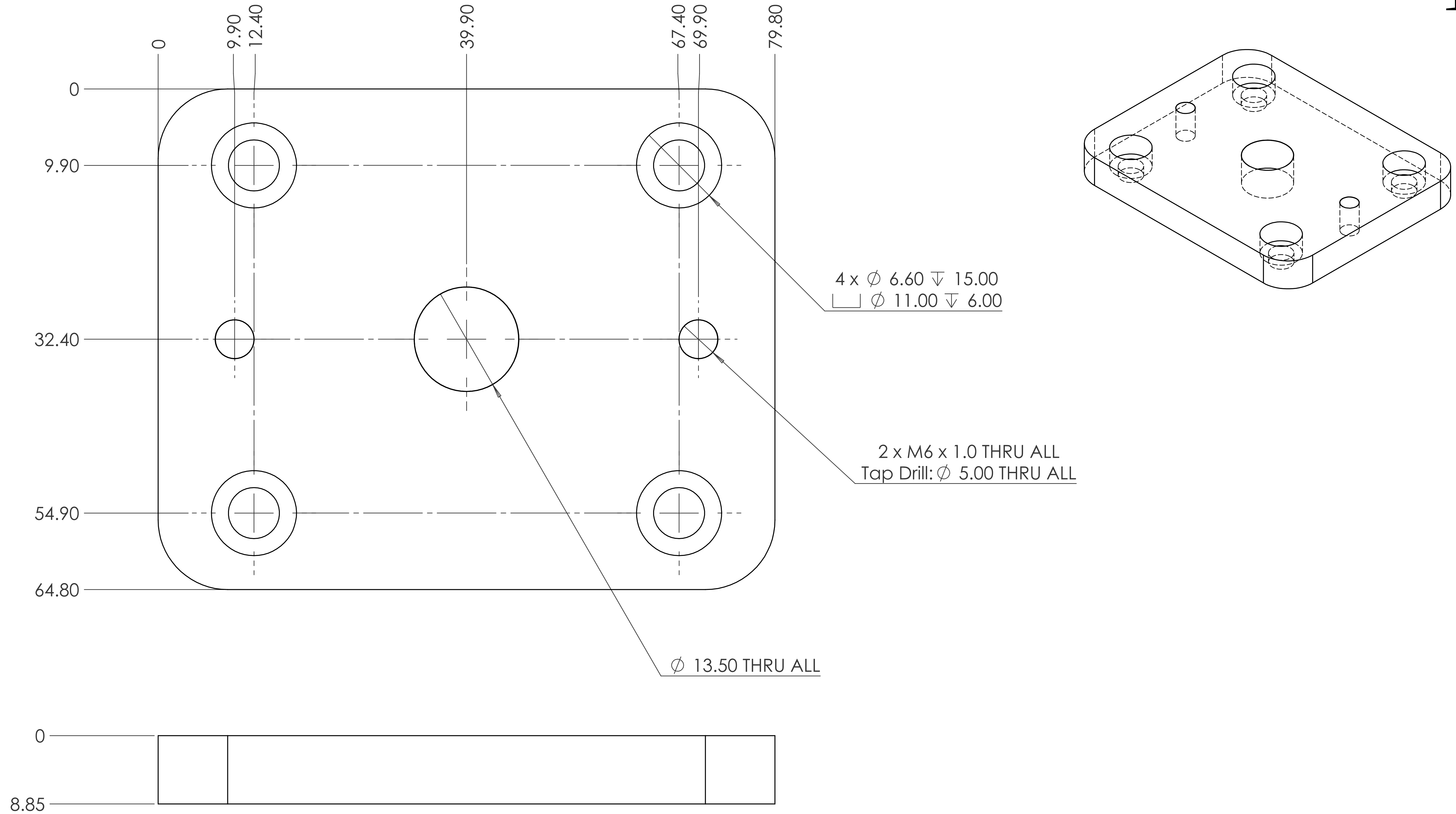

swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: 1018 CRS	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: Black Oxide			REV: 0
QTY: 1	PART NUMBER: A40-1400-11-011-005	PART NAME: Access Port		
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 2:1	SHEET: 1 OF 1

SIZE A3

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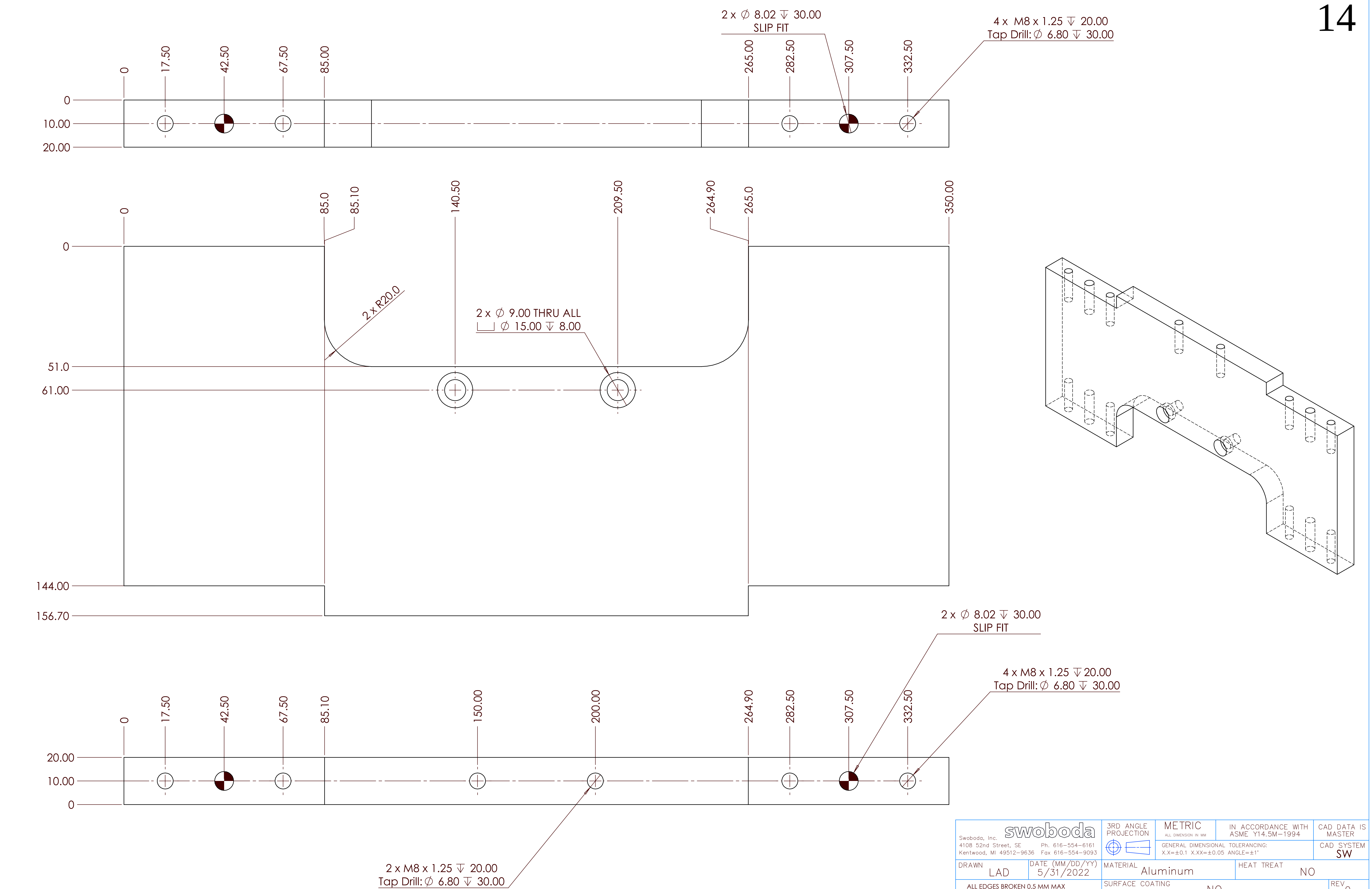

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4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
	GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM SW
DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL Aluminum	HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO	REV 0
QTY: 1		PART NUMBER A40-1400-11-011-006	PART NAME Base Upright
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1 / SHEET 1 OF 1

SIZE A2

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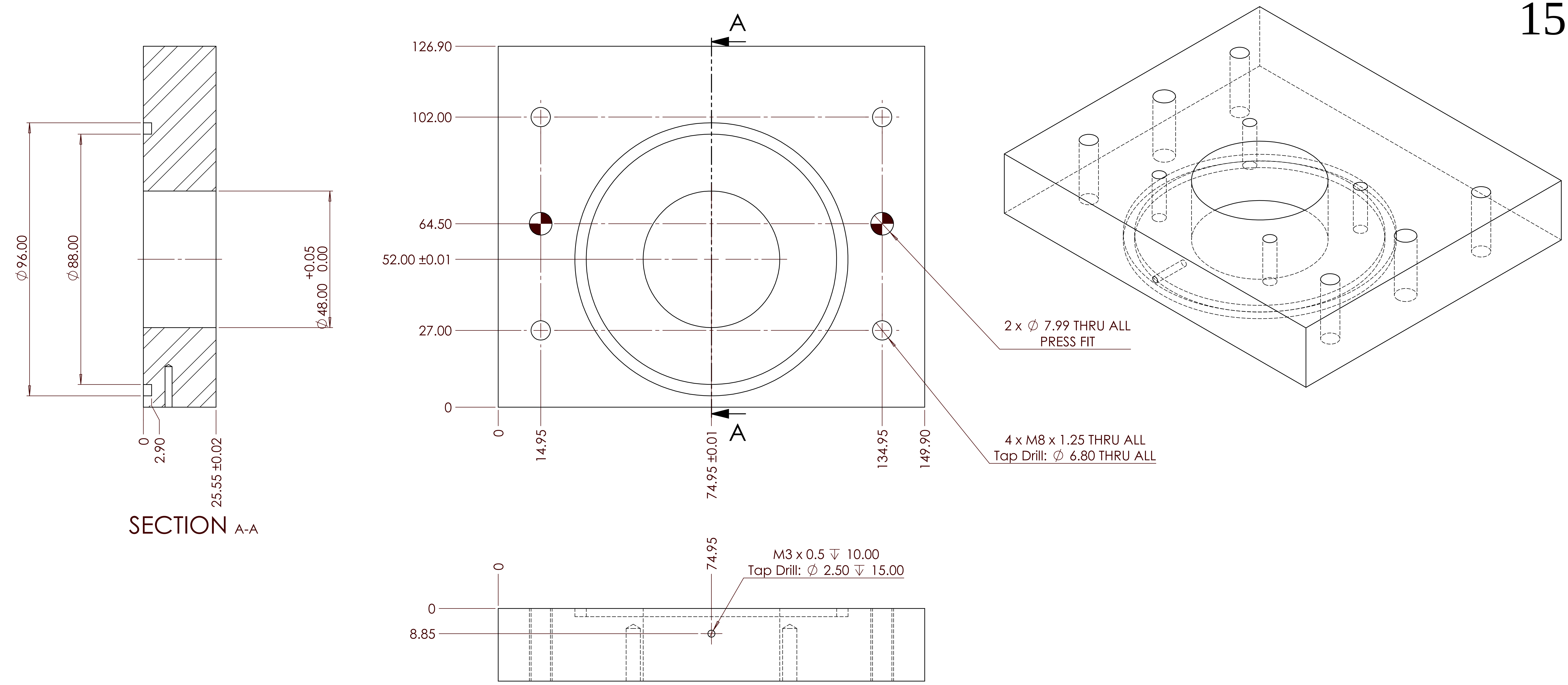

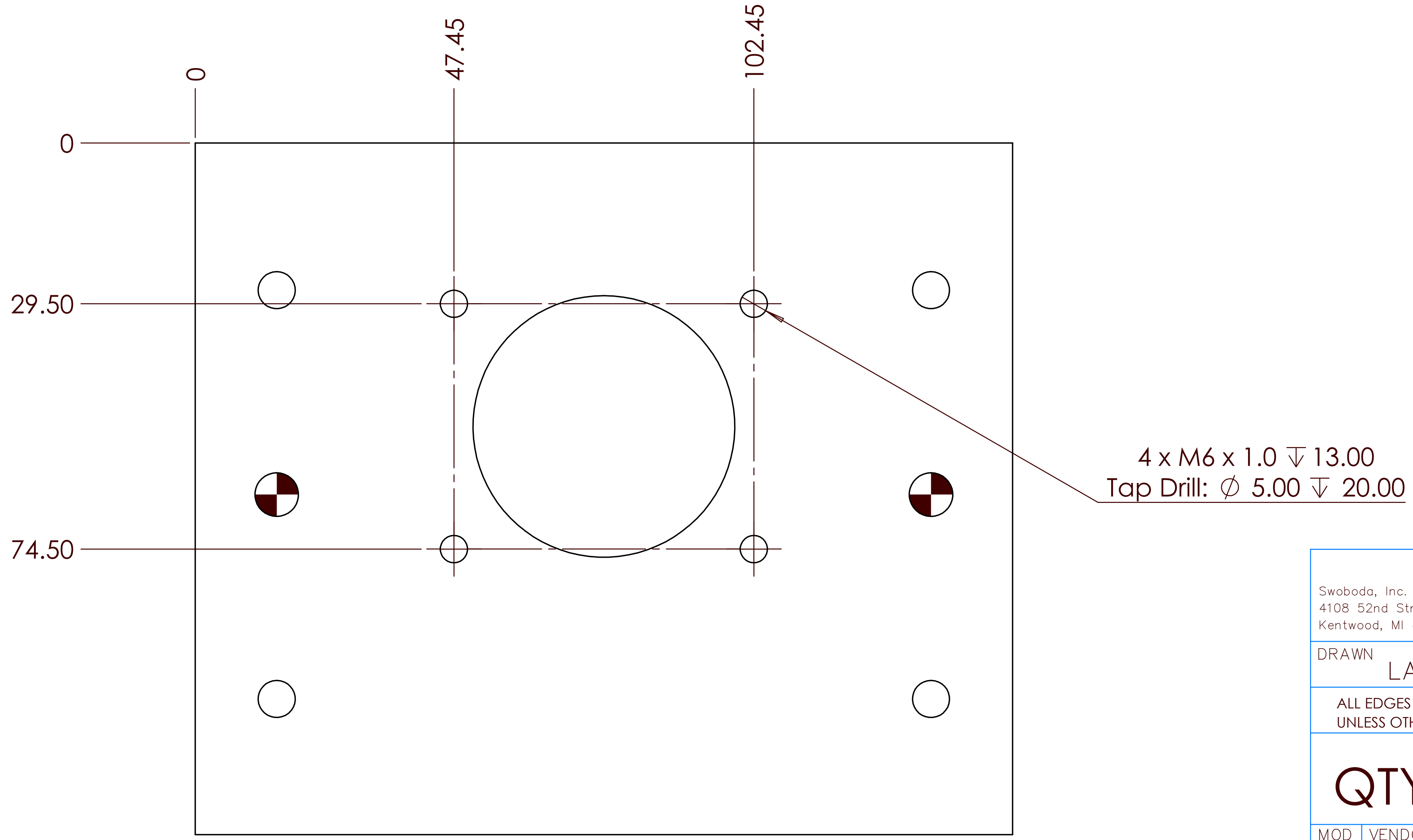

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL A2 Tool Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING Black Oxide		REV 0
QTY: 1		PART NUMBER A40-1400-11-011-007	PART NAME Shear Top	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 1

SIZE A2

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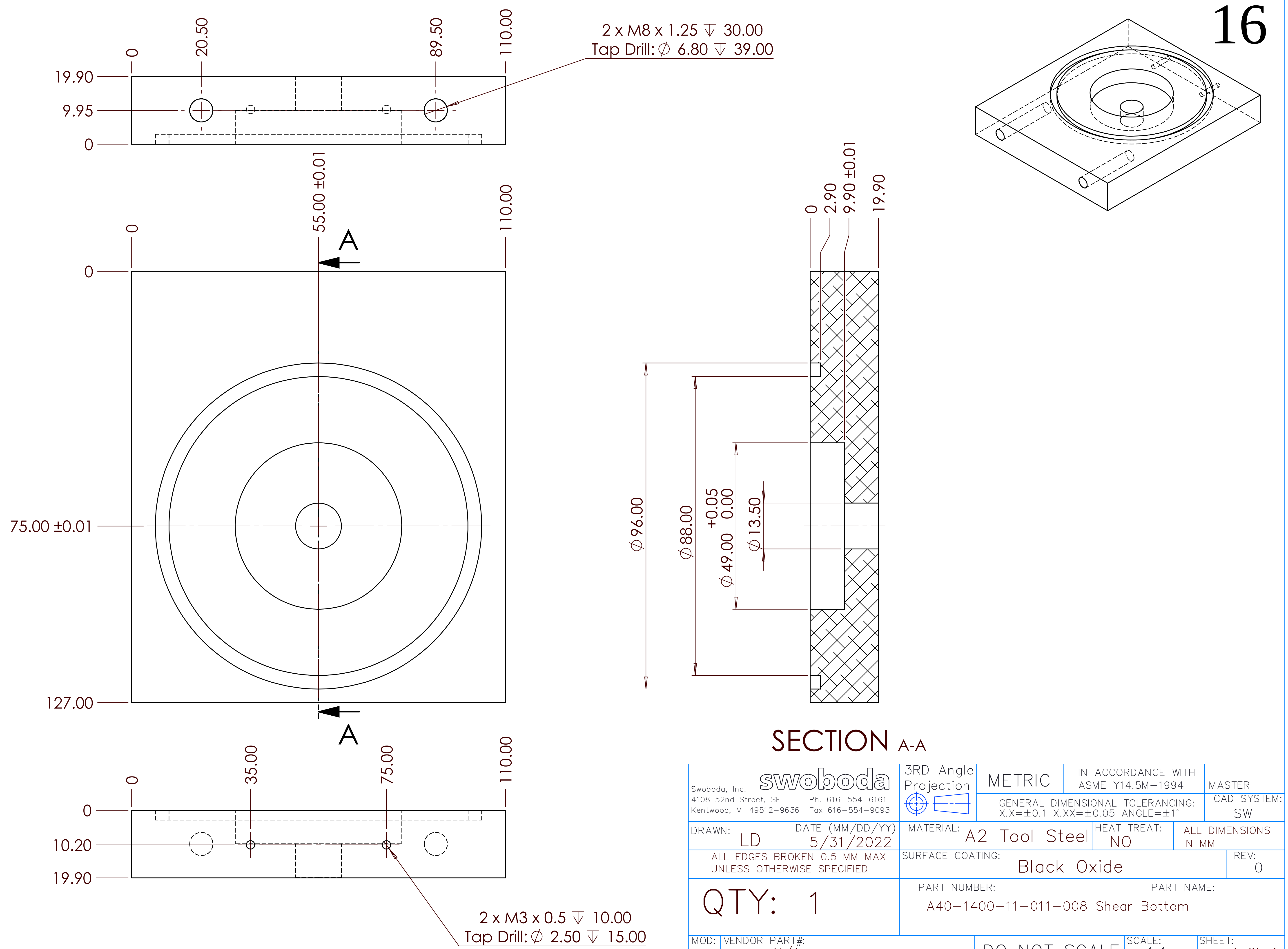

swoboda
Swoboda, Inc.
4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: A2 Tool Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-011-008

PART NAME: Shear Bottom

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 1

SIZE A3

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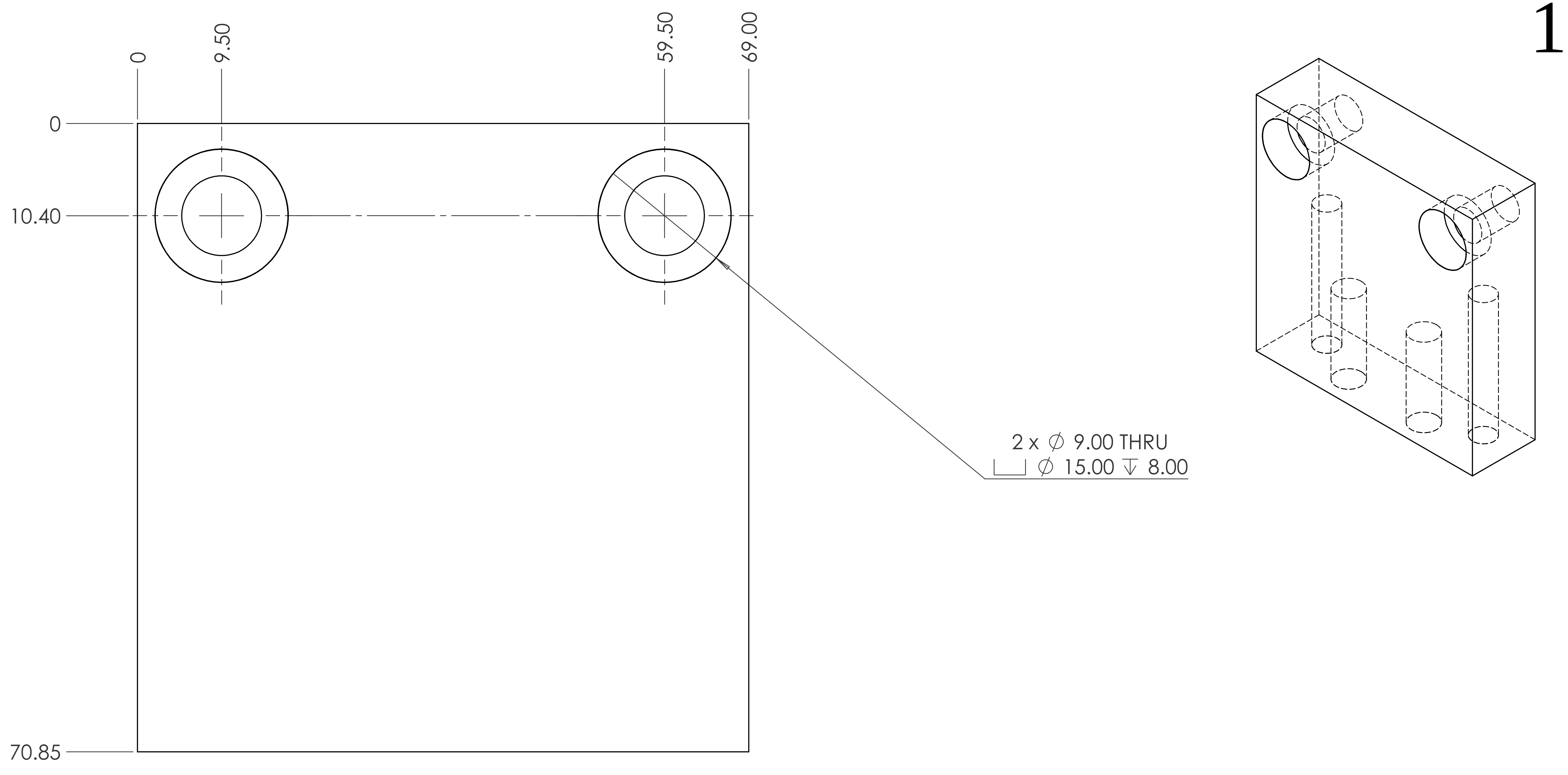

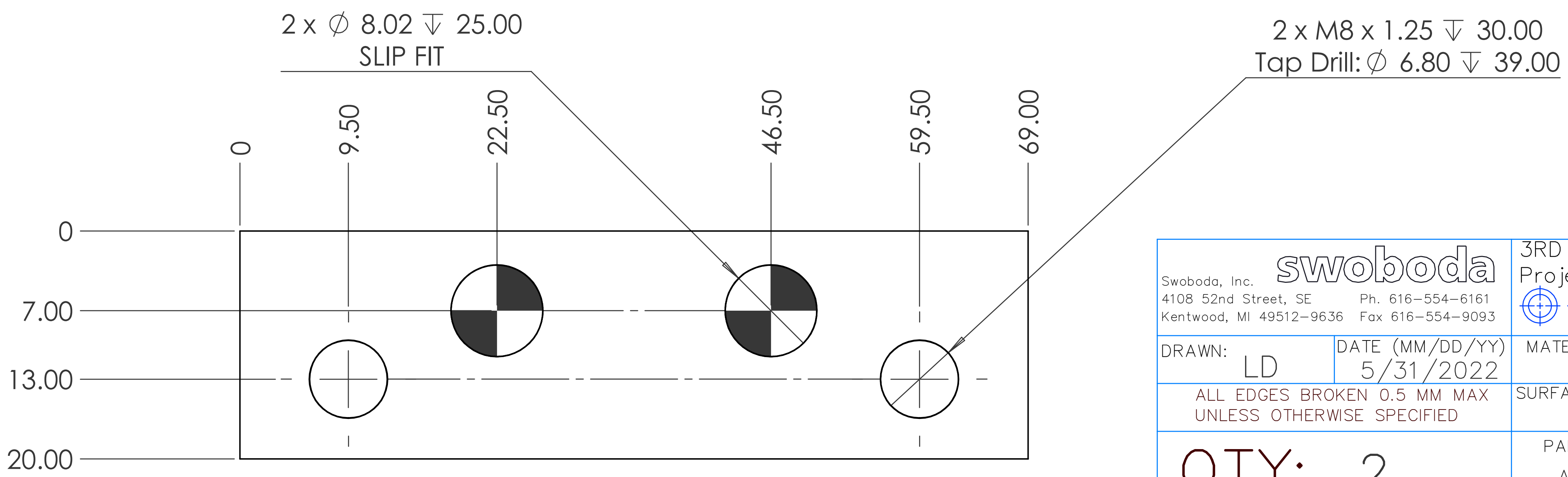

swoboda
Swoboda, Inc.
4108 52nd Street, SE Ph. 616–554–6161
Kentwood, MI 49512–9636 Fax 616–554–9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M–1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: ALUMINUM

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40–1400–11–011–009

PART NAME: Tert Upright

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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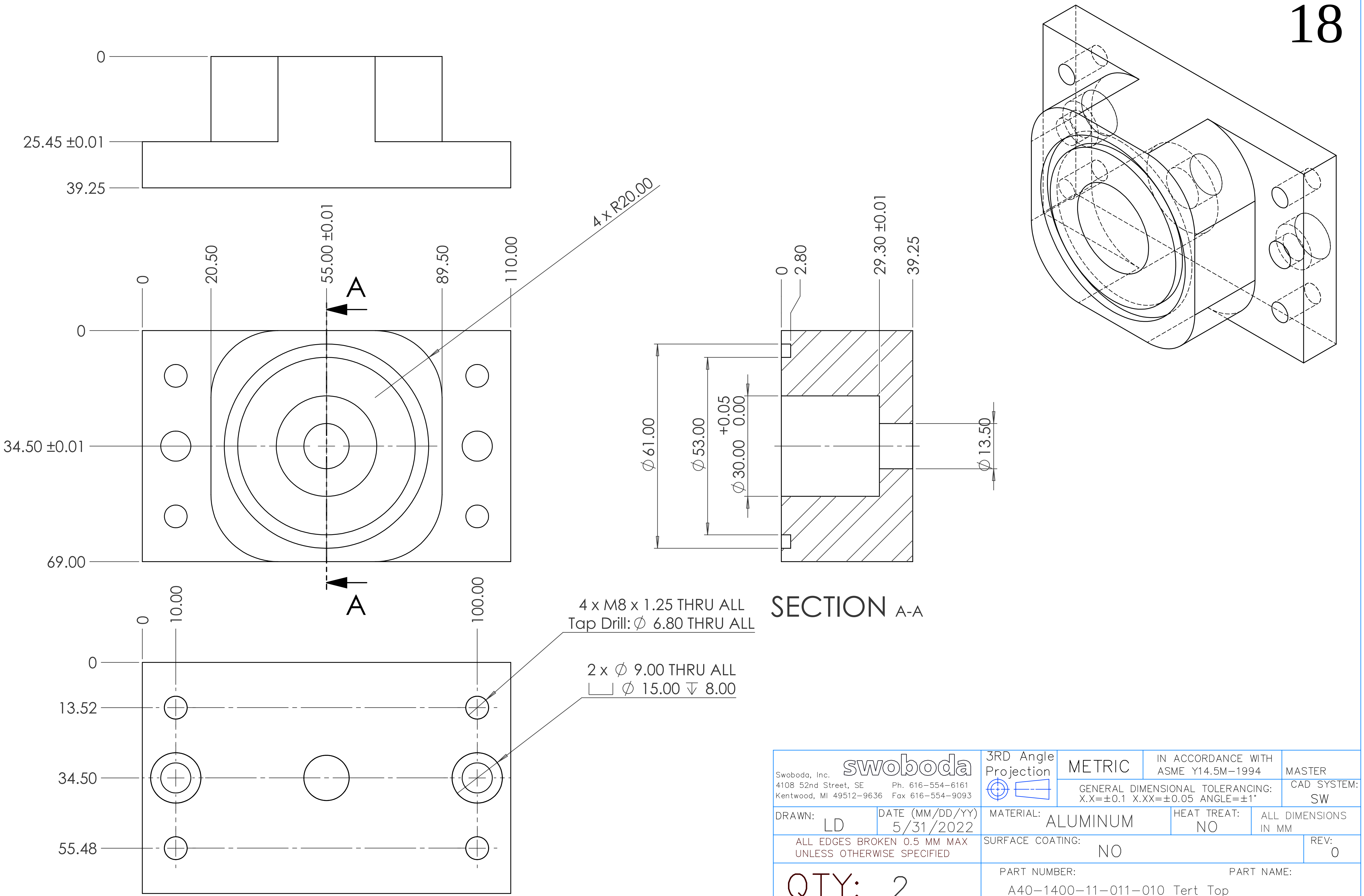

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: ALUMINUM	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO			REV: 0
QTY: 2	PART NUMBER: A40-1400-11-011-010	PART NAME: Tert Top		
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

SIZE A3

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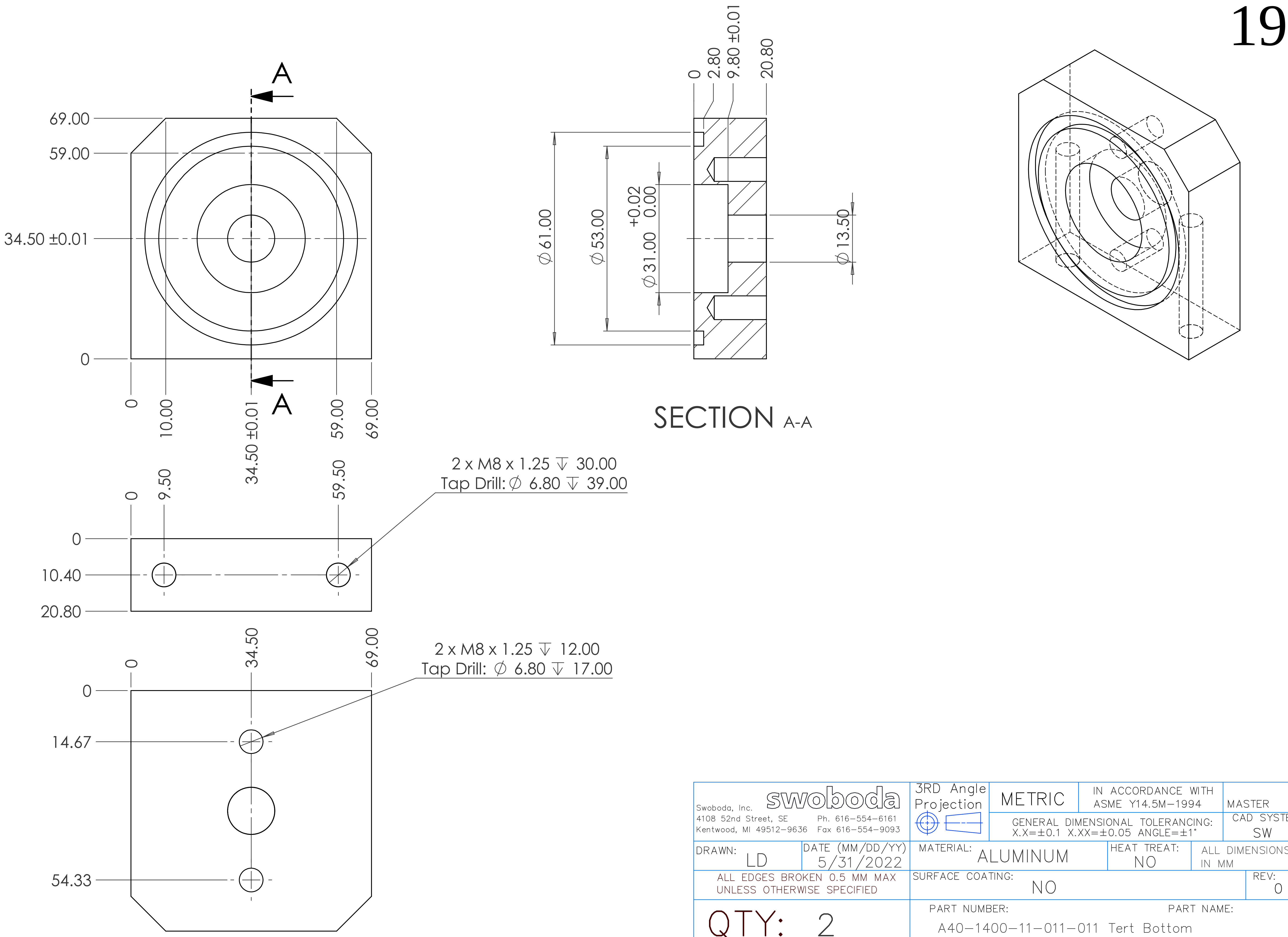

Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093 swoboda	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: ALUMINUM	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 2		PART NUMBER: A40-1400-11-011-011	PART NAME: Tert Bottom	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

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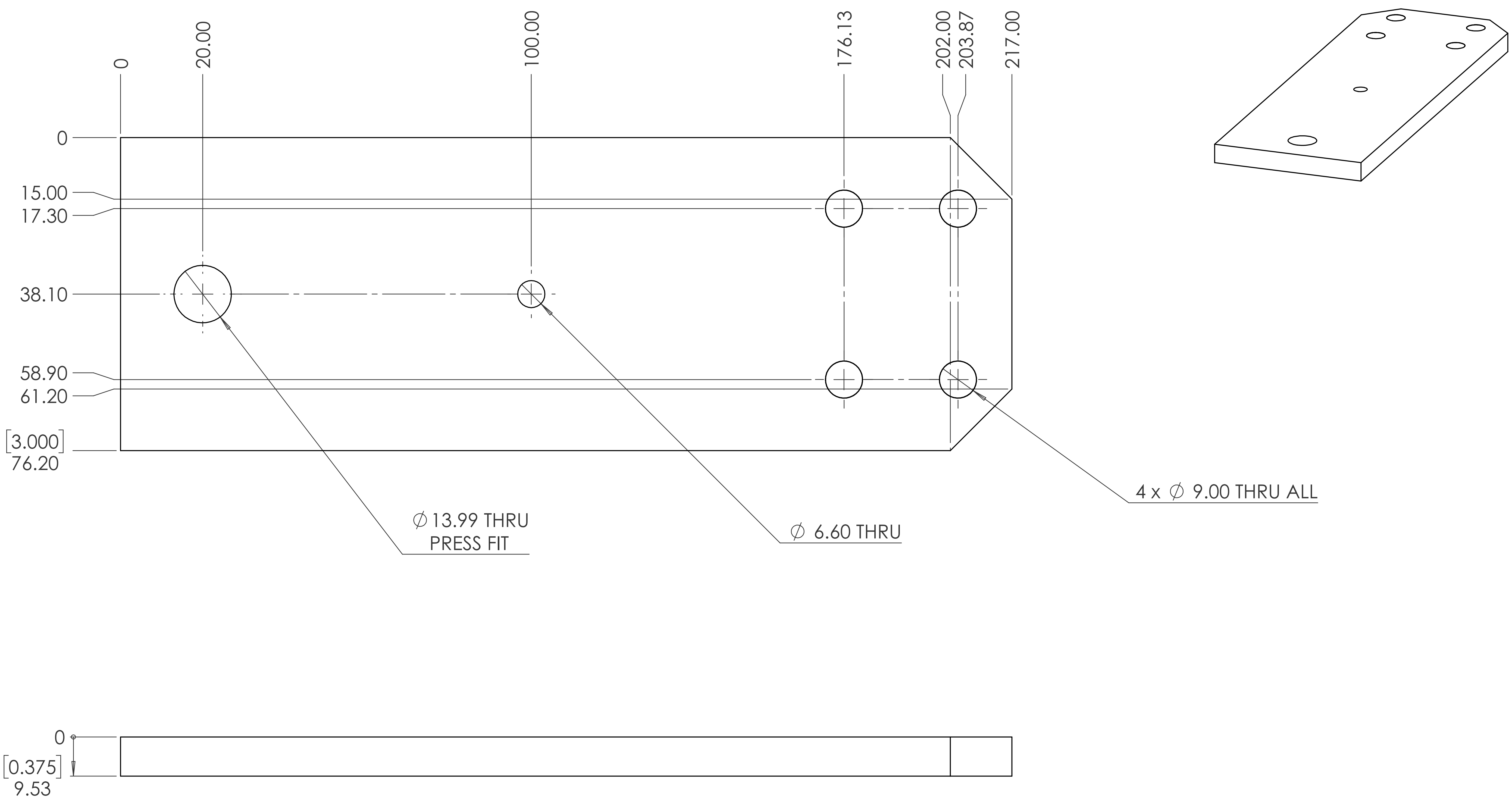

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Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: 1018 CRS

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-011-012

PART NAME: Cyl. Top

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 1

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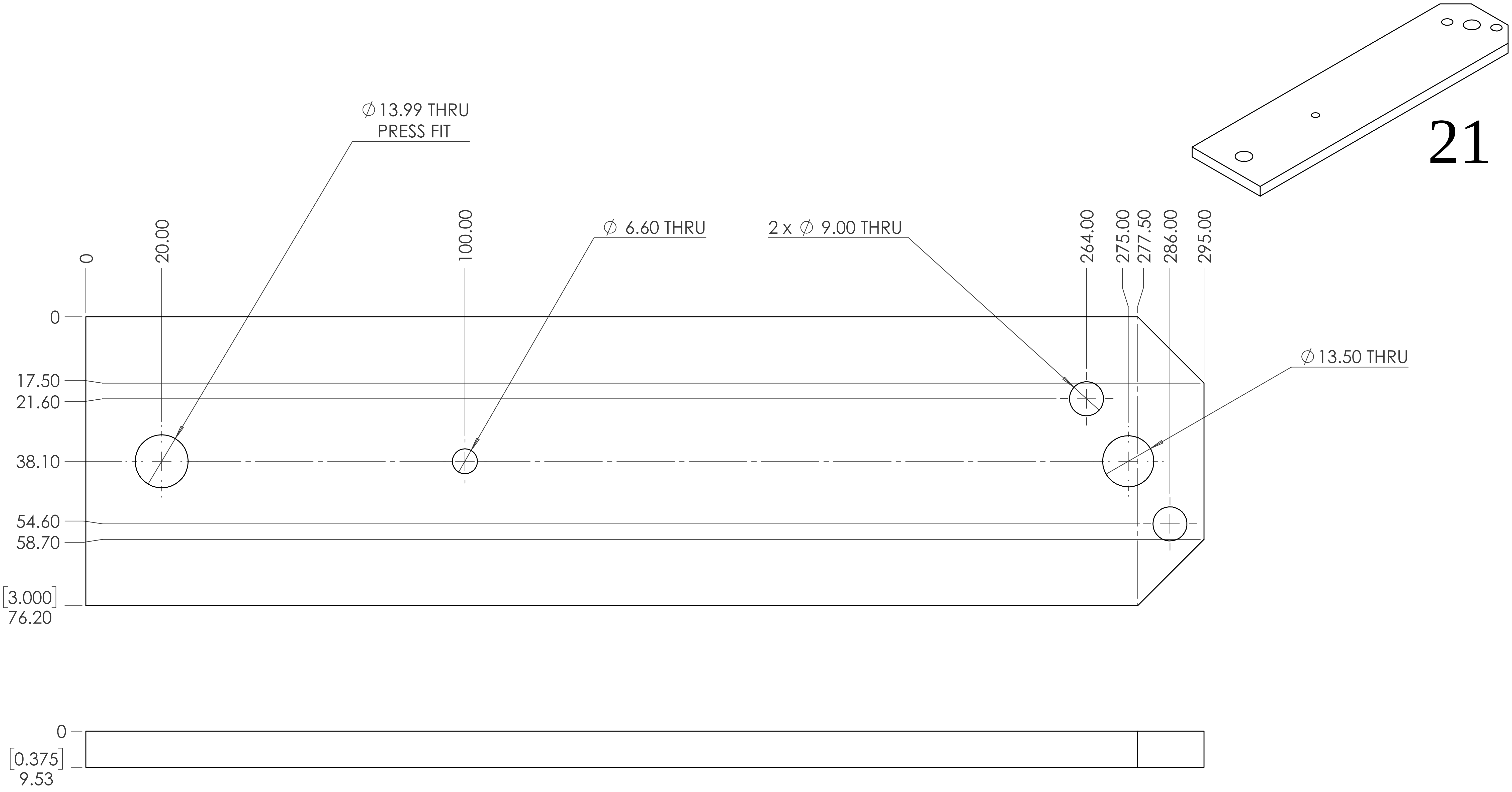

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: 1018 CRS

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-011-013

PART NAME: Cyl. Bottom

MOD: N

VENDOR PART#: N/A

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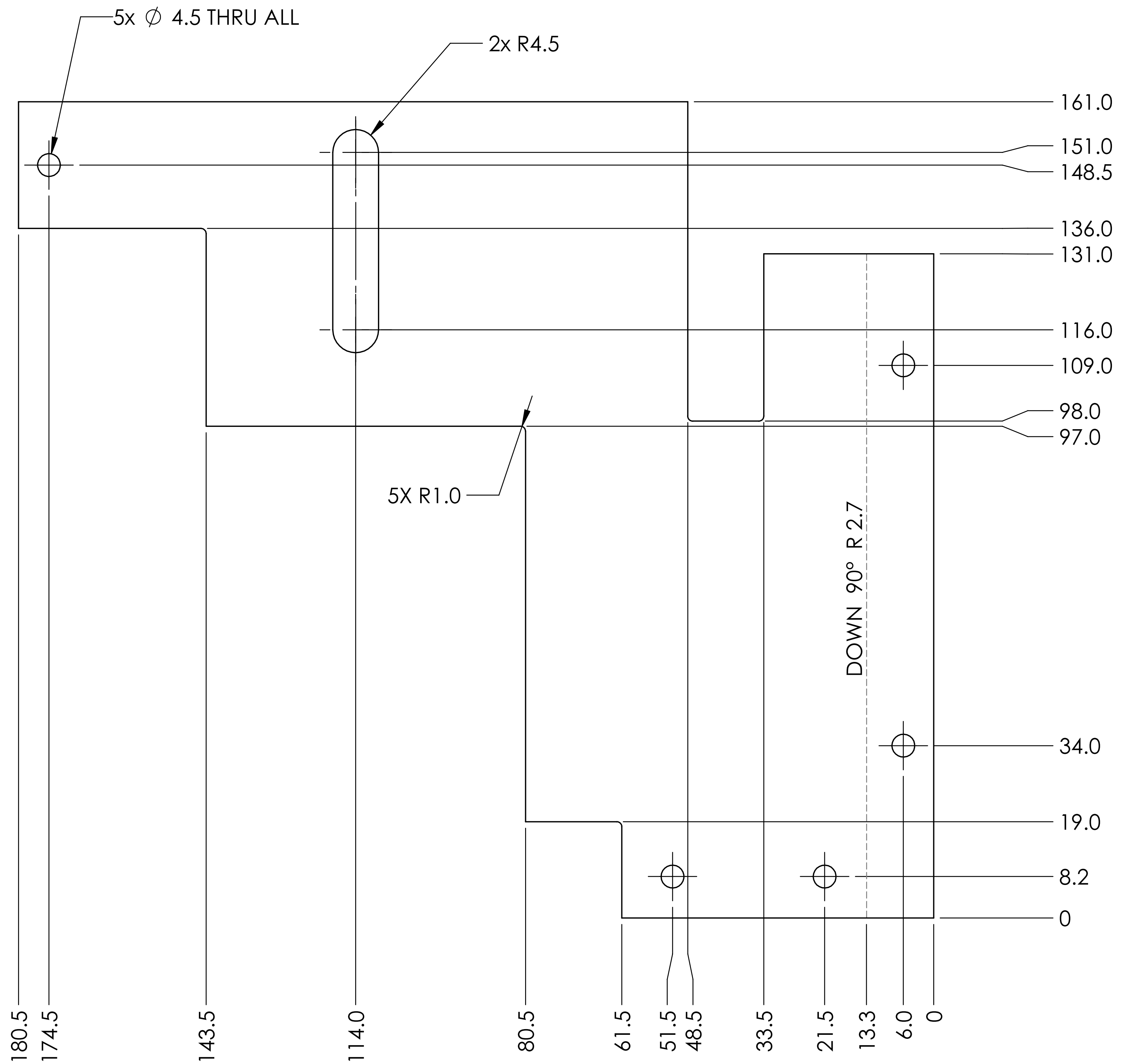

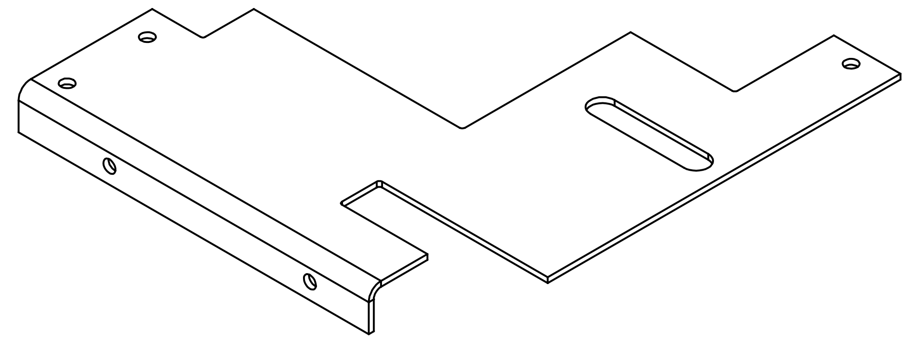

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL: 14 Gauge Stainless Steel	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO			REV: 0
QTY: 1	PART NUMBER: A40-1400-11-011-014	PART NAME: Shroud Right		
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 2

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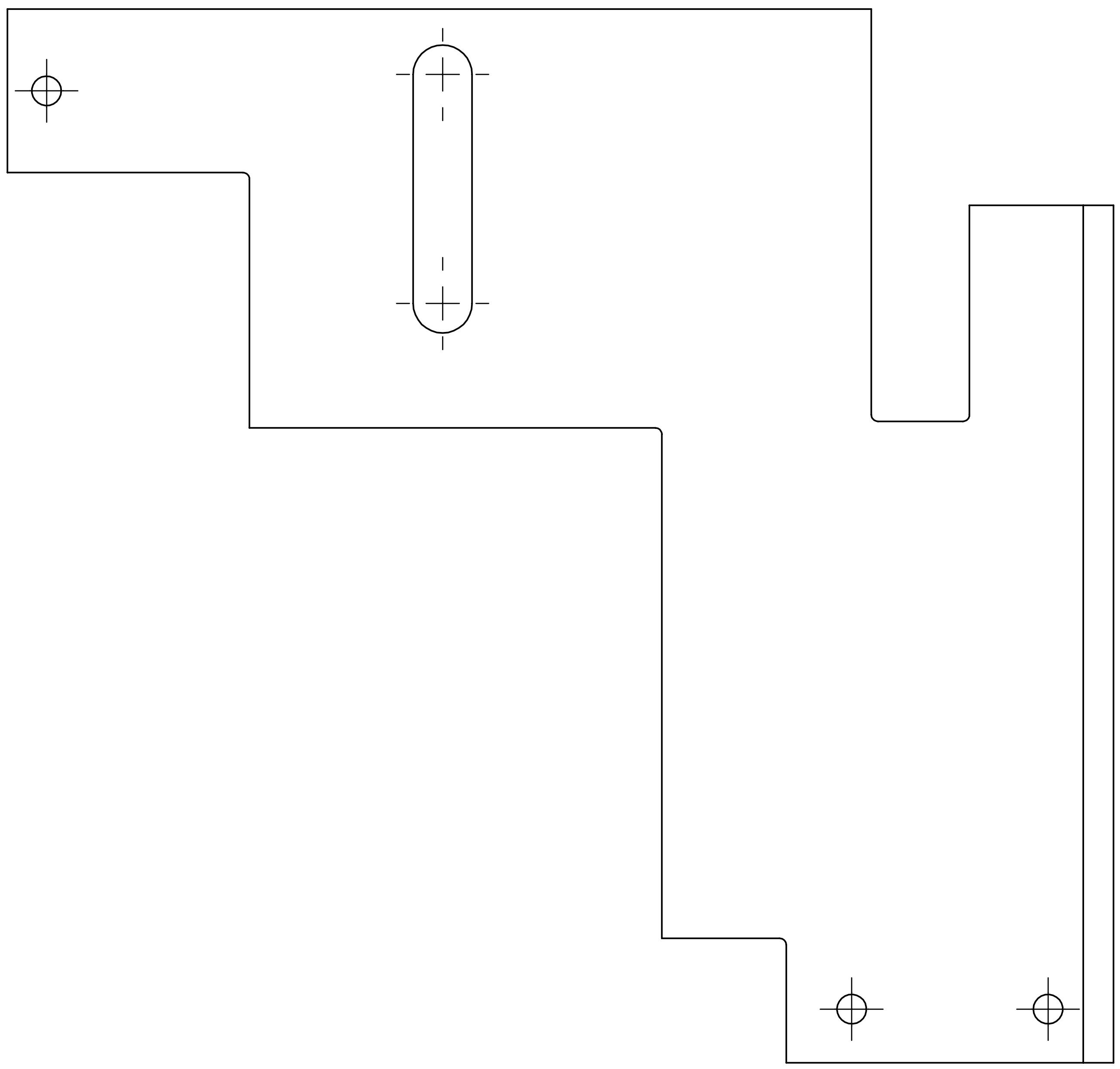

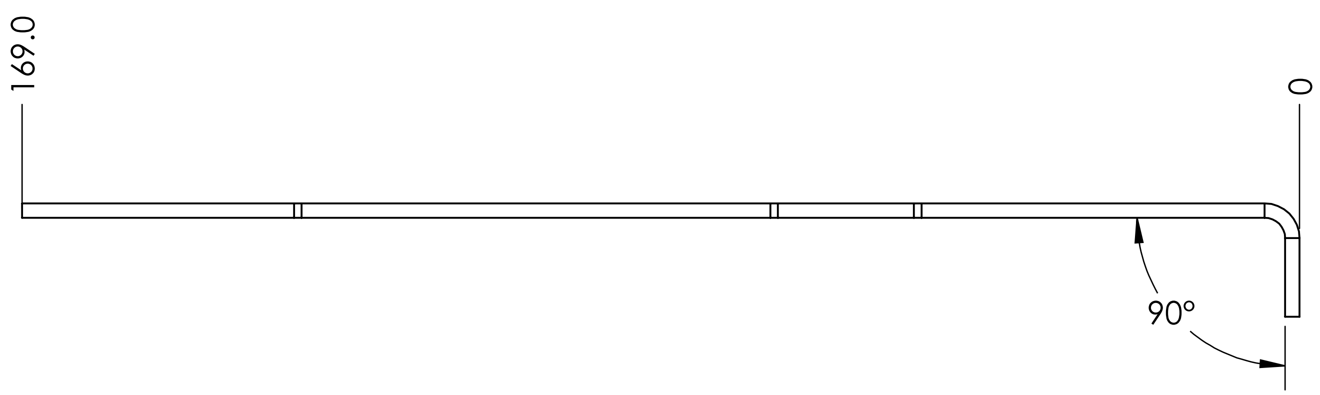

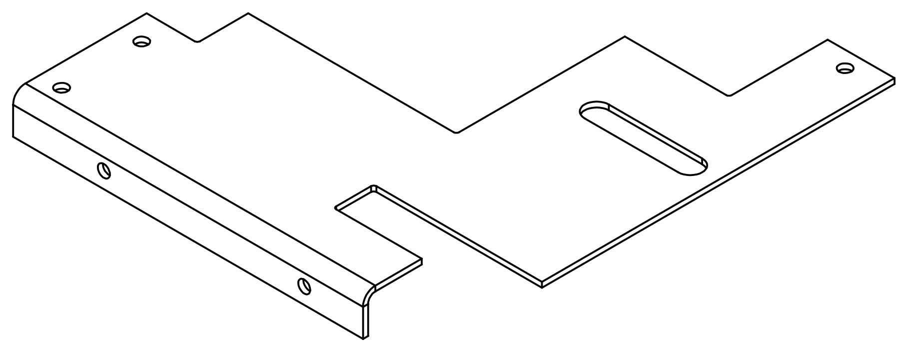

Swoboda, Inc. swoboda 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER CAD SYSTEM: SW
DRAWN: CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL: 14 Gauge Stainless Steel	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO			REV: 0
QTY: 1	PART NUMBER: A40-1400-11-011-014	PART NAME: Shroud Right		
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 2 OF 2

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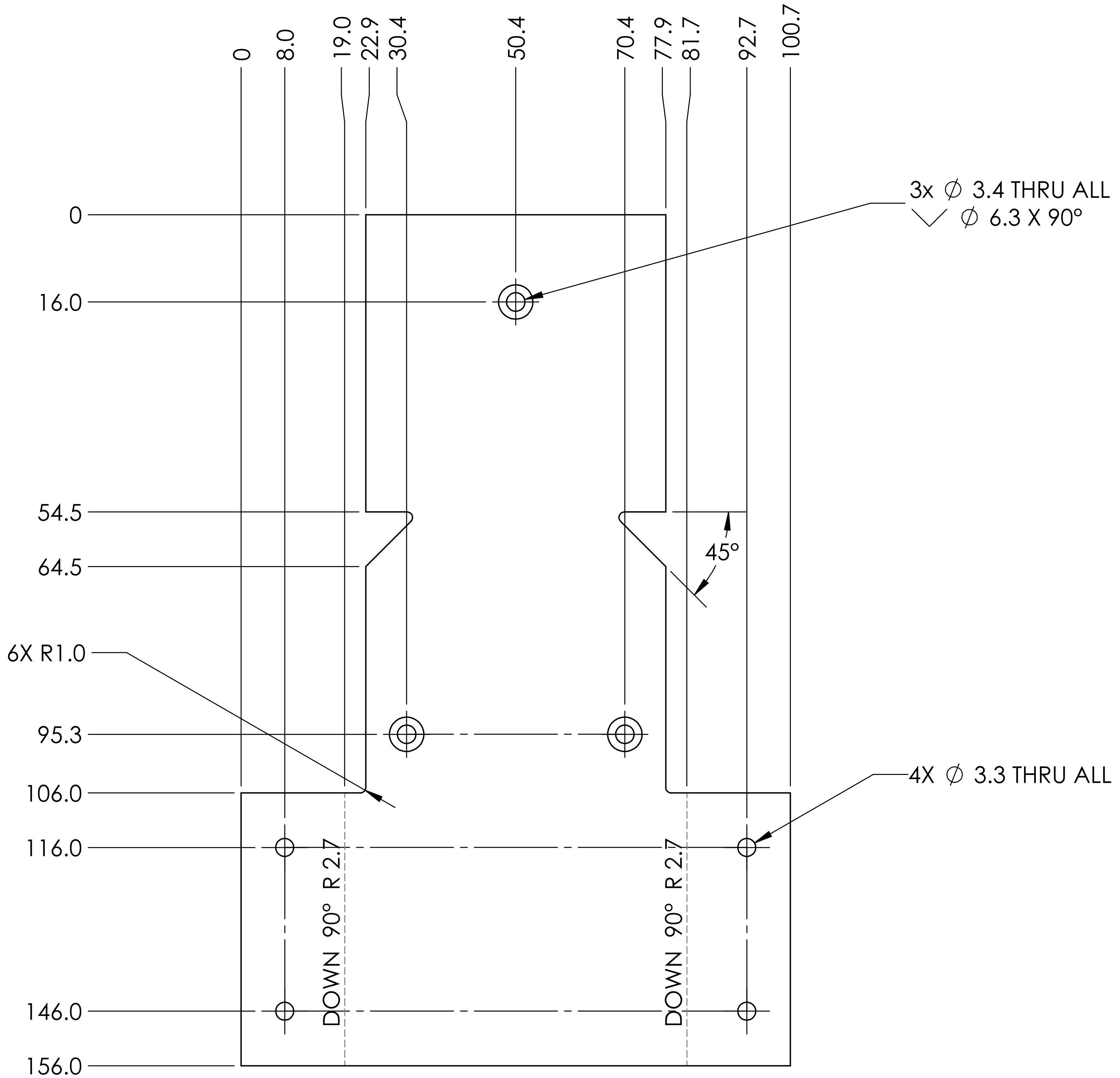

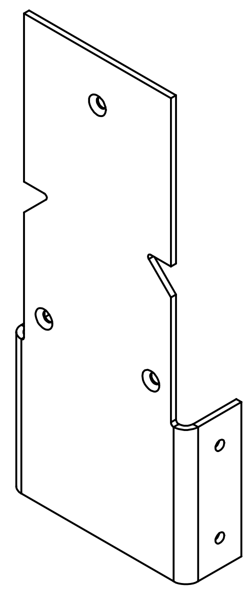

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: CRK

DATE (MM/DD/YY) 6/2/2022

MATERIAL: 14 Gauge Stainless Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-011-015

PART NAME: Shroud Middle

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 2

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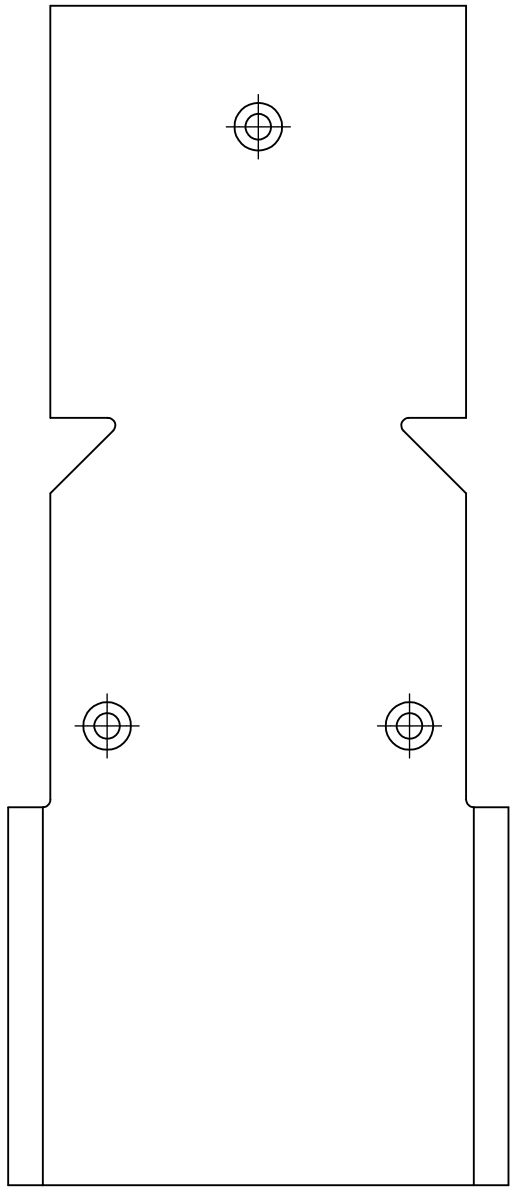

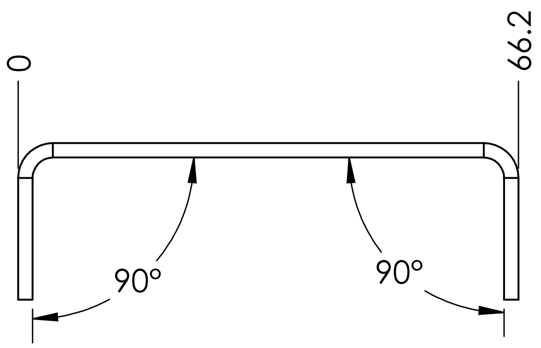

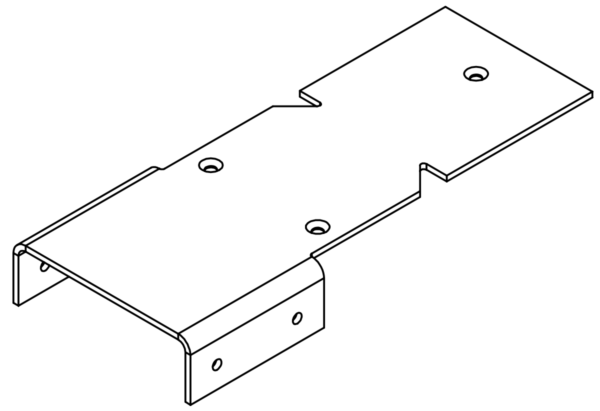

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: CRK

DATE (MM/DD/YY) 6/2/2022

MATERIAL: 14 Gauge Stainless Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-011-015

PART NAME: Shroud Middle

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 2 OF 2

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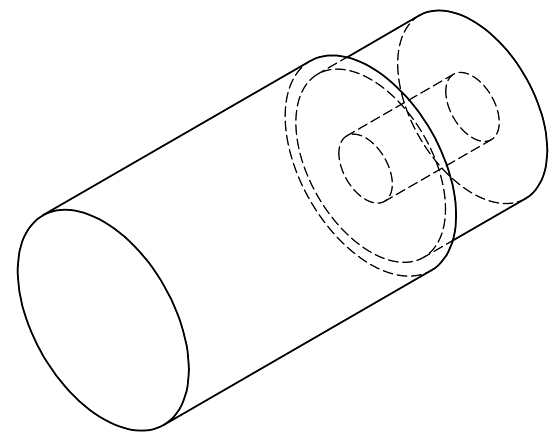

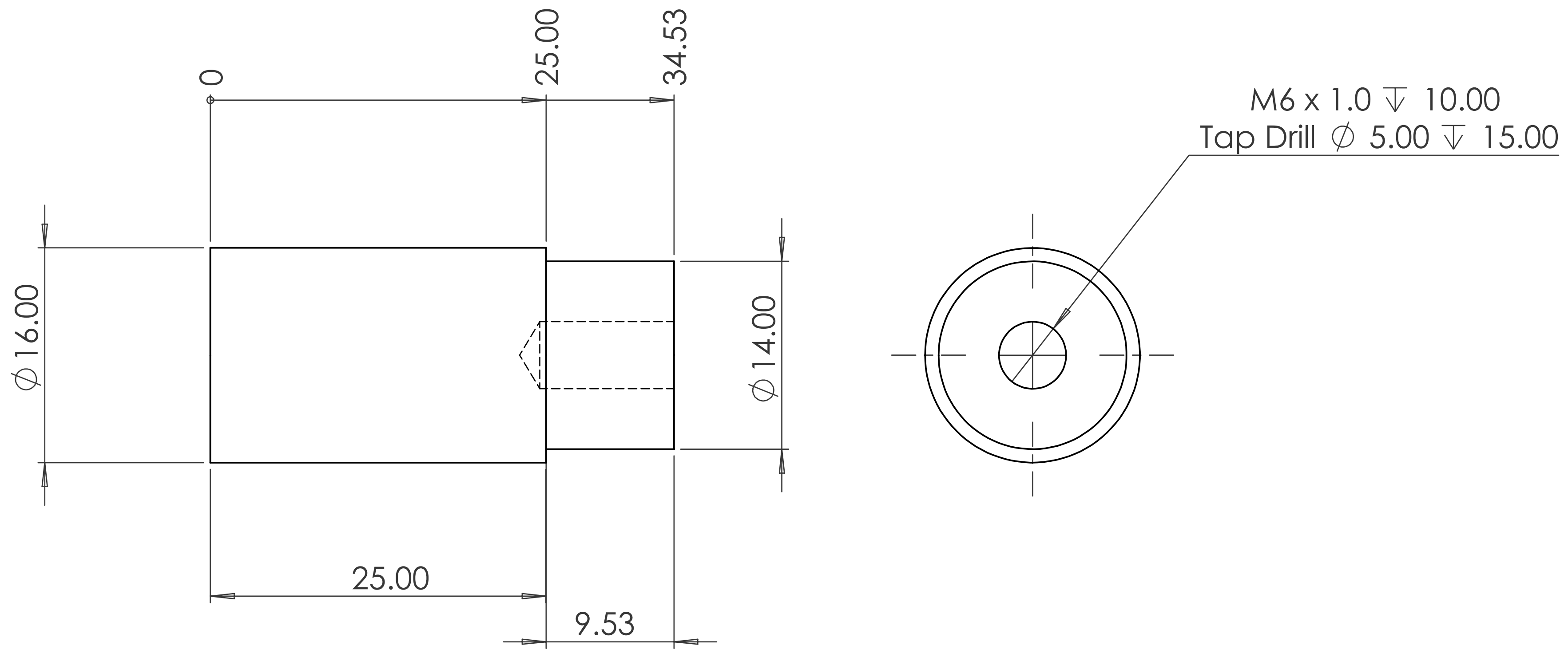

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 4

PART NUMBER: A40-1400-11-011-024

PART NAME: Cyl.Pivot Shaft

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

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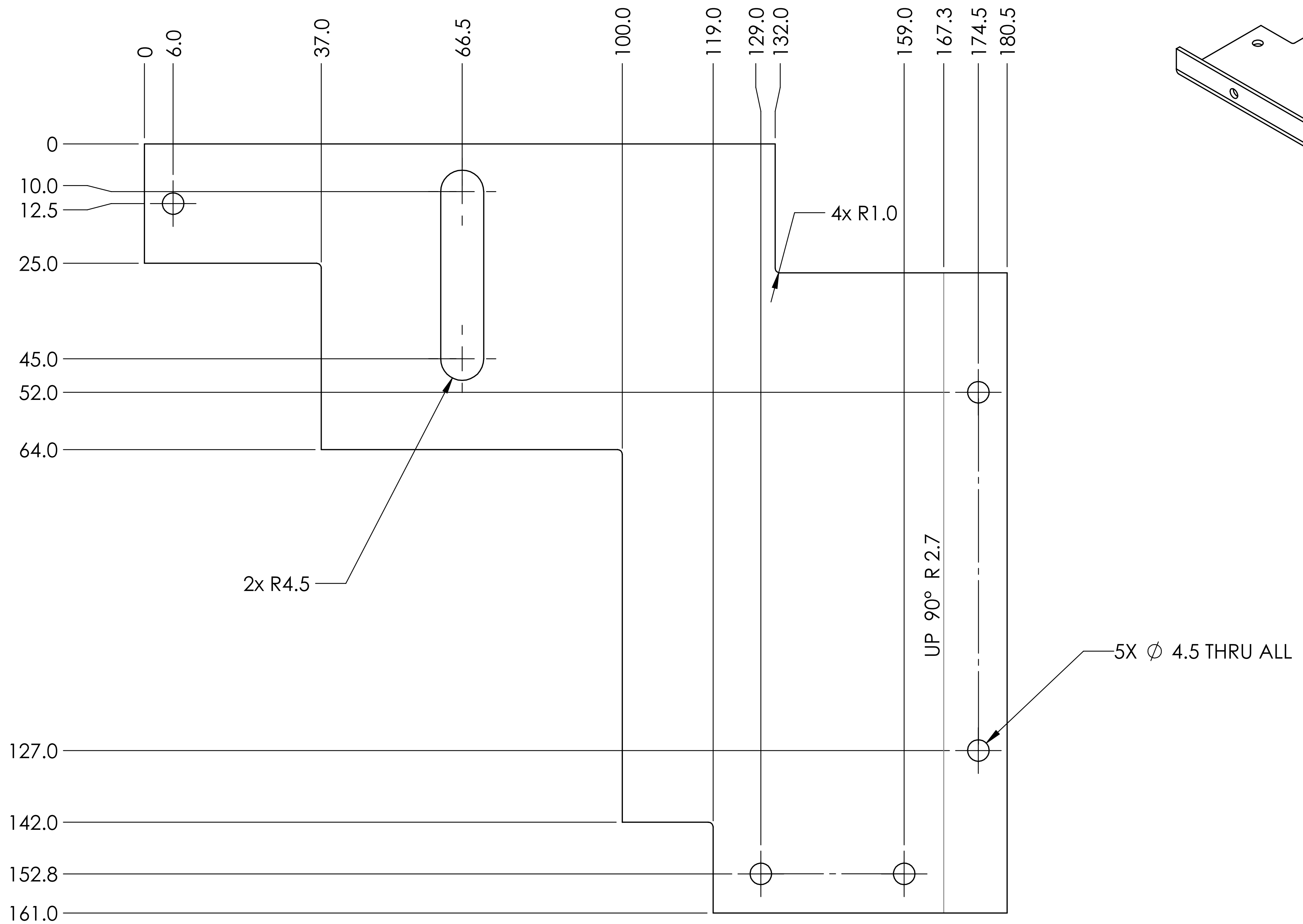

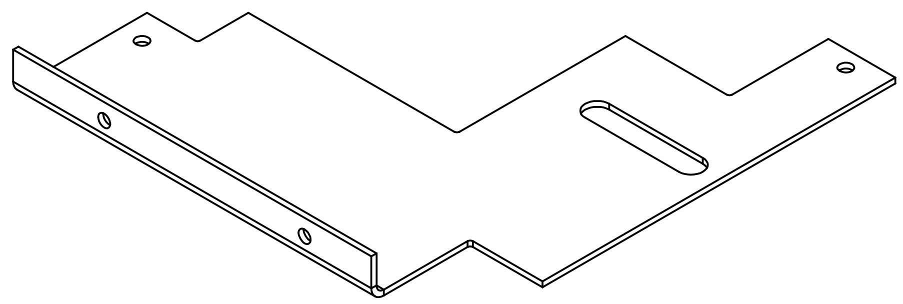

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3RD Angle Projection

METRIC

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MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: CRK

DATE (MM/DD/YY) 6/2/2022

MATERIAL: 14 Gauge Stainless Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-011-016

PART NAME: Shroud Left

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 2

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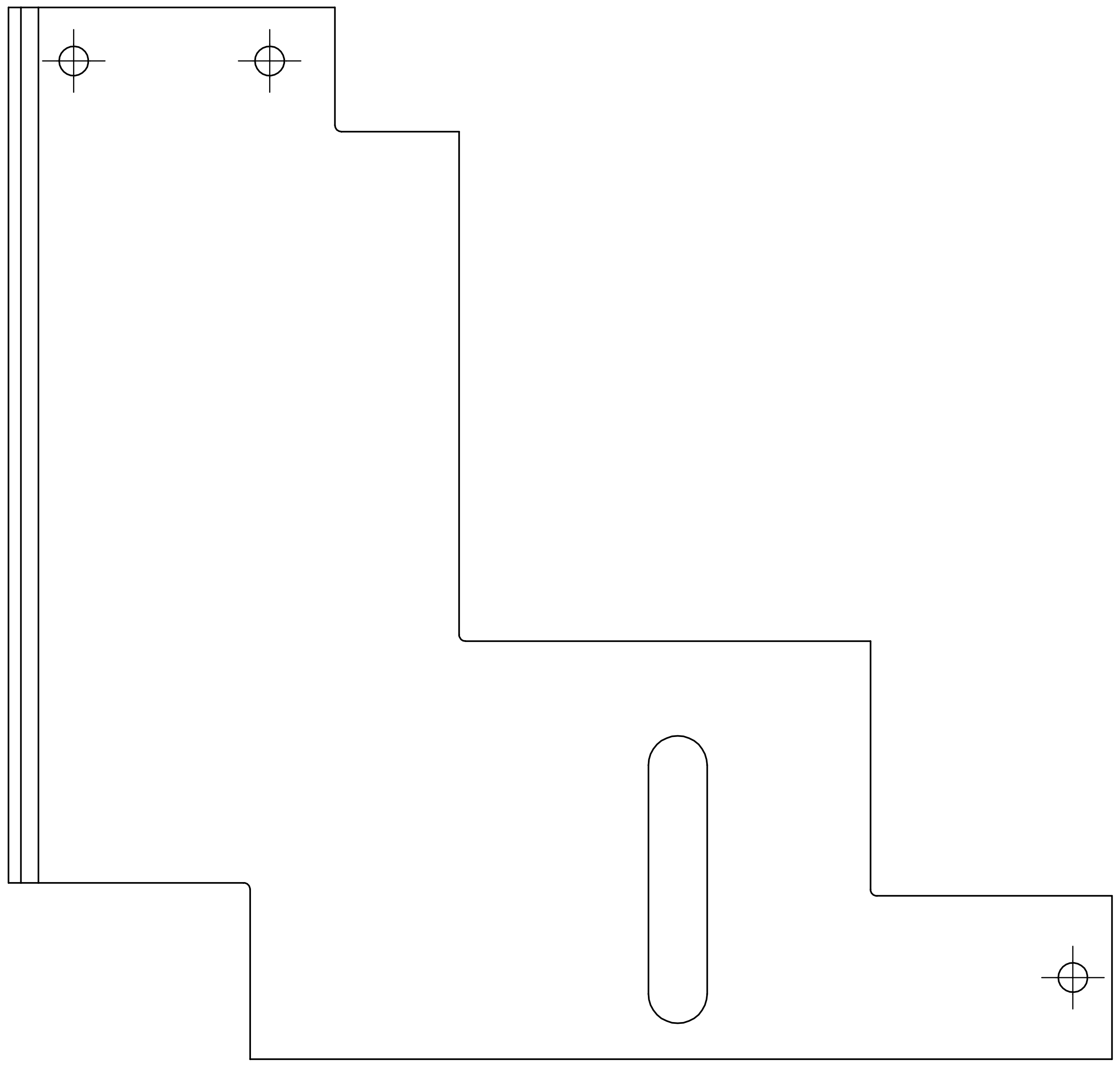

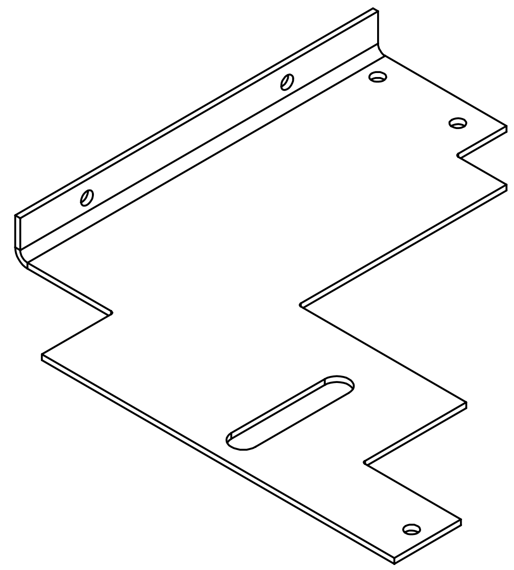

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: CRK

DATE (MM/DD/YY) 6/2/2022

MATERIAL: 14 Gauge Stainless Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-011-016

PART NAME: Shroud Left

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

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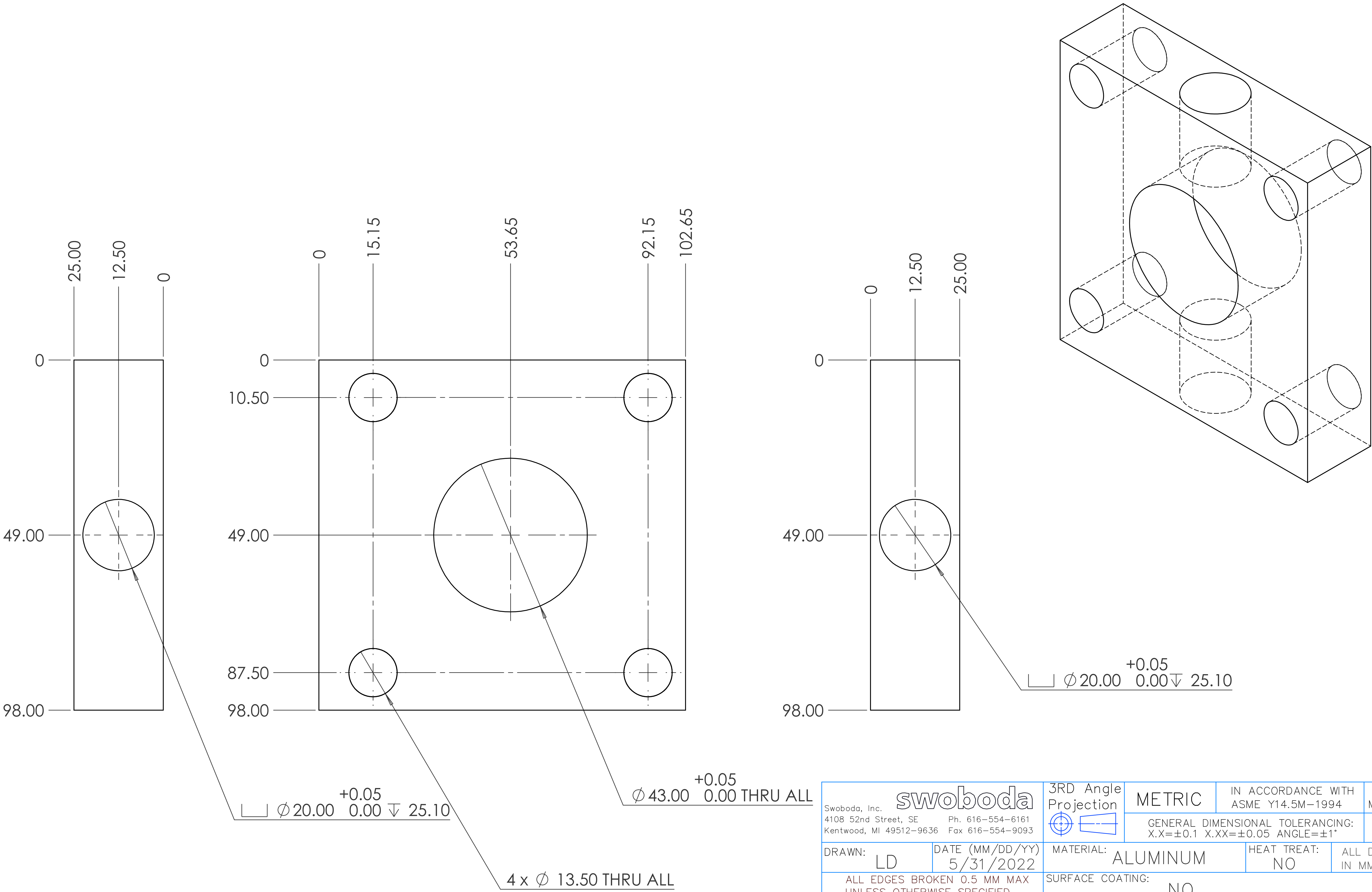

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: ALUMINUM

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-011-017

PART NAME: Cyl. Bracket

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

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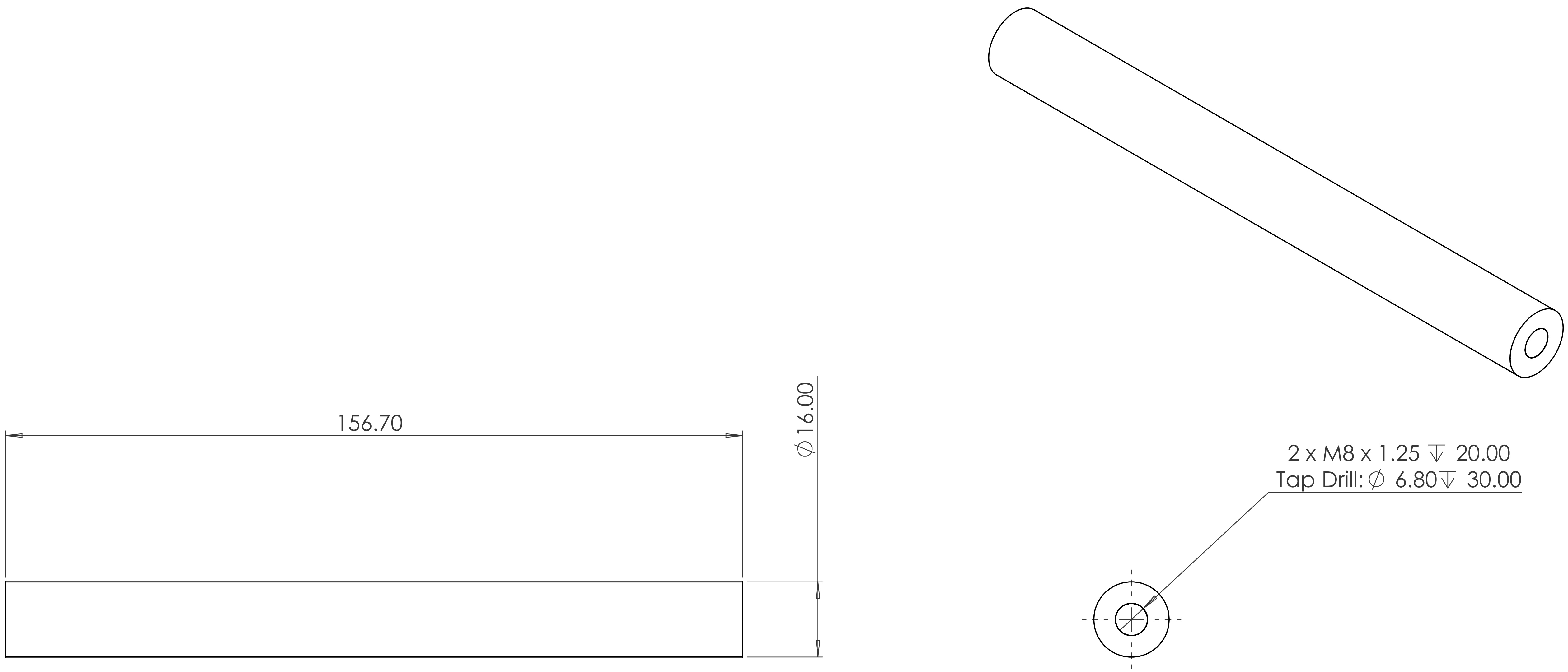

Swoboda, Inc. swoboda 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER	
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW	
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: STEEL	HEAT TREAT: NO	ALL DIMENSIONS IN MM	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0	
QTY: 2		PART NUMBER: A40-1400-11-011-018	PART NAME: Base Pin		
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1	SIZE A3

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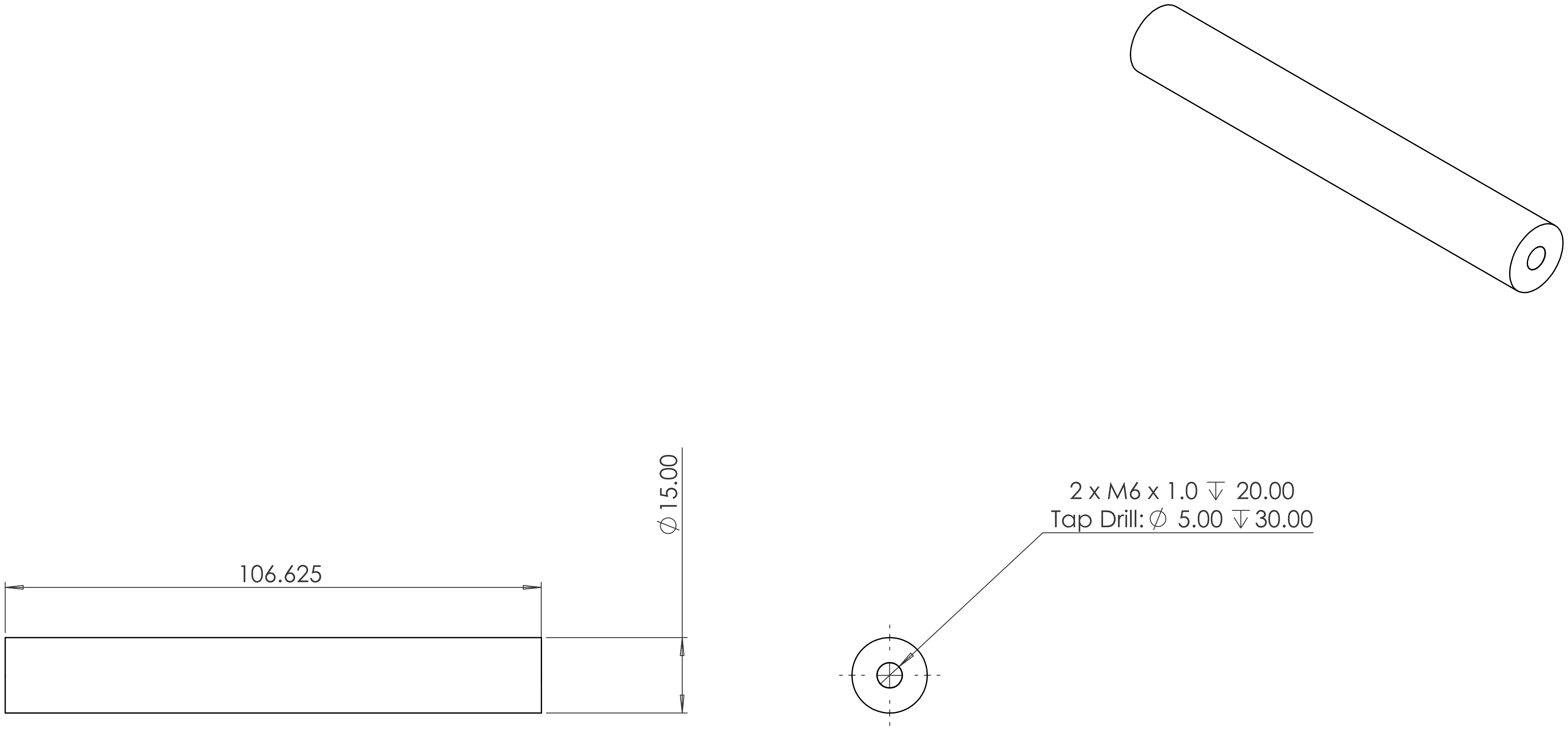

Swoboda, Inc. swoboda 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: STEEL	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO			REV: 0
QTY: 2	PART NUMBER: A40-1400-11-011-019	PART NAME: Cyl. Pin		
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

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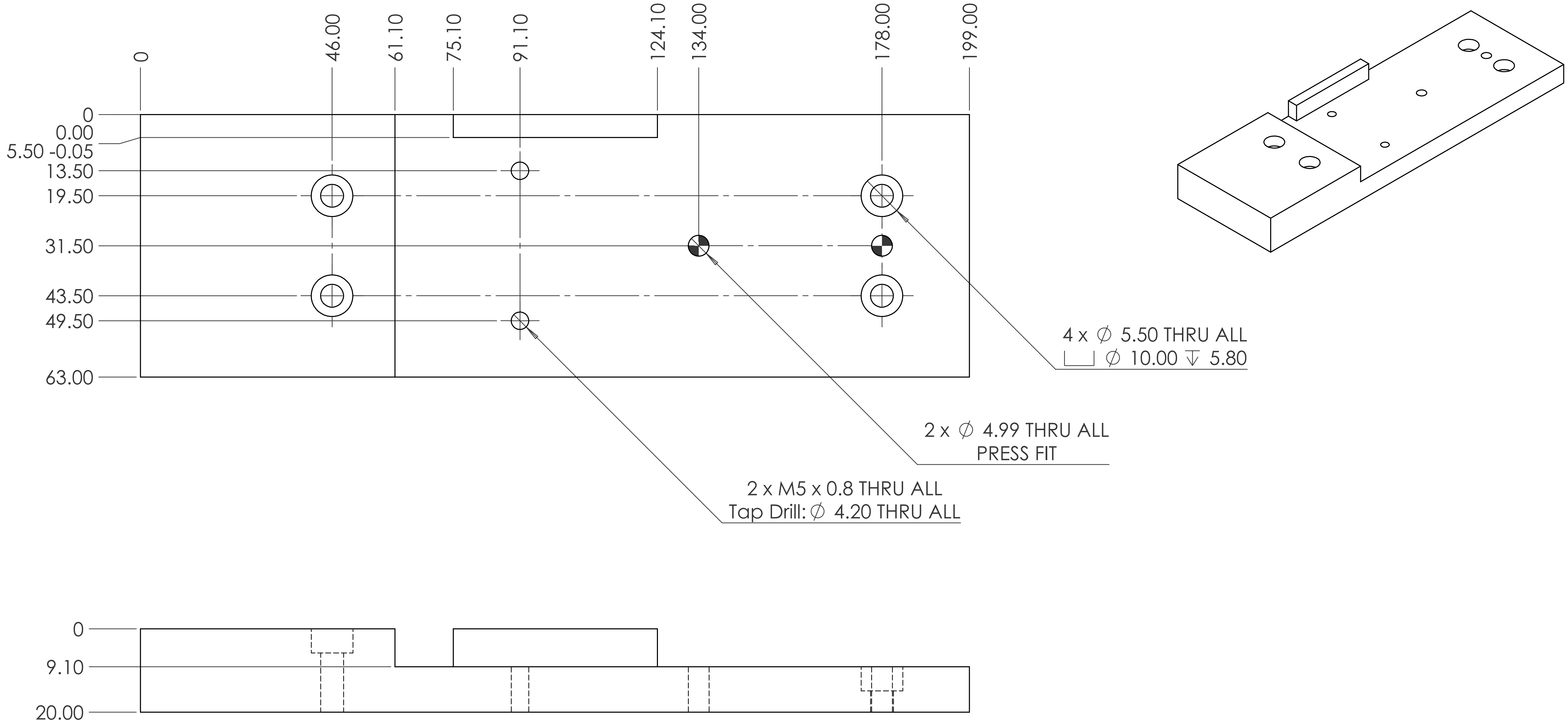

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: ALUMINUM

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-011-020

PART NAME: Part Transfer

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 1

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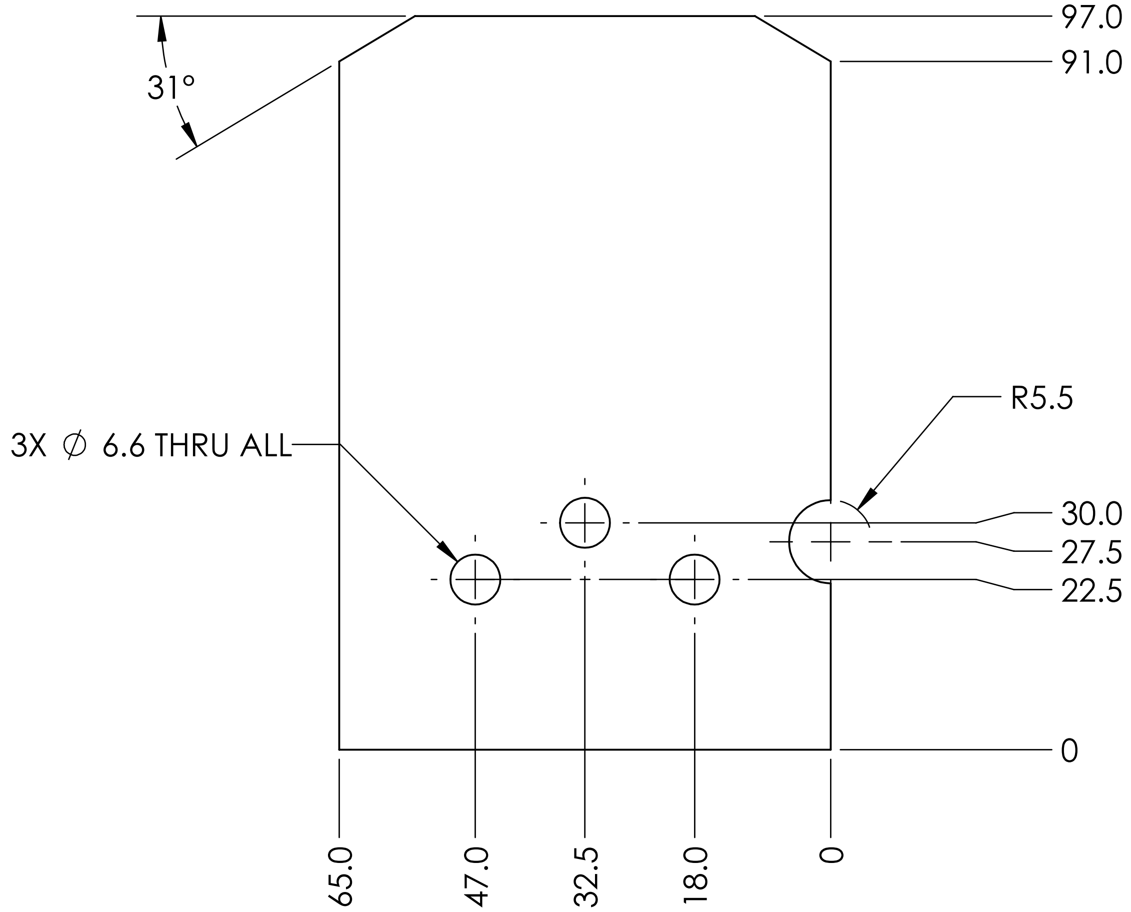

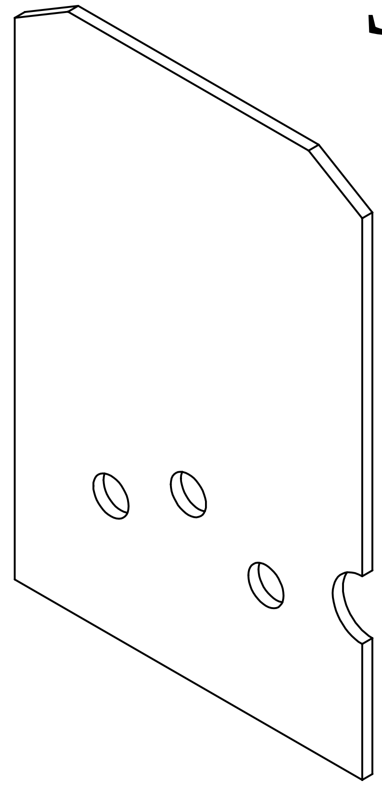

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		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: CRK	DATE (MM/DD/YY) 6/3/2022	MATERIAL: 14 Gauge Stainless Steel	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 1		PART NUMBER: A40-1400-11-011-021	PART NAME: Transfer Gaurd	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

SIZE A3

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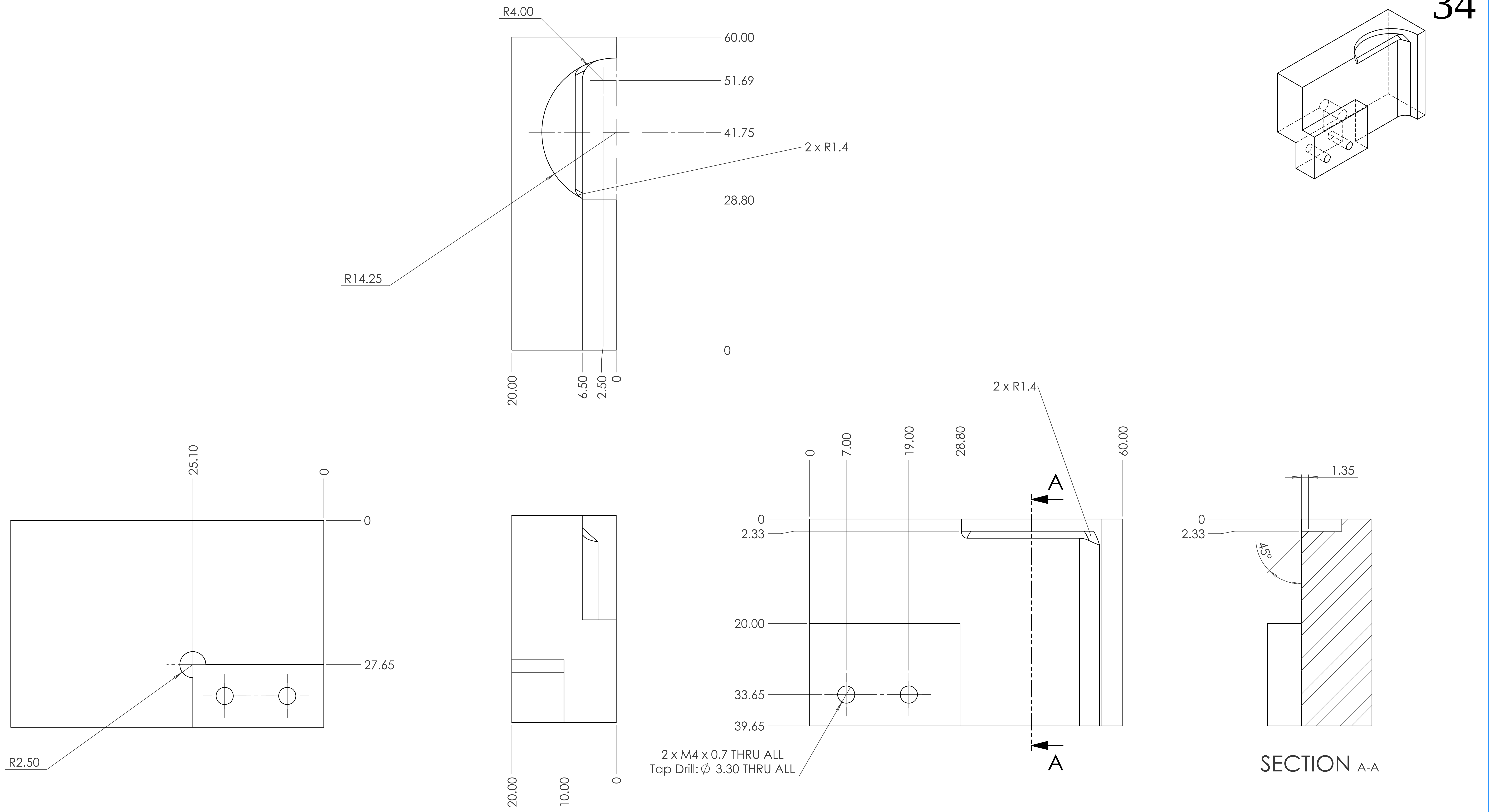

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM SW
DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL A2 Tool Steel	HEAT TREAT 54-56	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO	REV 0	
QTY: 1		PART NUMBER A40-1400-11-011-022	PART NAME Gripper Left	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 1

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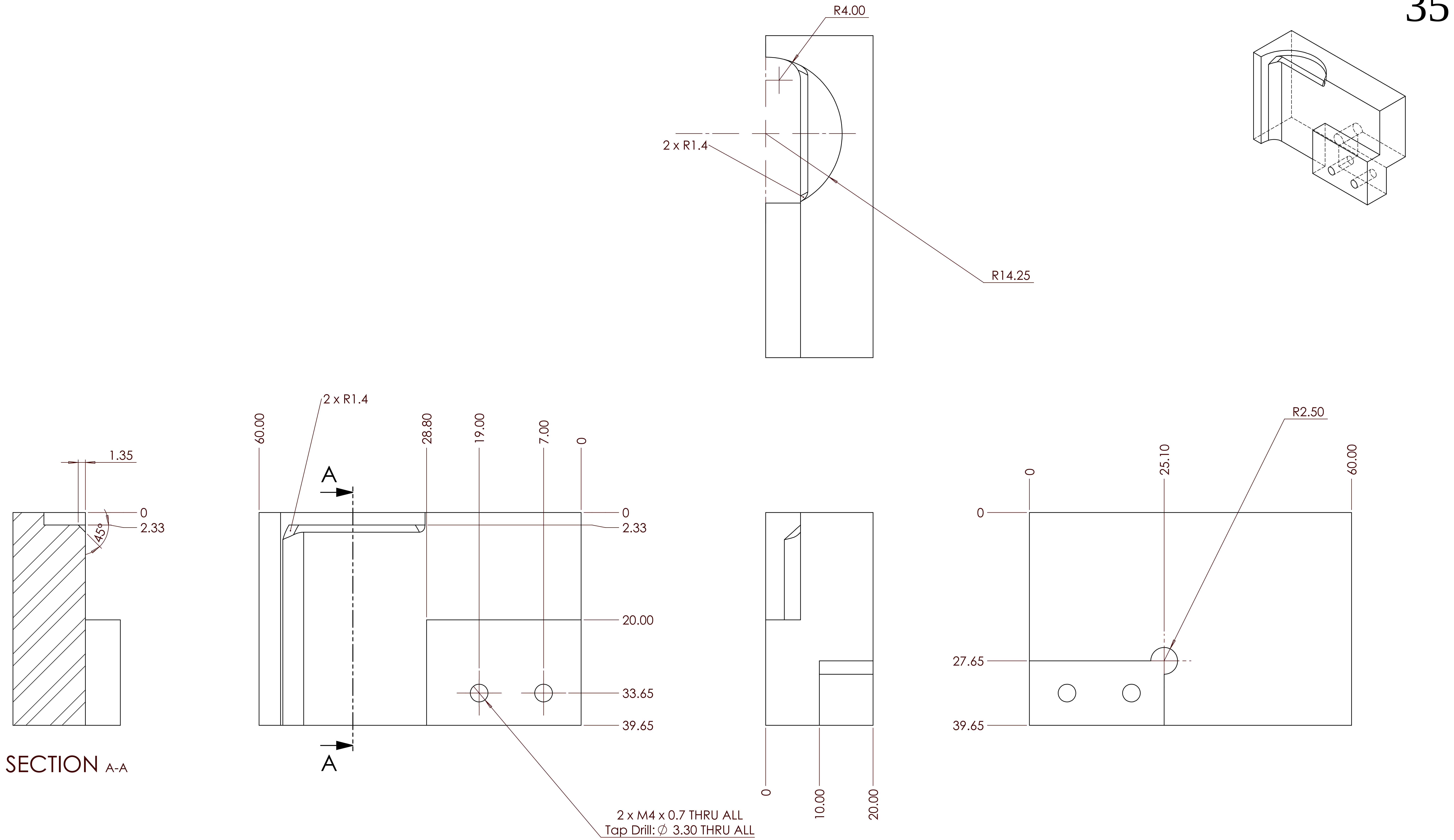

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL A2 Tool Steel	HEAT TREAT 54-56	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-011-023	PART NAME Gripper Right	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 1

SIZE A2

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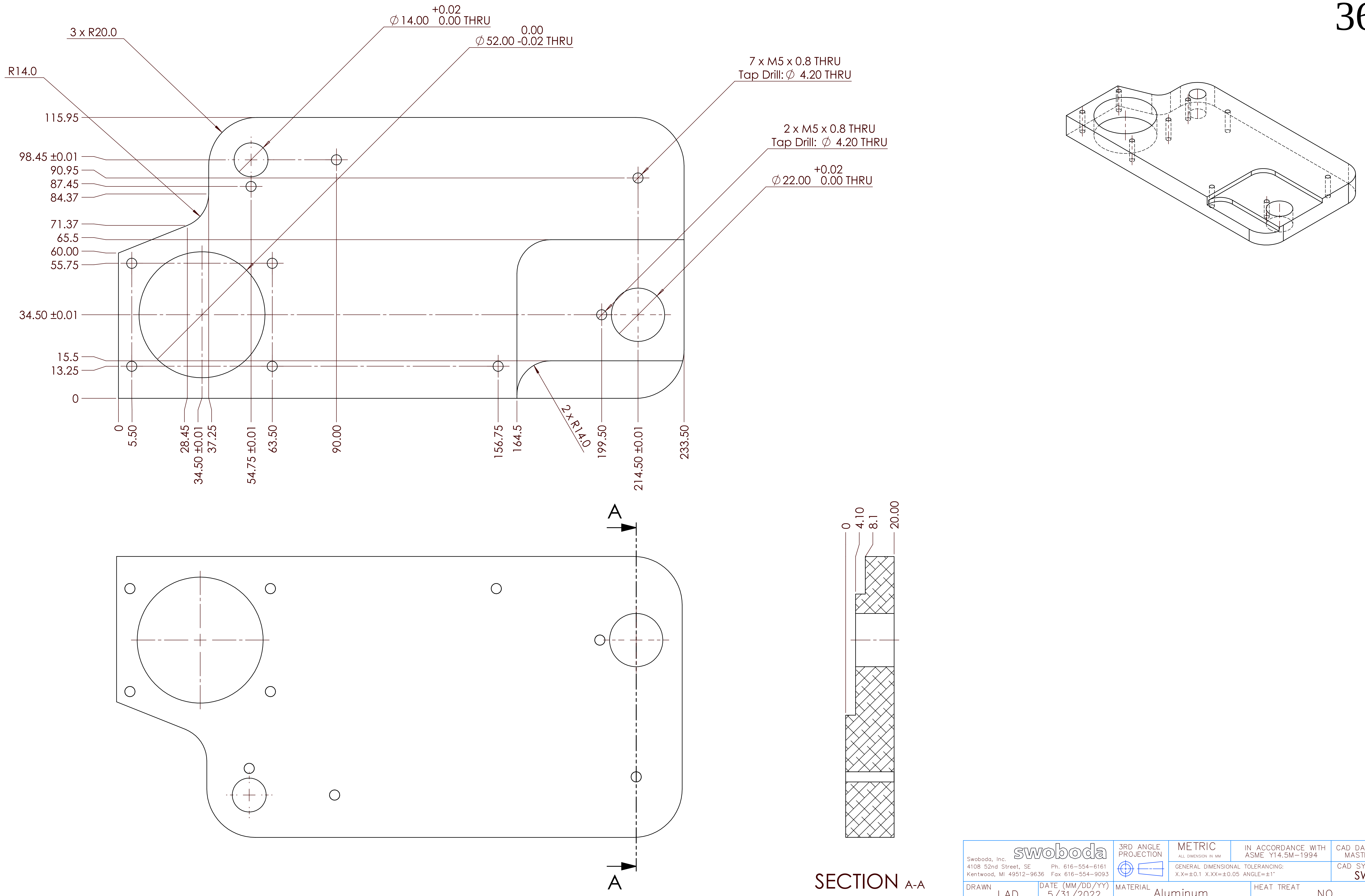

swoboda

Swoboda, Inc.
4108 52nd Street, SE Ph. 616-554-6161
Kentwood, MI 49512-9636 Fax 616-554-9093

3RD ANGLE PROJECTION

METRIC
ALL DIMENSION IN MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM SW

DRAWN LAD | DATE (MM/DD/YY) 5/31/2022 | MATERIAL Aluminum | HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING NO | REV 0

QTY: 2

PART NUMBER A40-1400-11-012-001 | PART NAME Bottom Link

MOD N | VENDOR PART# N/A | DO NOT SCALE | SCALE 1:1 | SHEET 1 OF 1

SIZE A2

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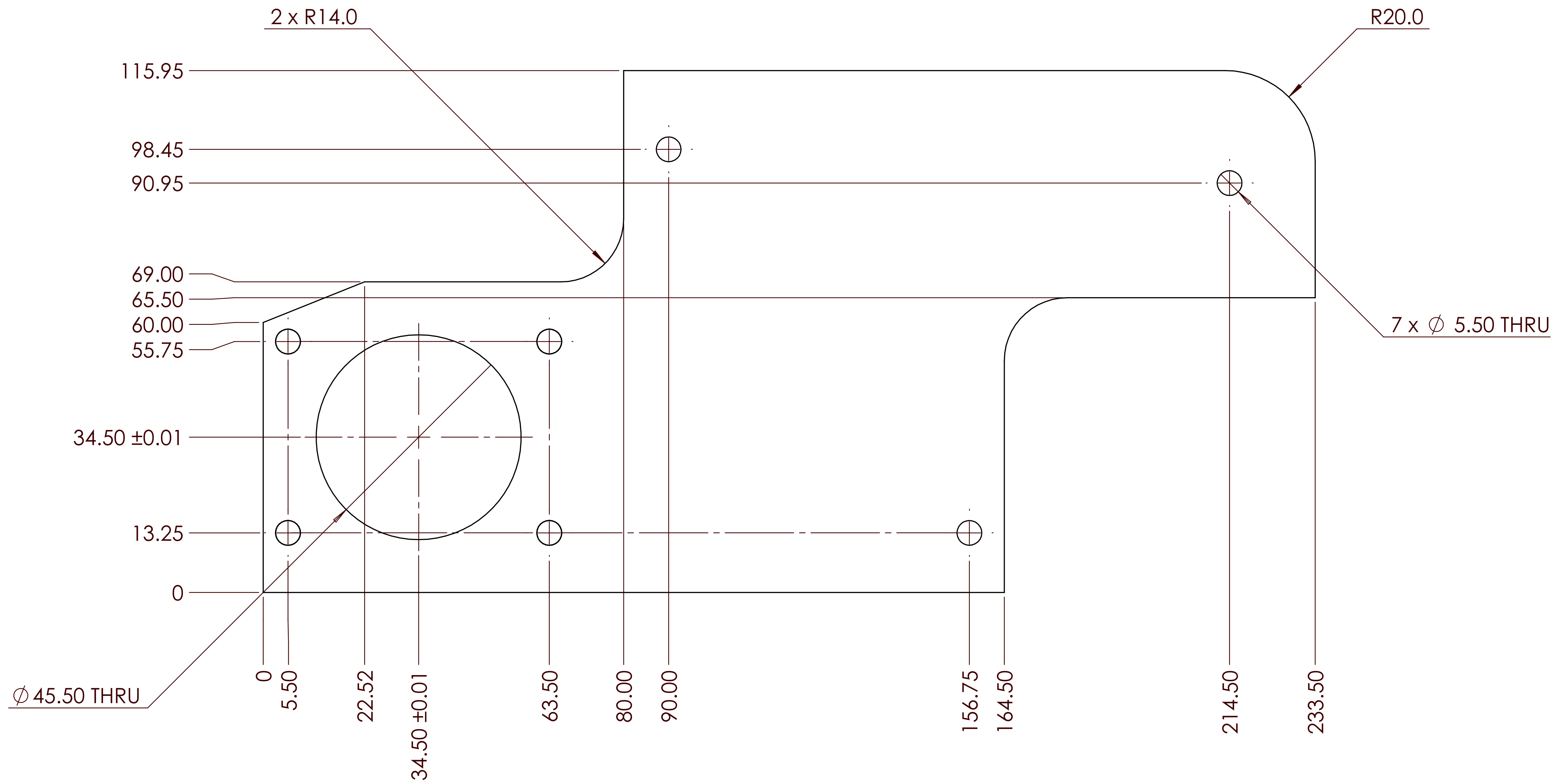

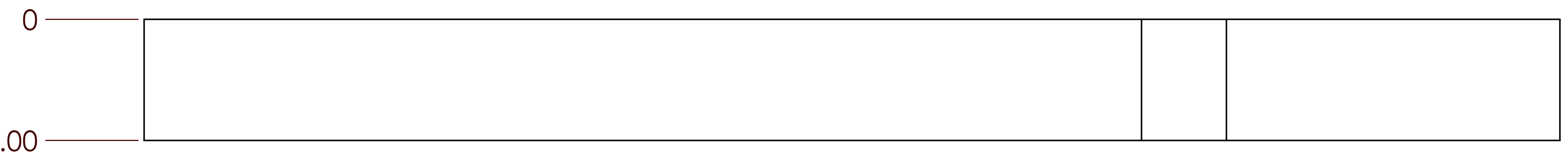

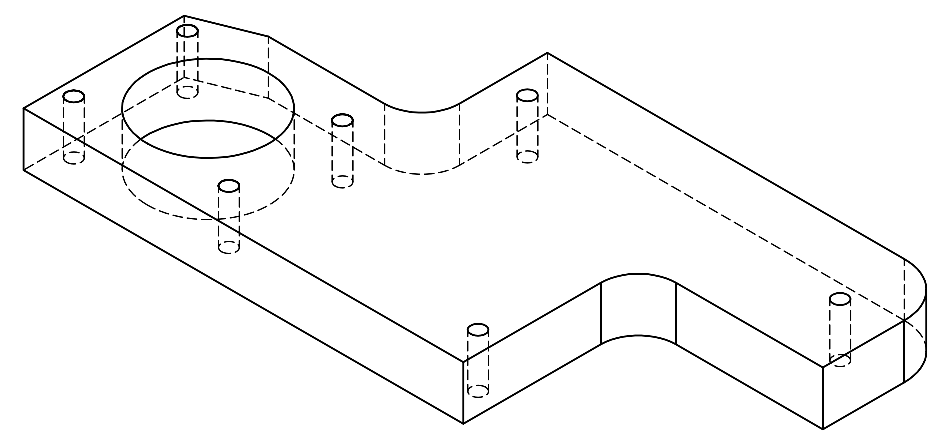

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL Aluminum	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 2		PART NUMBER A40-1400-11-012-002	PART NAME Middle Link	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 1

SIZE A2

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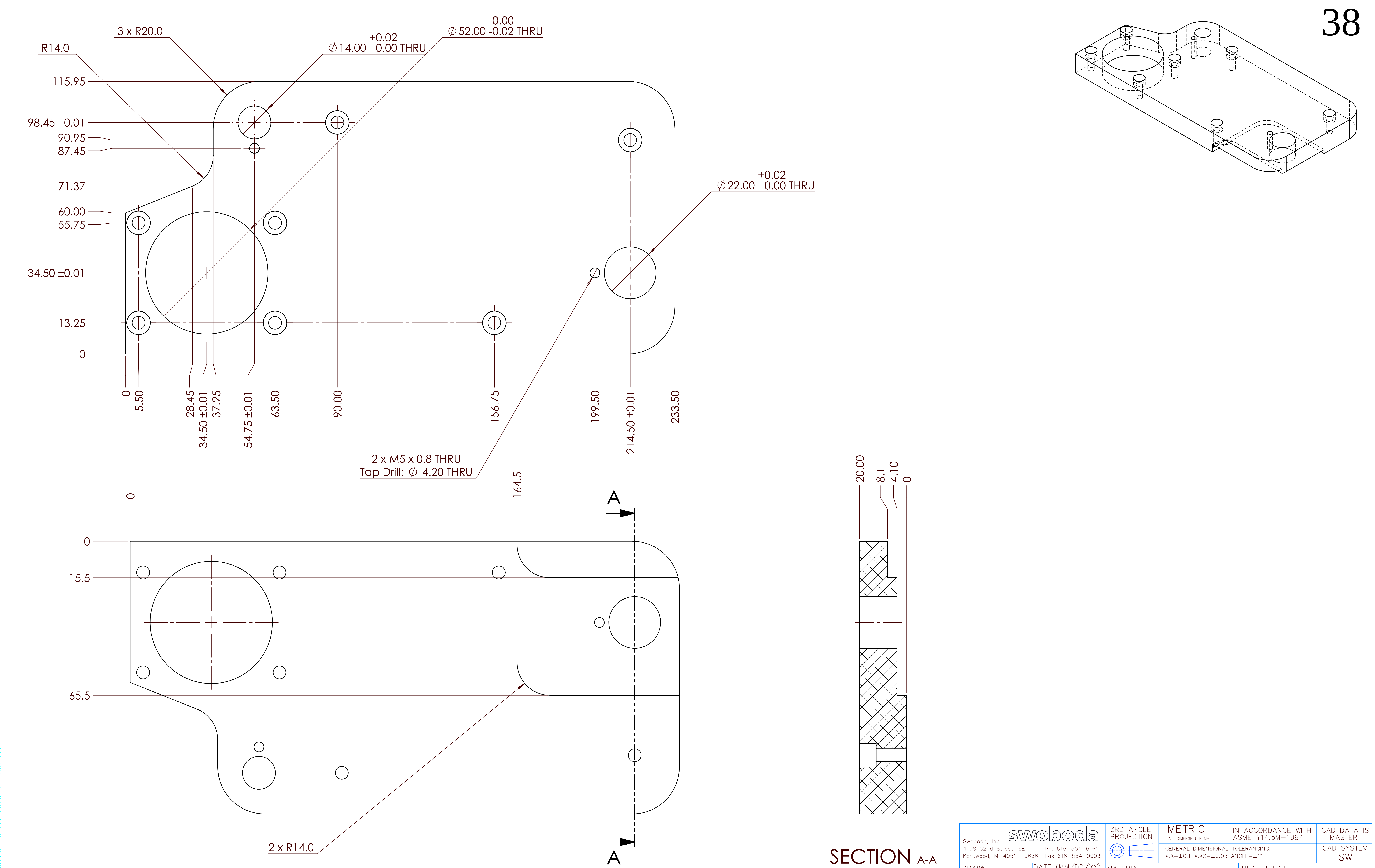

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL Aluminum	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 2		PART NUMBER A40-1400-11-012-003	PART NAME Top Link	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 1

SIZE A2

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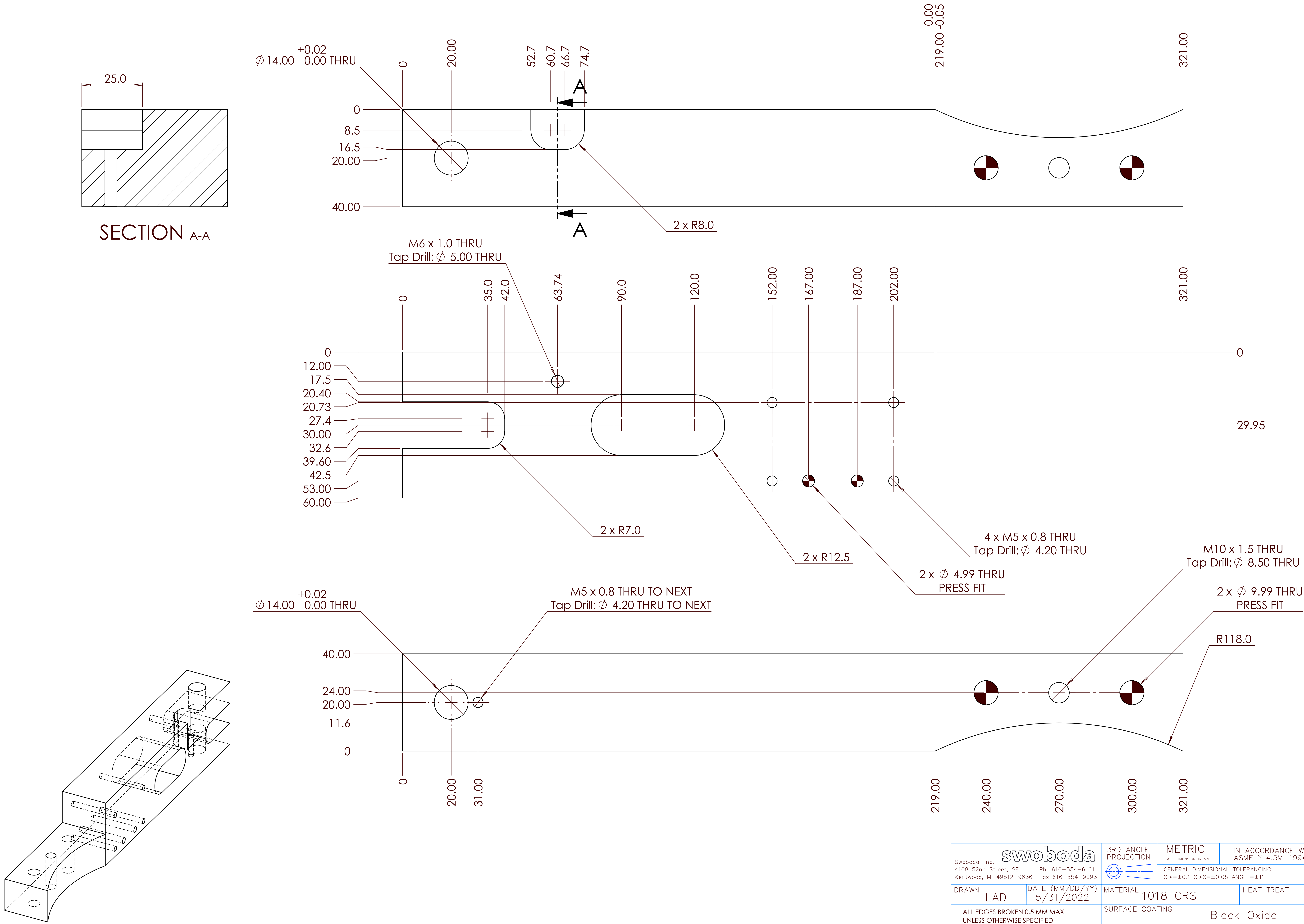

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3RD ANGLE PROJECTION

METRIC
ALL DIMENSION IN MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM SW

DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL 1018 CRS	HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING Black Oxide	REV 0
QTY: 1		PART NUMBER A40-1400-11-013-001	PART NAME Upper Right Shear Arm
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1 / SHEET 1 OF 1

SIZE A2

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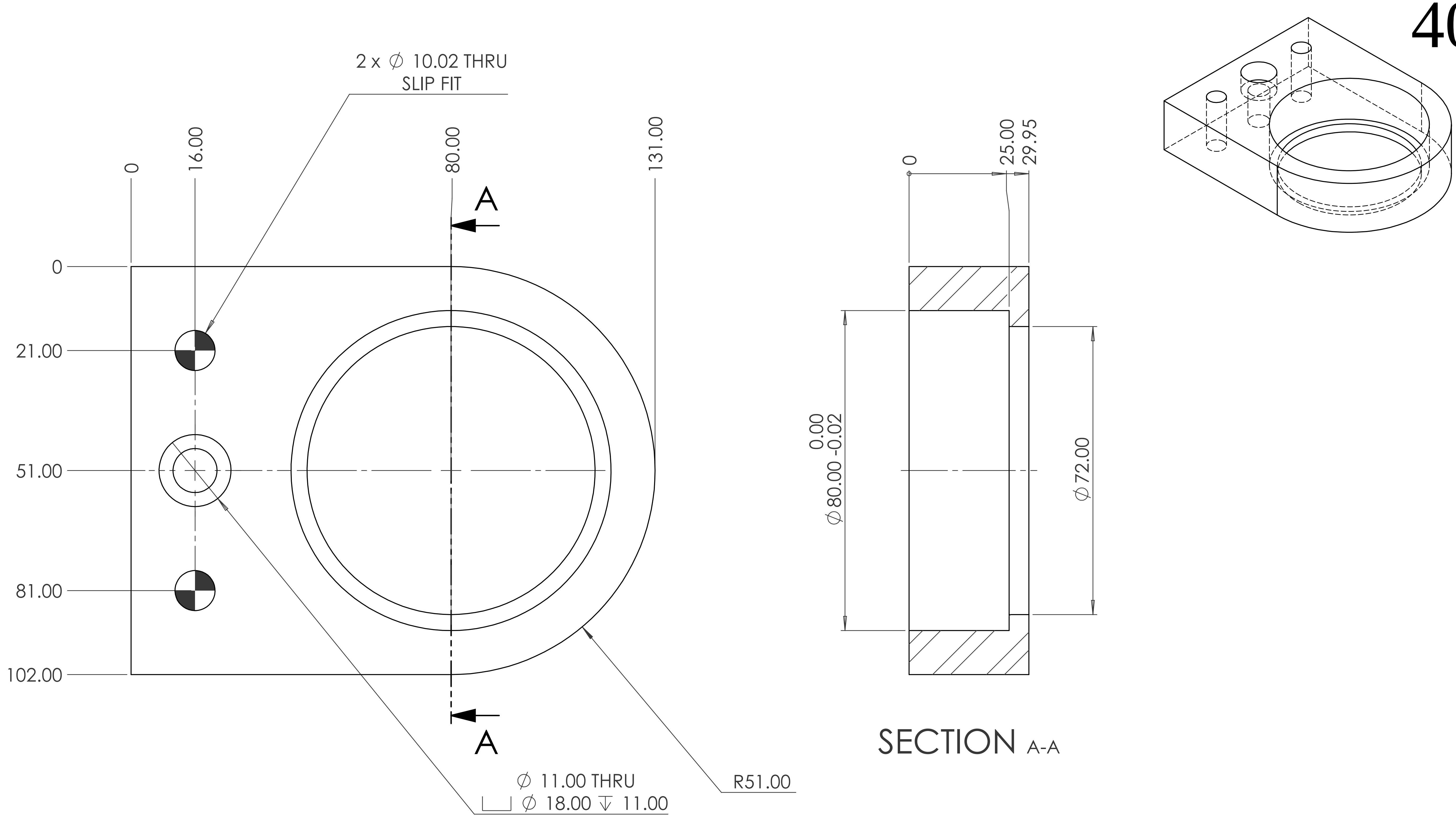

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: A2 Tool Steel	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: Black Oxide		REV: 0
QTY: 1		PART NUMBER: A40-1400-11-013-002	PART NAME: Upper Right Bearing Insert	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

SIZE A3

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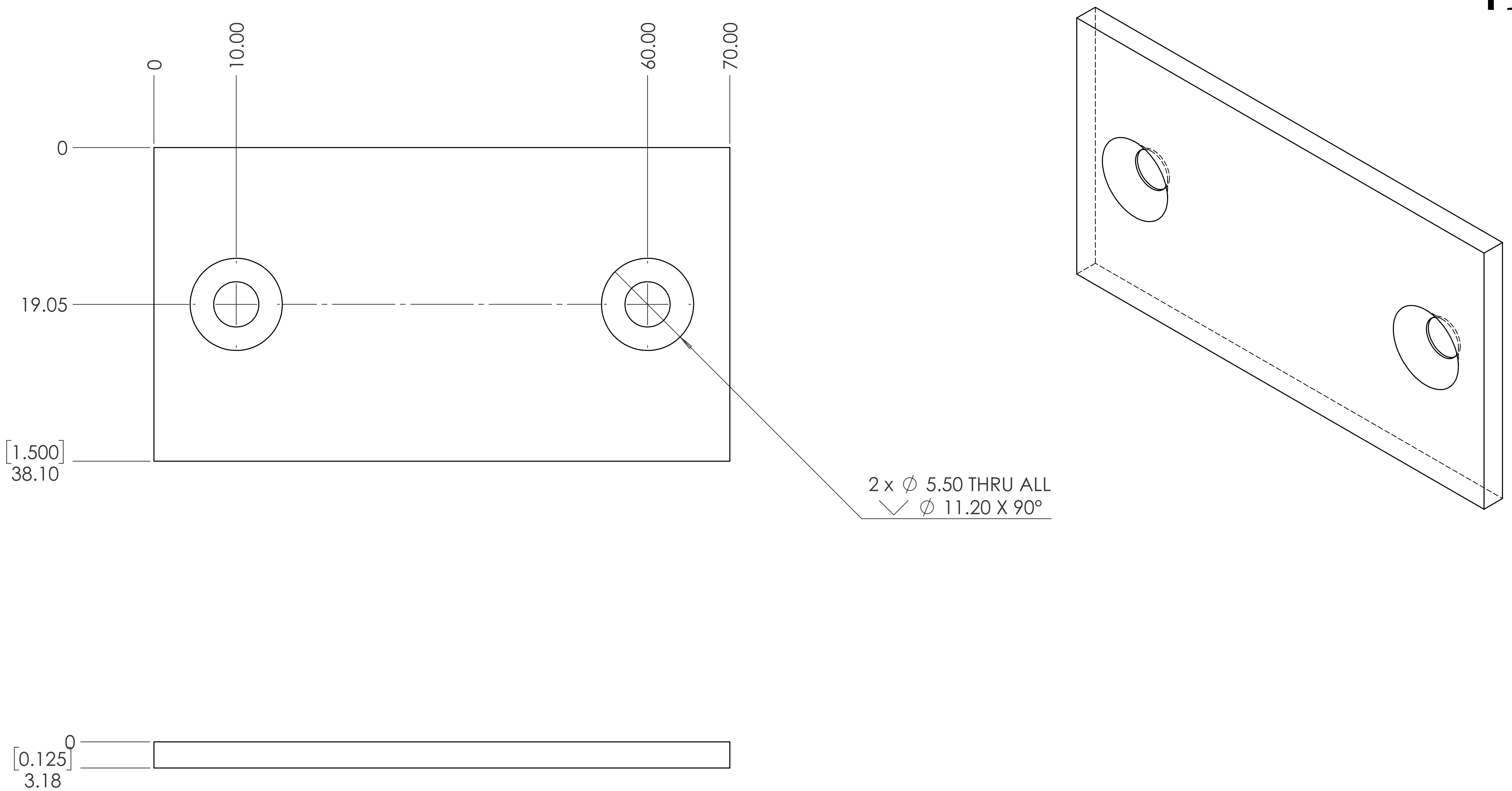

Swoboda, Inc. swoboda
4108 52nd Street, SE Ph. 616-554-6161
Kentwood, MI 49512-9636 Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: A2 Tool Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-013-003

PART NAME: Blade Back

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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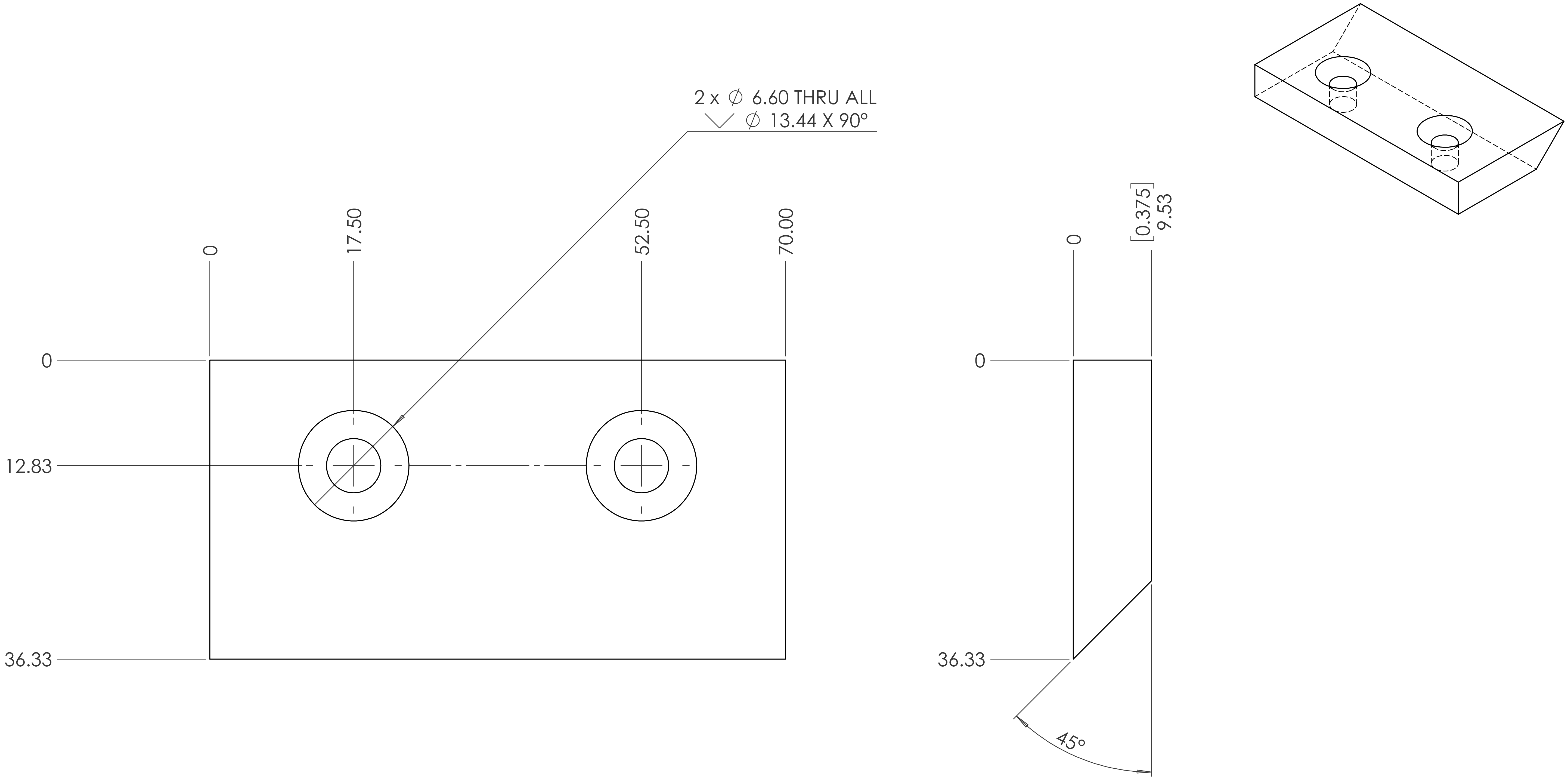

Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093 swoboda	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: D2 Steel	HEAT TREAT: 54-56	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 4		PART NUMBER: A40-1400-11-013-004	PART NAME: Blade	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 2:1	SHEET: 1 OF 1

SIZE A3

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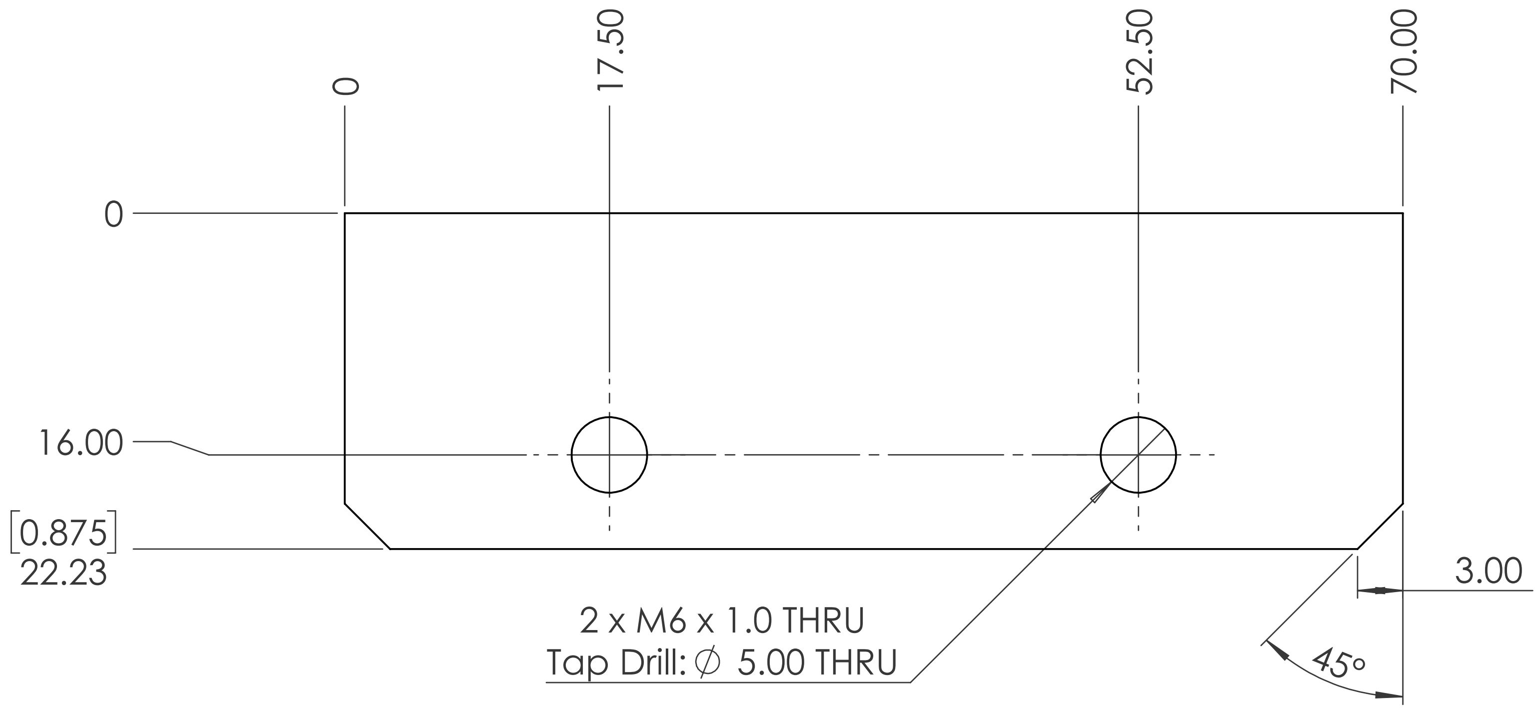

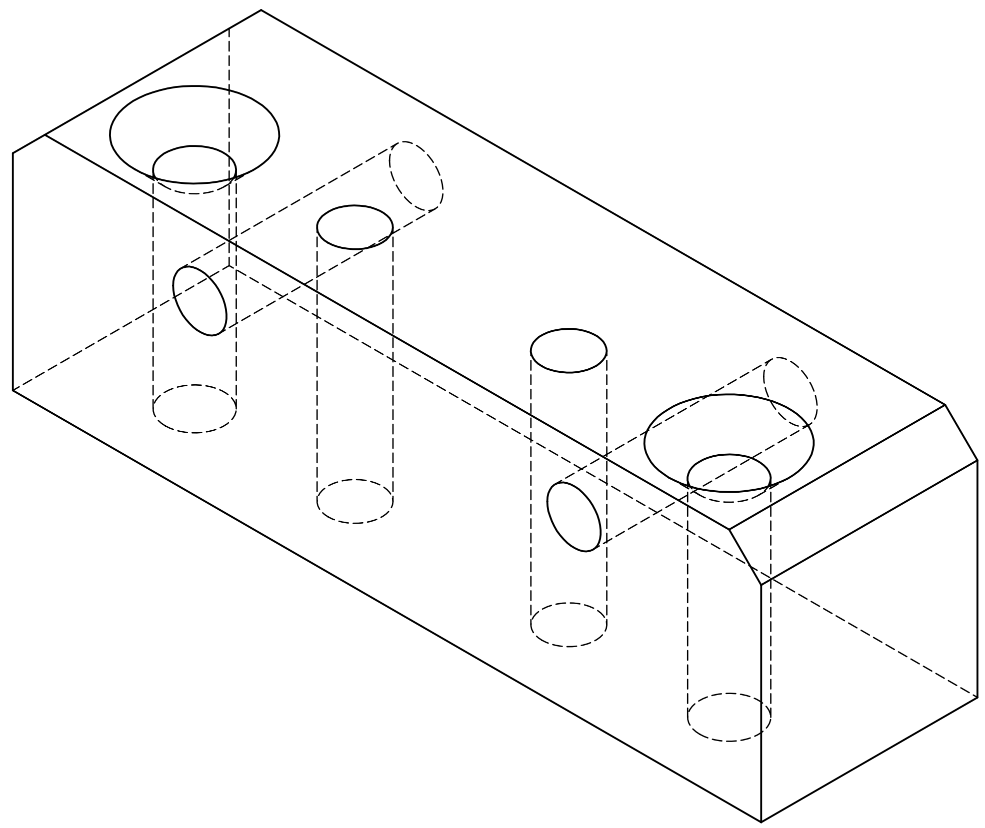

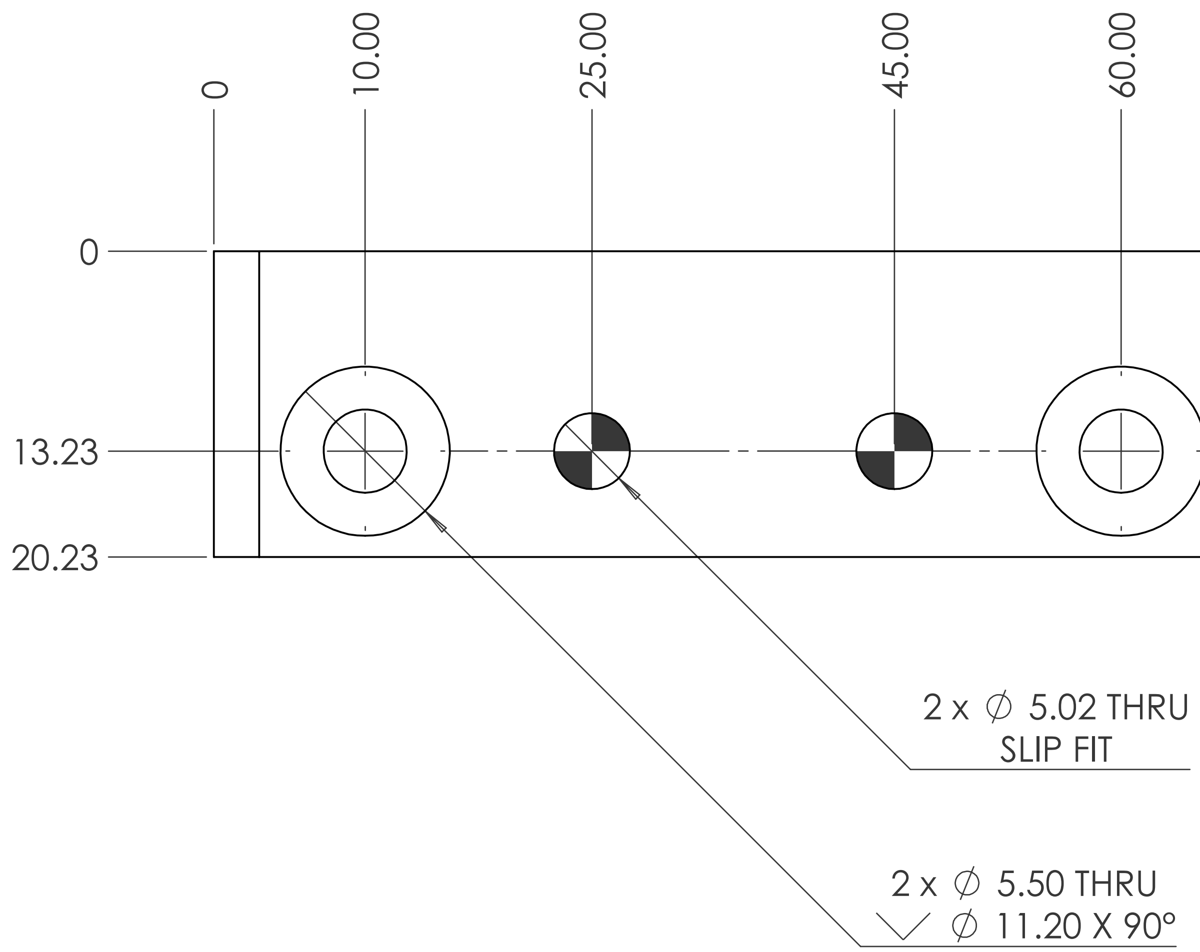

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Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: 1018 CRS

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-013-005

PART NAME: Blade Bottom

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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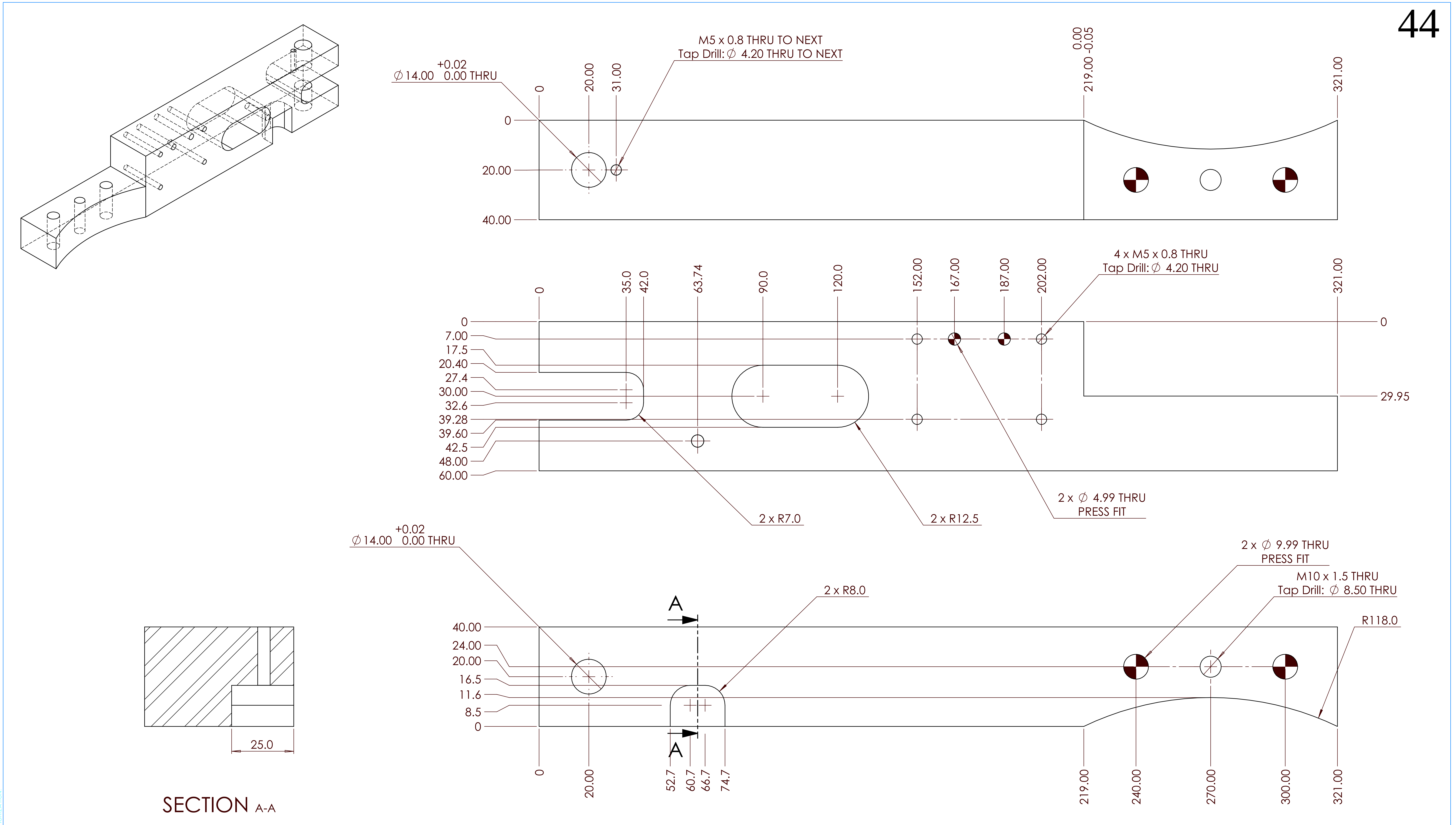

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3RD ANGLE PROJECTION

METRIC
ALL DIMENSION IN MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM SW

DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL 1018 CRS	HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING Black Oxide	REV 0
QTY: 1		PART NUMBER A40-1400-11-014-001	PART NAME Lower Left Shear Arm
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1 / SHEET 1 OF 1

SIZE A2

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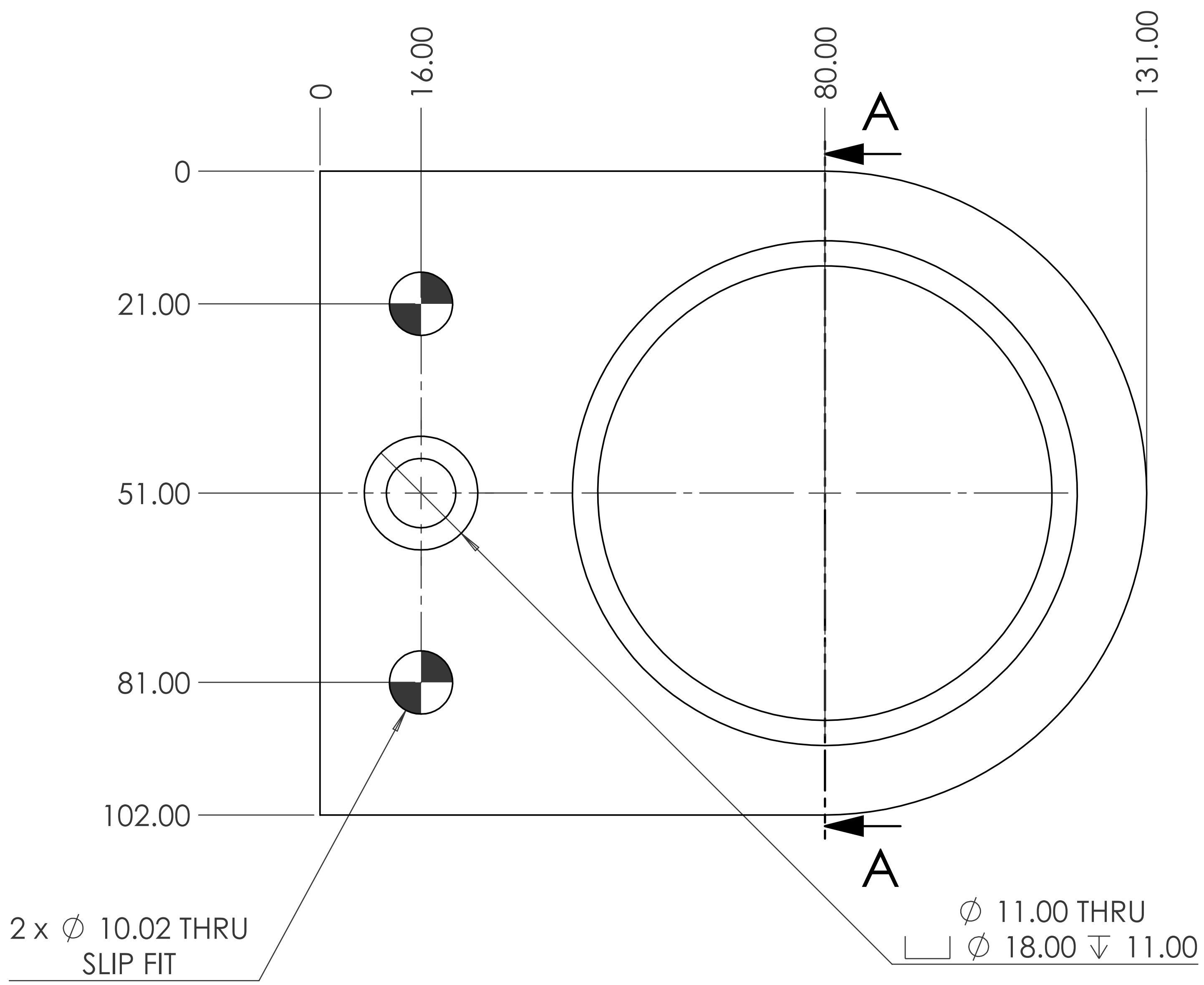
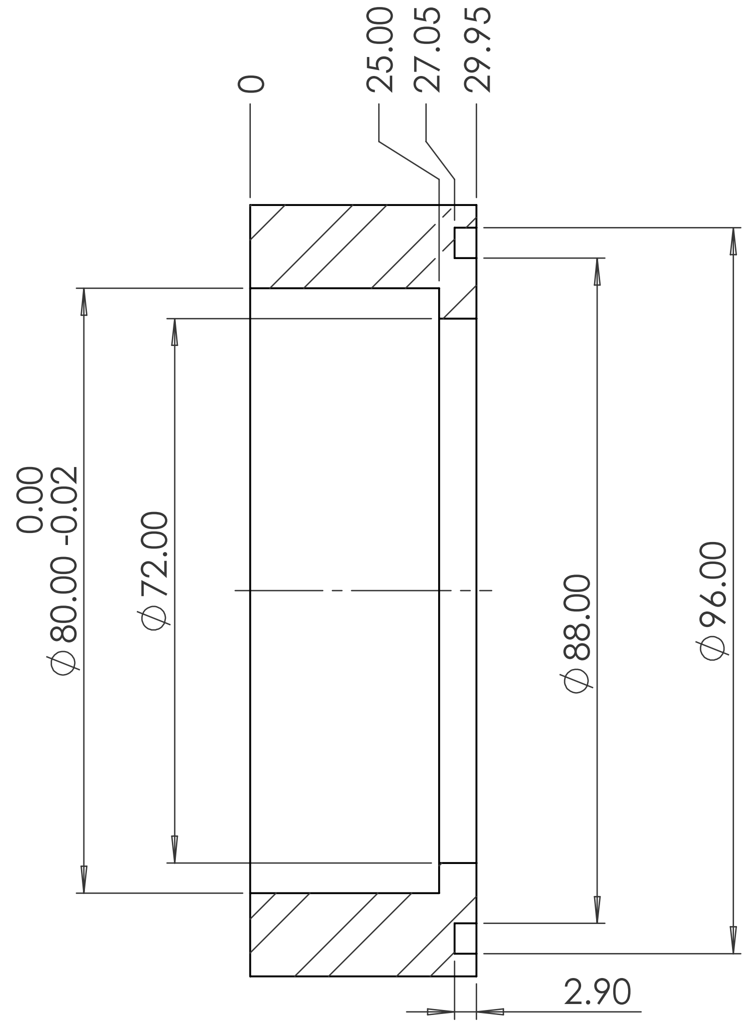
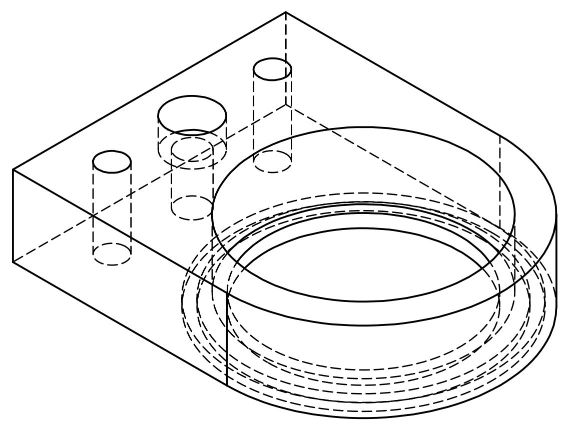
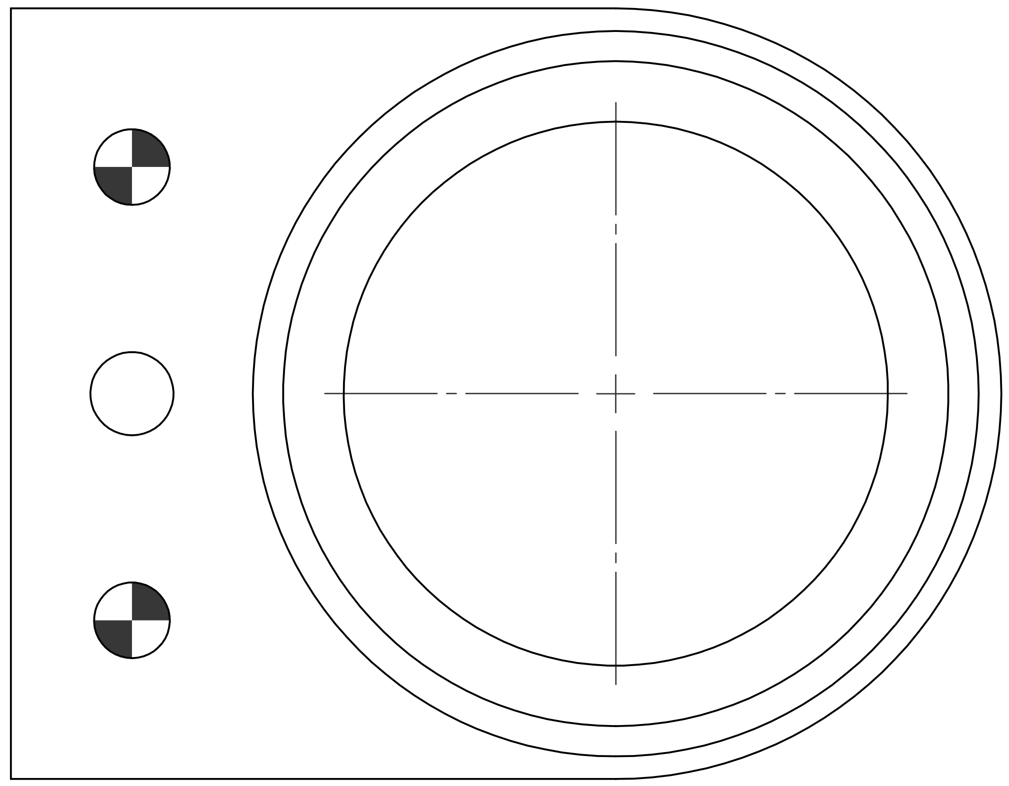




SECTION A-A





Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: A2 Tool Steel	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: Black Oxide		REV: 0
QTY: 1		PART NUMBER: A40-1400-11-014-002	PART NAME: Lower Left Bearing Insert	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

SIZE A3

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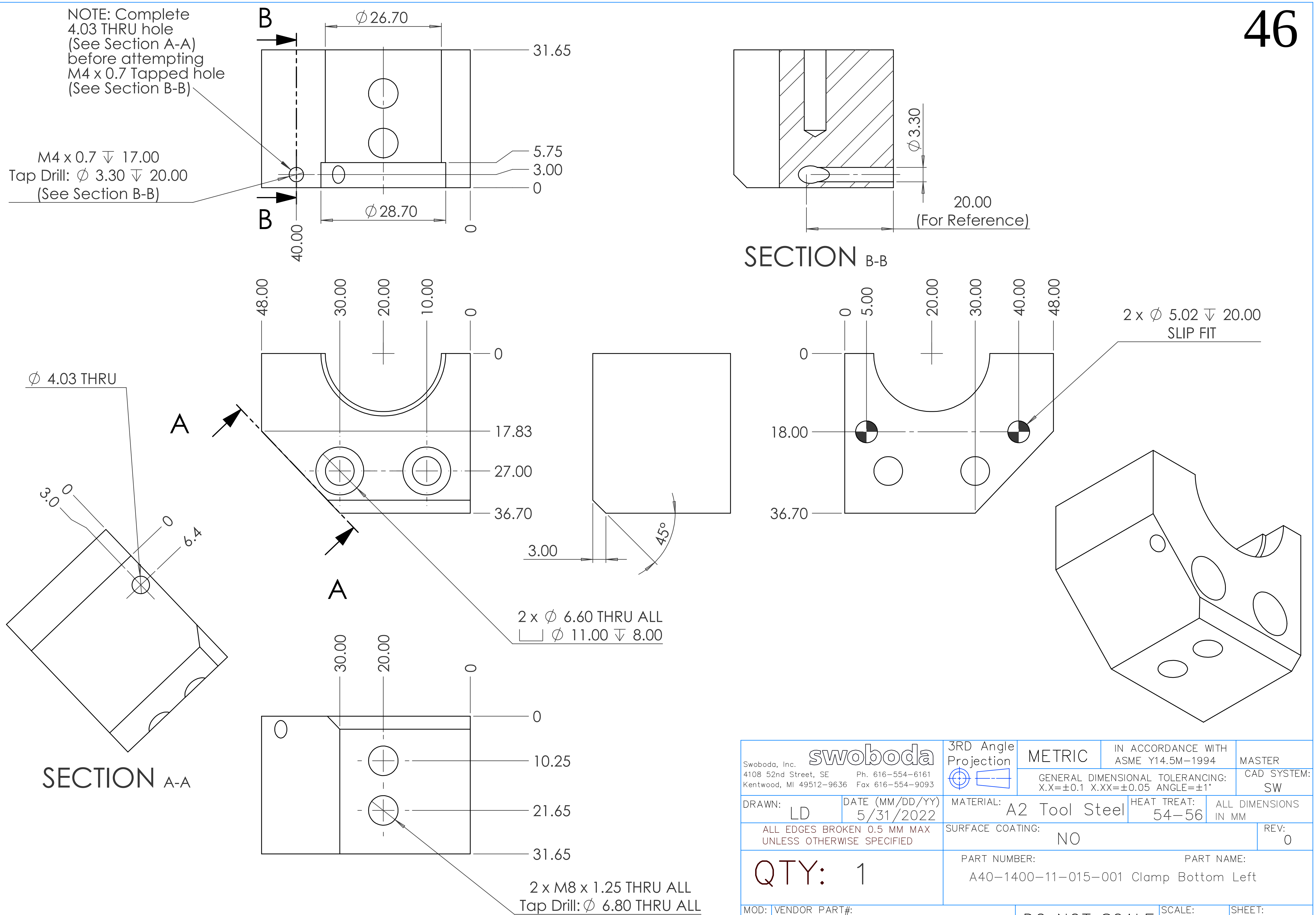

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Kentwood, MI 49512-9636 Fax 616-554-9093

3RD Angle Projection | METRIC | IN ACCORDANCE WITH ASME Y14.5M-1994 | MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1° | CAD SYSTEM: SW

DRAWN: LD | DATE (MM/DD/YY) 5/31/2022 | MATERIAL: A2 Tool Steel | HEAT TREAT: 54-56 | ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED | SURFACE COATING: NO | REV: 0

QTY: 1

PART NUMBER: A40-1400-11-015-001 | PART NAME: Clamp Bottom Left

MOD: N | VENDOR PART#: N/A | DO NOT SCALE | SCALE: 2:1.5 | SHEET: 1 OF 1

SIZE A3

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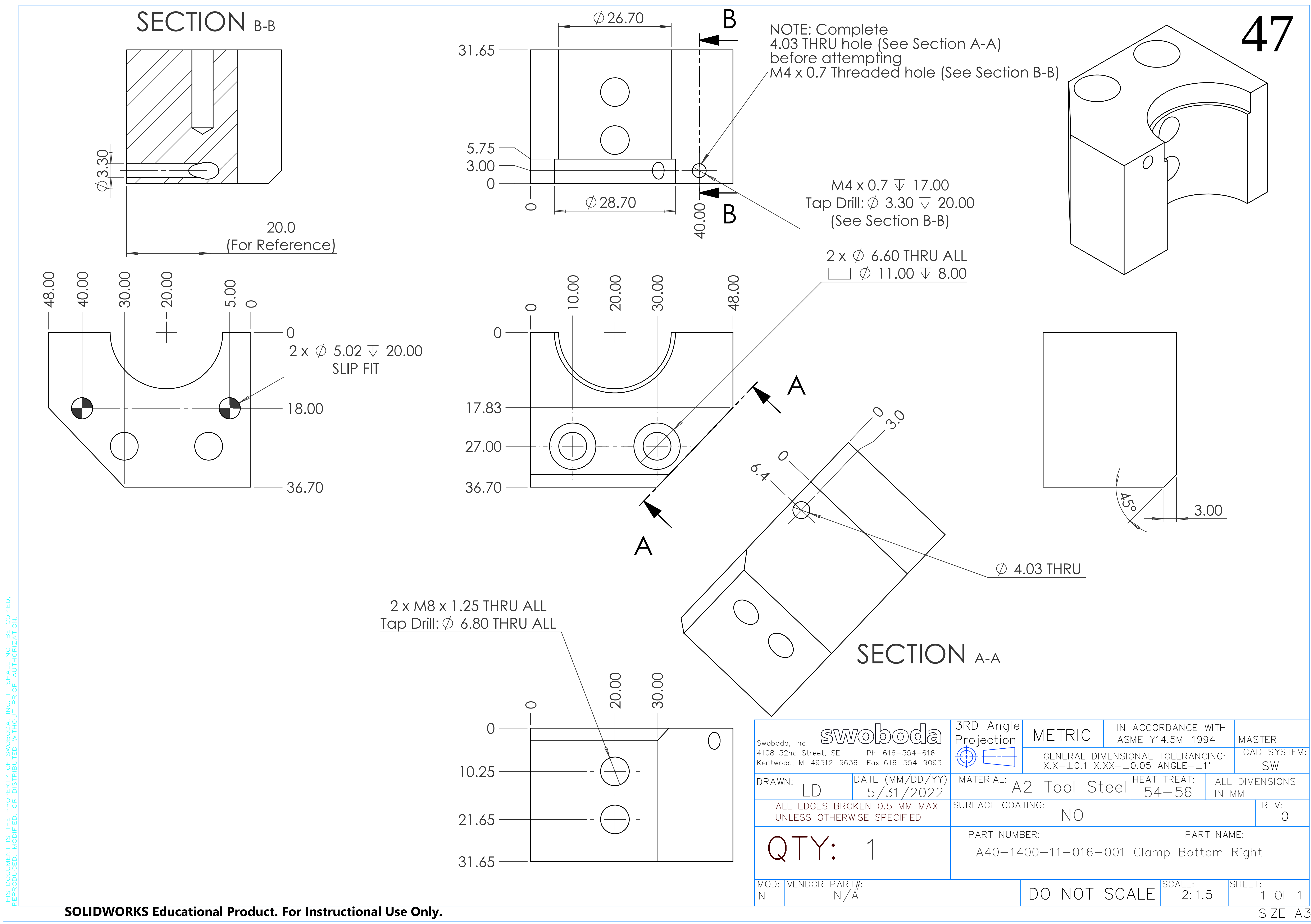

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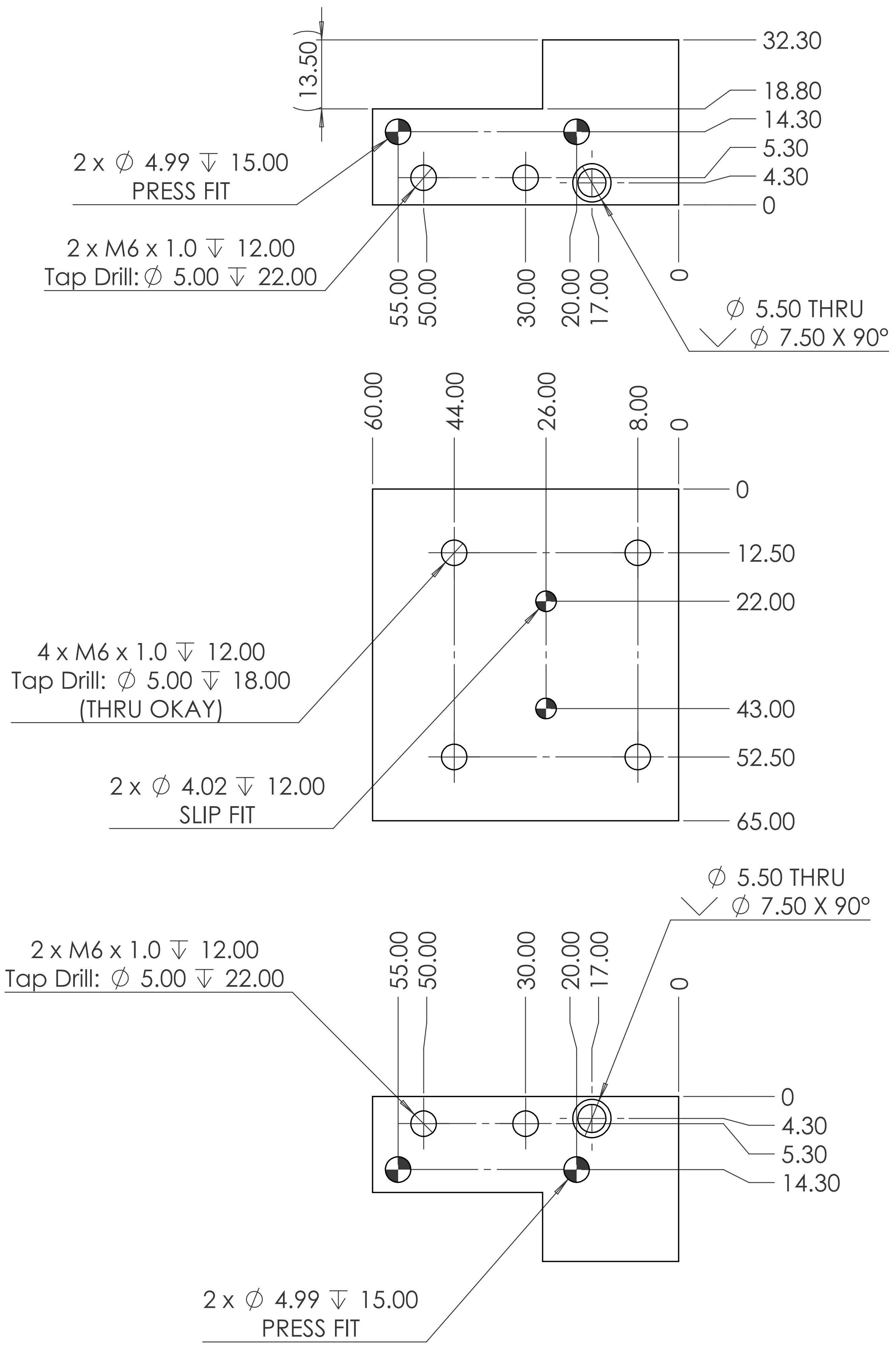

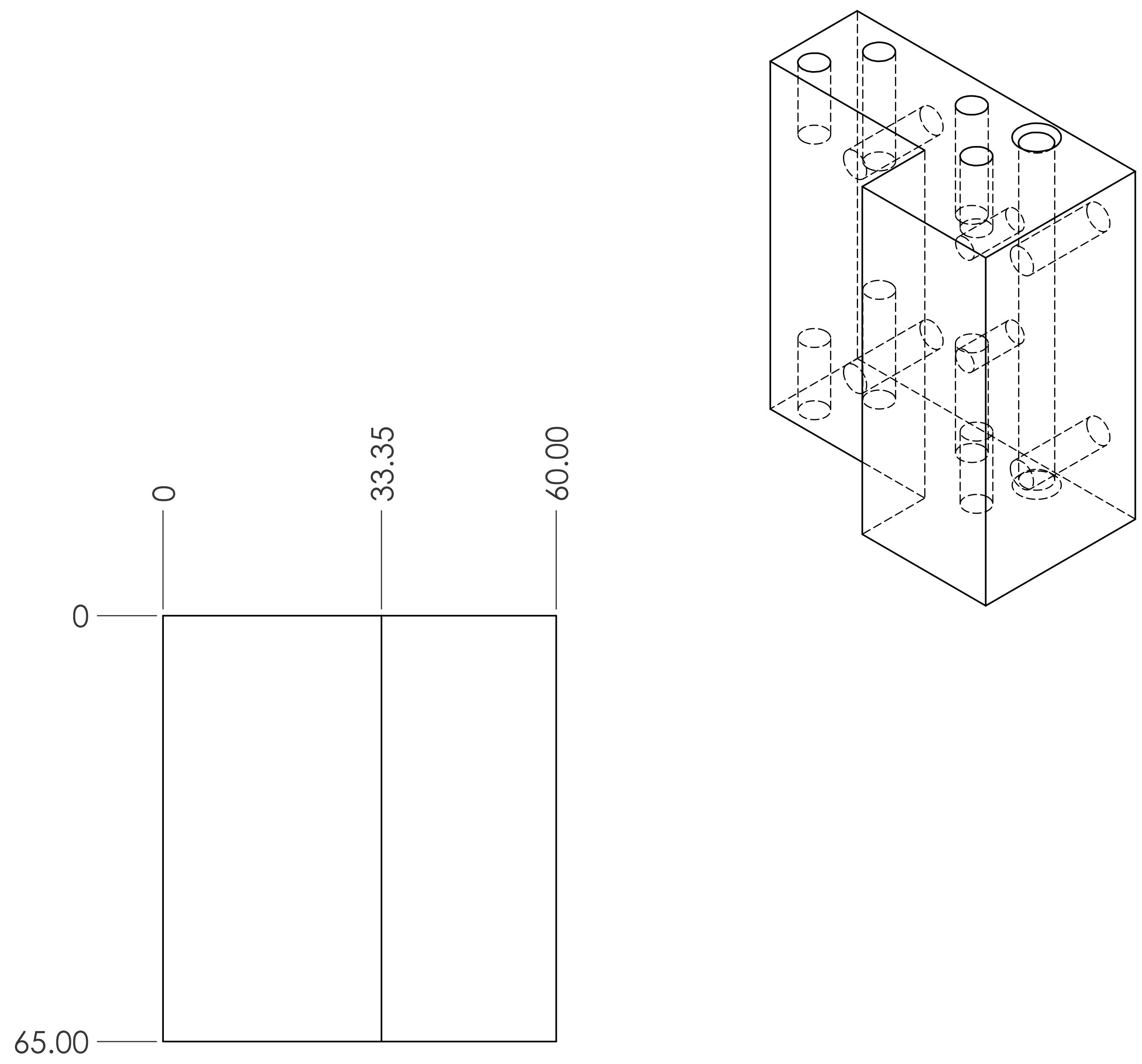

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Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY): 5/31/2022

MATERIAL: ALUMINUM

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-016-002

PART NAME: Clamp Mid

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 1

SIZE A3

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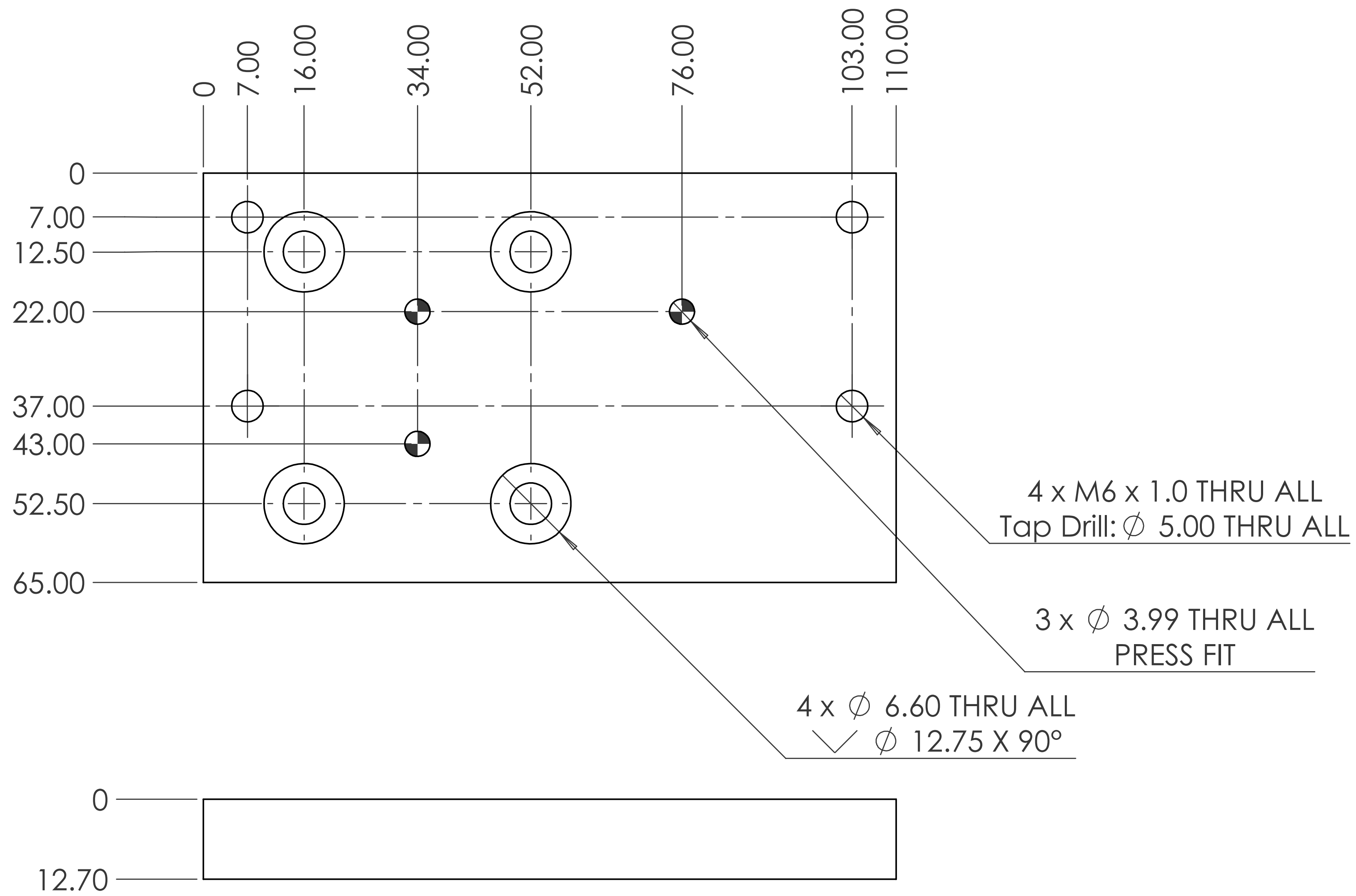

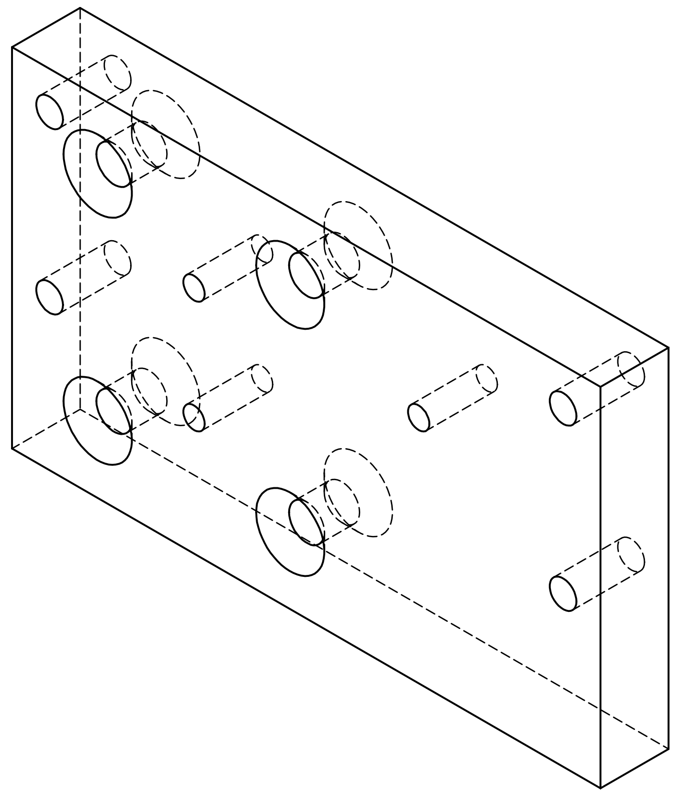

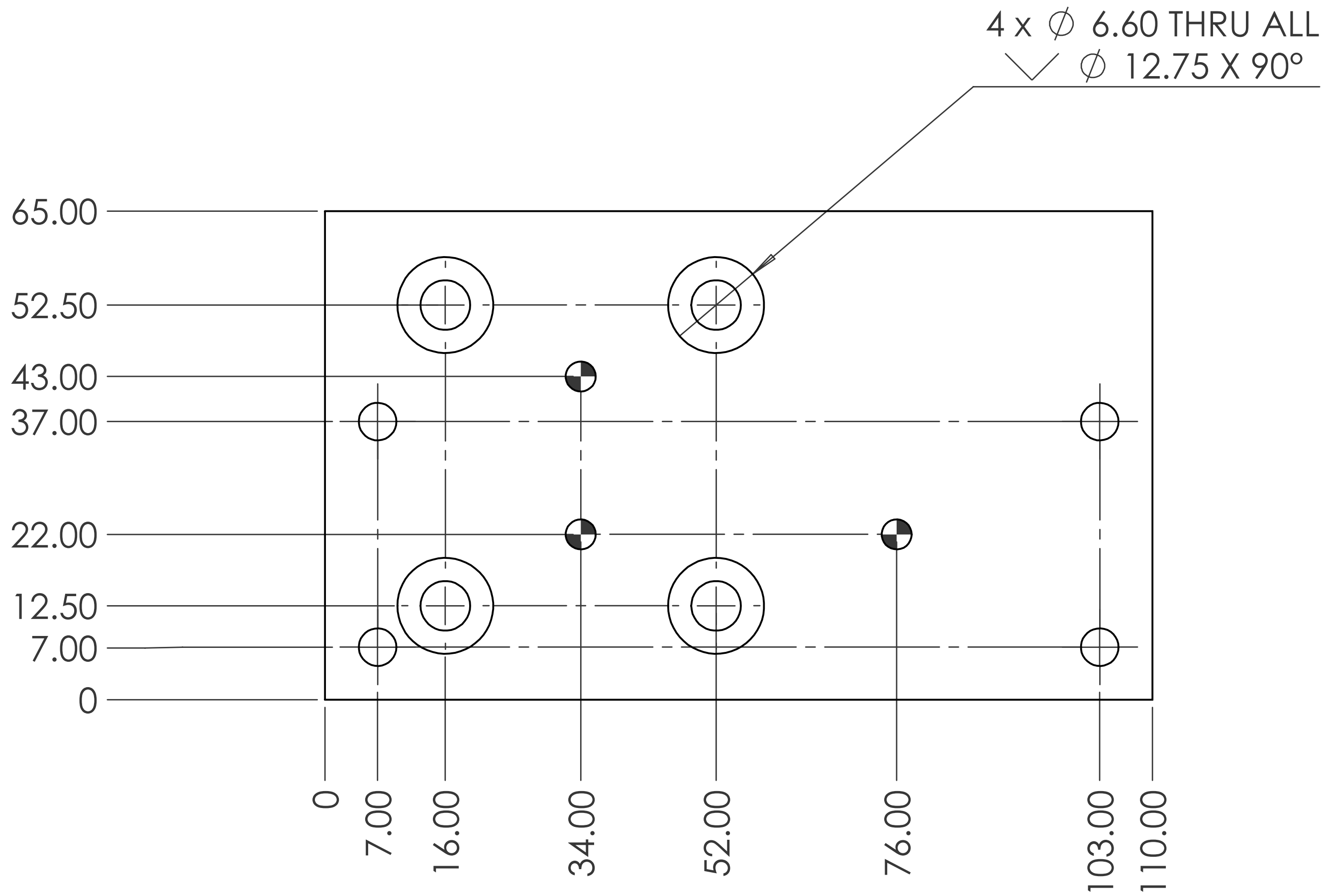

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: MIC 6

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-016-003

PART NAME: Clamp Back

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 1

SIZE A3

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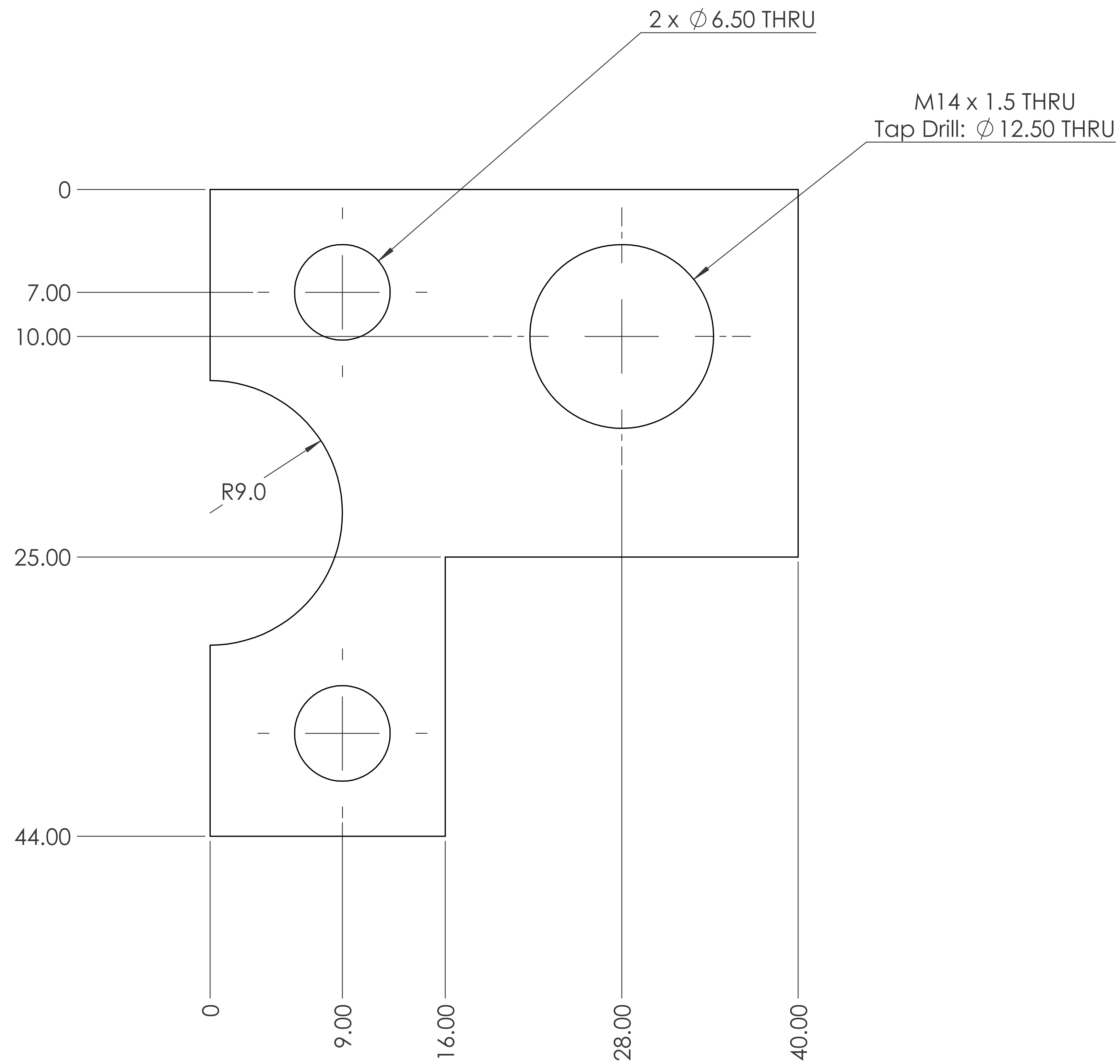

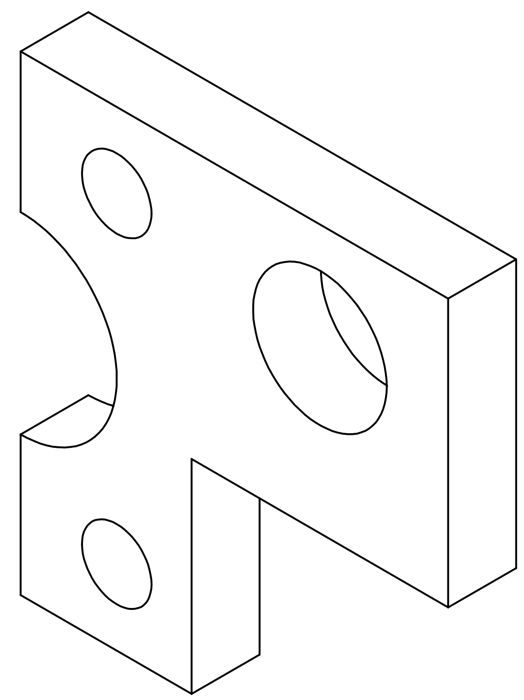

THICKNESS: 6.35
(0.25 inch)

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Kentwood, MI 49512-9636 Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 6/1/2022

MATERIAL: 1018 CRS

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-016-004

PART NAME: Clamp Stop

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 3:1

SHEET: 1 OF 1

SIZE A3

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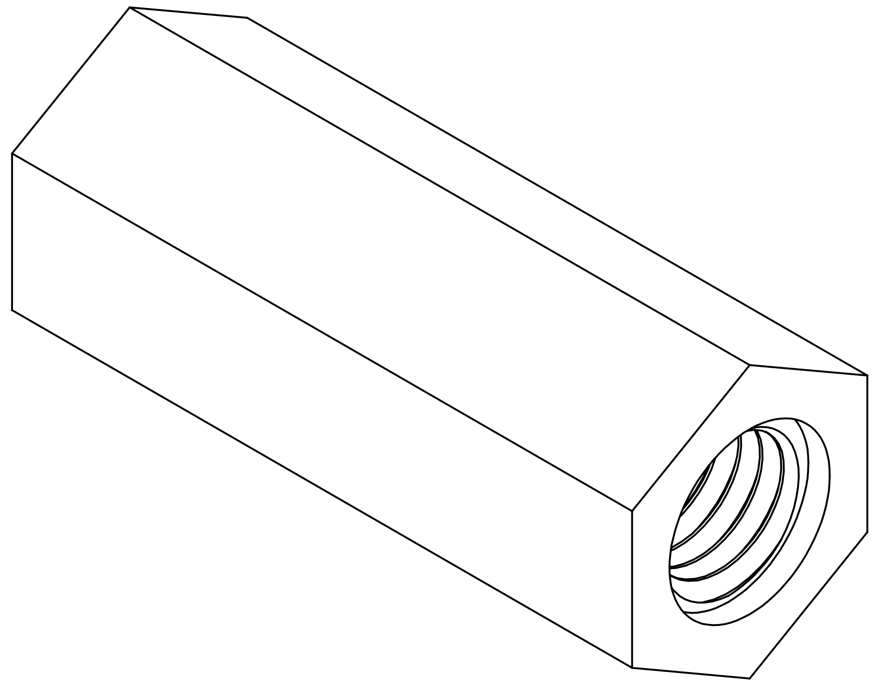

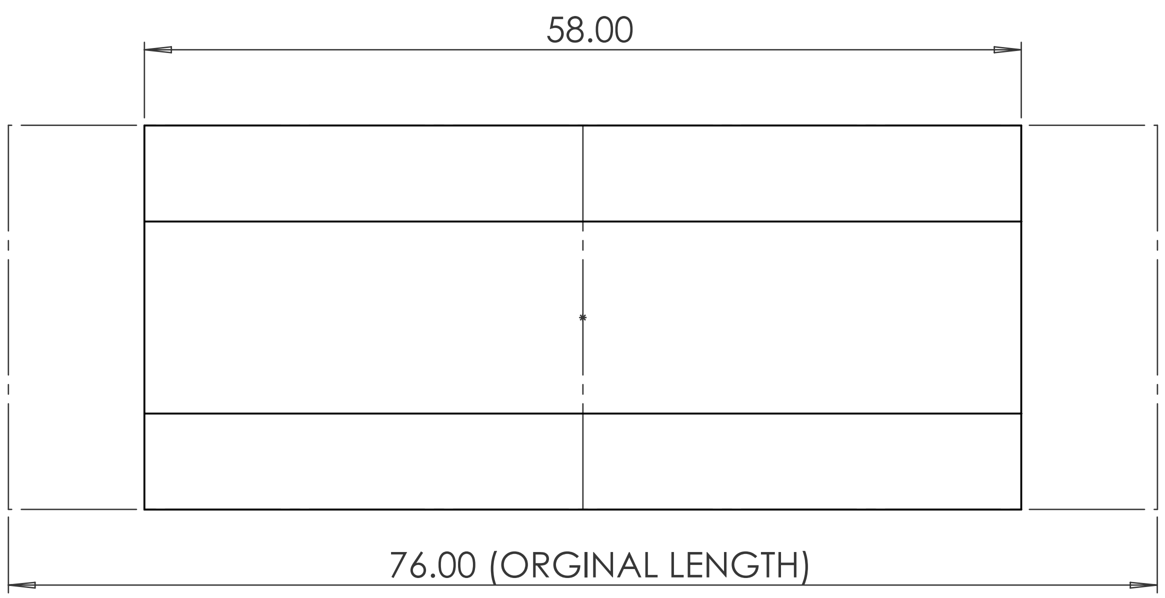

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Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 4/21/2022

MATERIAL: 18-8 Stainless Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-017-001

PART NAME: (8416N25_18-8 Stainless Stee

MOD: Y

VENDOR PART#: 8416N25 (McMaster-Carr)

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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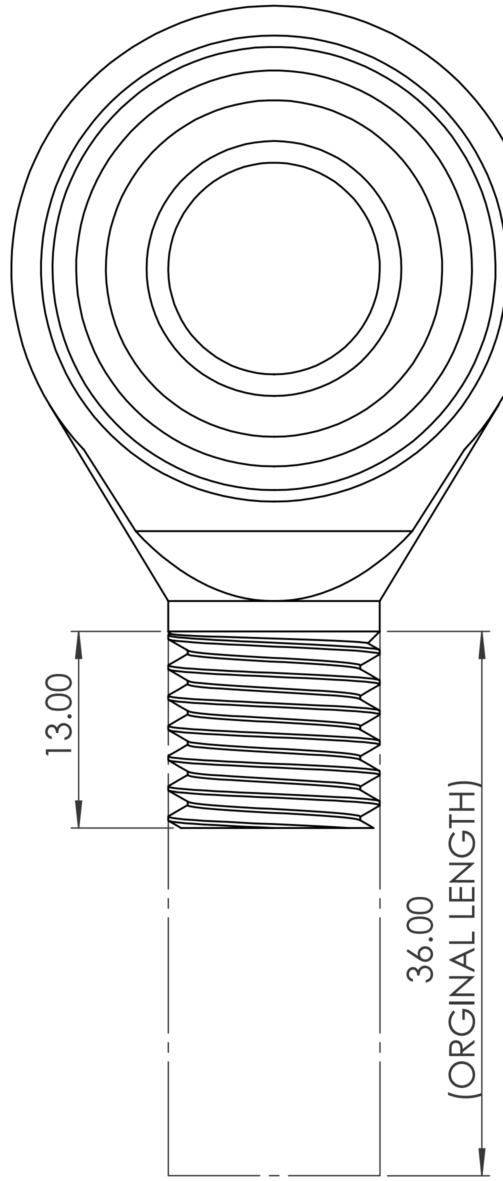

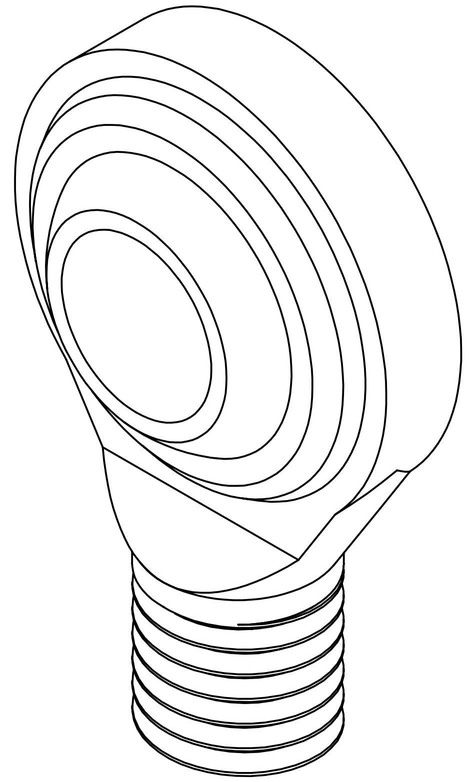

Swoboda, Inc. swoboda
4108 52nd Street, SE Ph. 616–554–6161
Kentwood, MI 49512–9636 Fax 616–554–9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M–1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 4/21/2022

MATERIAL: Carbon Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40–1400–11–017–002

PART NAME: (60645K981_Ball Joint Rod En

MOD: Y

VENDOR PART#: 60645K82 (LH THREAD)

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 1

SIZE A3

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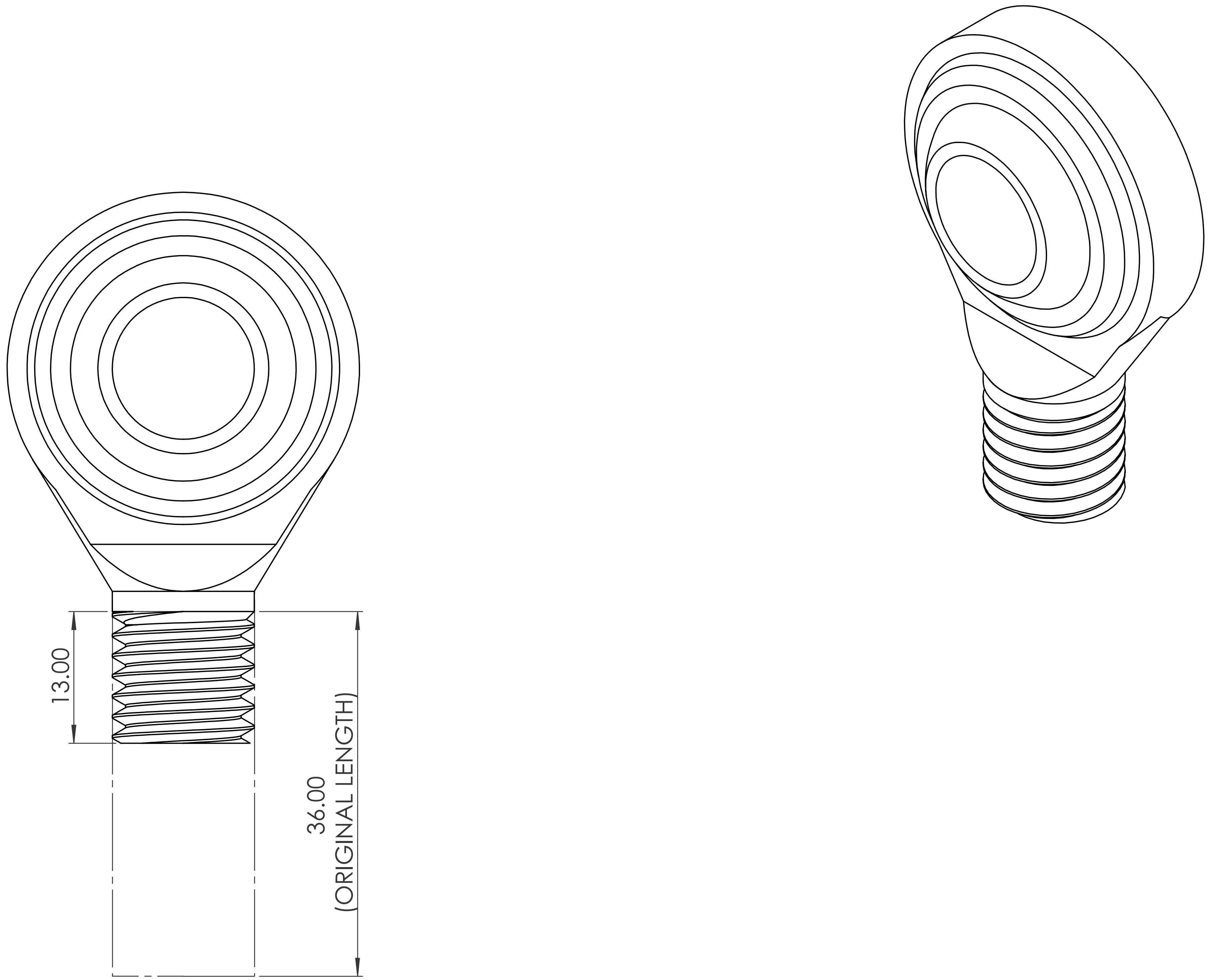

Swoboda, Inc. swoboda 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 4/21/2022	MATERIAL: Carbon Steel	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO			REV: 0
QTY: 2	PART NUMBER: A40-1400-11-017-003	PART NAME: (60645K981_Ball Joint Rod End)		
MOD: Y	VENDOR PART#: 60645K981 (RH THREAD)	DO NOT SCALE	SCALE: 2:1	SHEET: 1 OF 1

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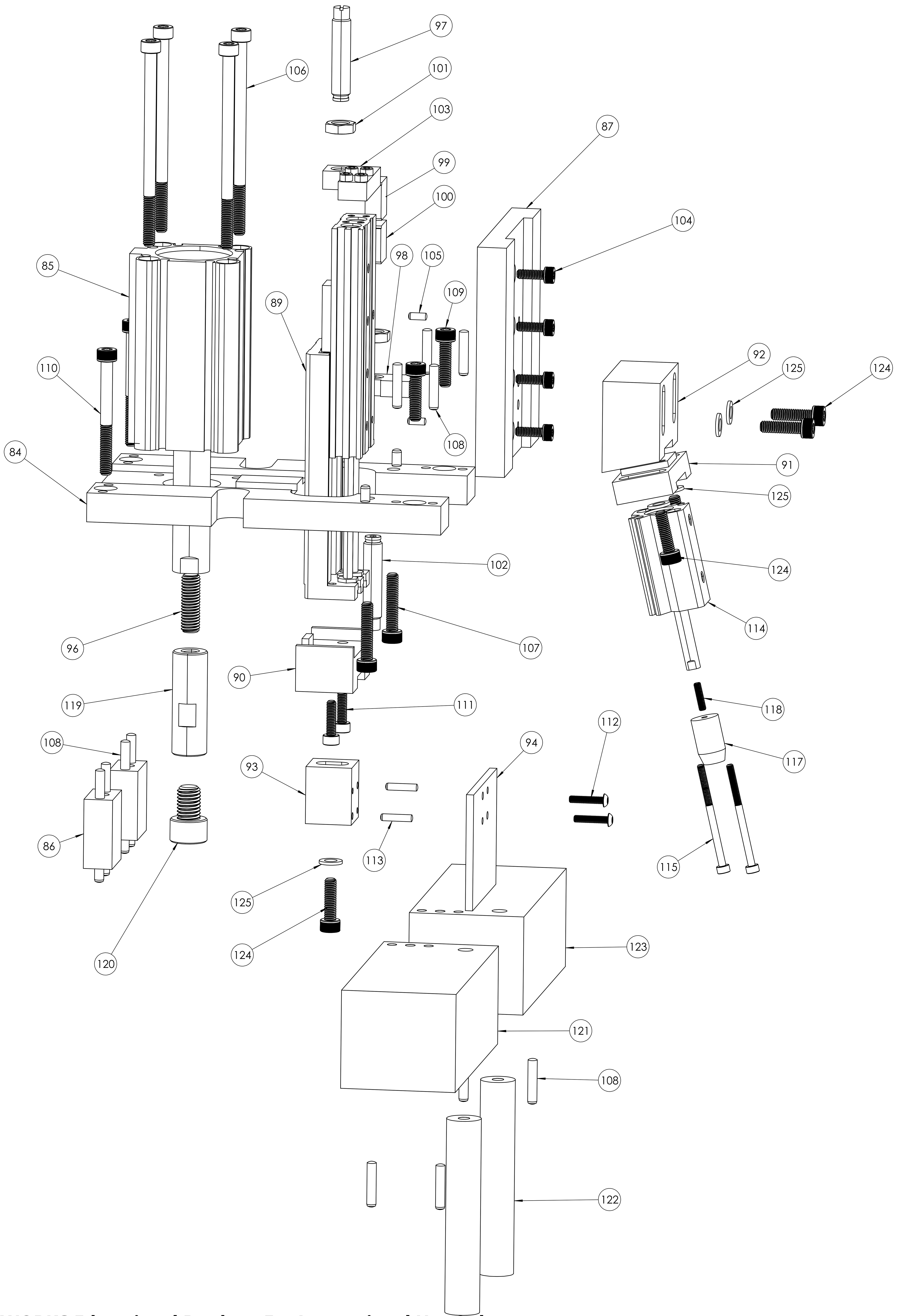
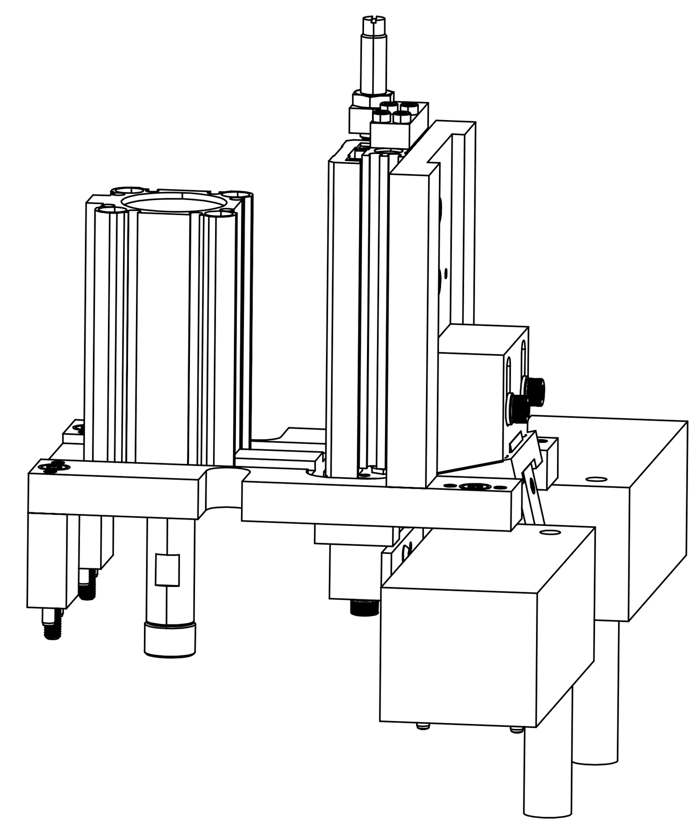
54

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
84	A40-1400-11-018-001 Washer Base		1
85	CDQ2B32_50DZ_0_1_0__5		1
86	A40-1400-11-018-002 Washer Upright		2
87	A40-1400-11-018-006 Cyl. Support		1
88	MXS8_50B_0_0__20		1
89	MXS8_50B_0_0__18		1
90	A40-1400-11-018-009 EndStop Base		1
91	A40-1400-11-018-008 PreStop In Out		1
92	A40-1400-11-018-007 PreStop Up Down		1
93	A40-1400-11-018-010 EndStop In Out		1
94	A40-1400-11-018-011 EndStop		1
95	CDQ2B32_50DZ_0_1_0__3		1
96	THRD_ROD_M8_x_25	93675A250	1
97	MXS_BT8_X12	Shock Absorber	1
98	MXS_BS8	Extension End	1
99	MXS_8	Table Mount	1
100	MXS_8_2	Table Mount	1
101	MXS_B8_NUT	Nut	2
102	MXS_BS8_X12	Shock Absorber	1
103	MXS_BT8	Retraction End	1
104	HEX_SOC_CAP_SCR_M4_X_12	91290A148	4
105	DOWEL_M3_X_8	91595A104	2
106	HEX_SOC_CAP_SCR_M5_X_85	91290A105	4
107	HEX_SOC_CAP_SCR_M5_X_25	91290A252	2
108	DOWEL_M4_X_20	91595A167	18
109	HEX_SOC_CAP_SCR_M5_X_20	91290A242	2
110	HEX_SOC_CAP_SCR_M5_X_50	91290A262	2
111	HEX_SOC_CAP_SCR_M4_X_15	91290A306	2
112	BUTT_HD_SCR_M3_X_15	91239A811	2
113	DOWEL_M3_X_14	91595A114	2
114	CDQ2B12_15DCZ_0_1_0__8		1
115	HEX_SOC_CAP_SCR_M3_X_45	91290A079	2
116	CDQ2B12_15DCZ_0_1_0__6		1
117	FPSFJTB_D12_L20_N3_J5 (Misumi)	12 x 20 Pre Stop Plug	1
118	THRD_ROD_M3_x_12	93805A629	1
119	PSFGZ15_45_M8_N10_SC22(Misumi)	15 x 45 Washer Removal Shaft	1
120	HEX_SOC_CAP_SCR_M10_X_14	91290A127	1
121	A40-1400-11-018-003 Stop Block Left		1
122	A40-1400-11-018-005 Stop Pin		2
123	A40-1400-11-018-004 Stop Block Right		1
124	91290A238	Alloy Steel Socket Head Screw	5
125	98687A110	General Purpose Steel Washer	5





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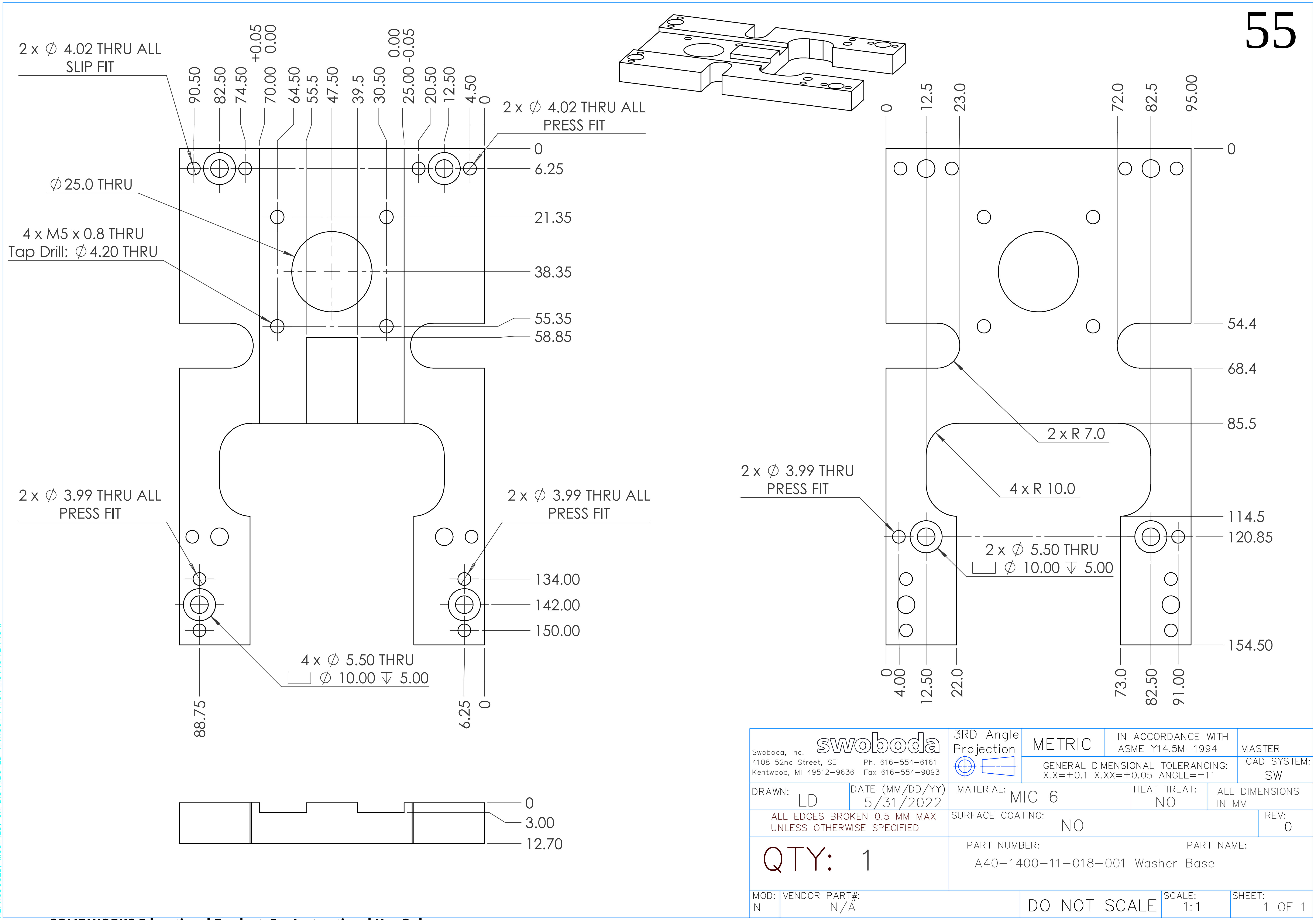
swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER	PART NAME SA-5	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 9 OF 11

SIZE A1



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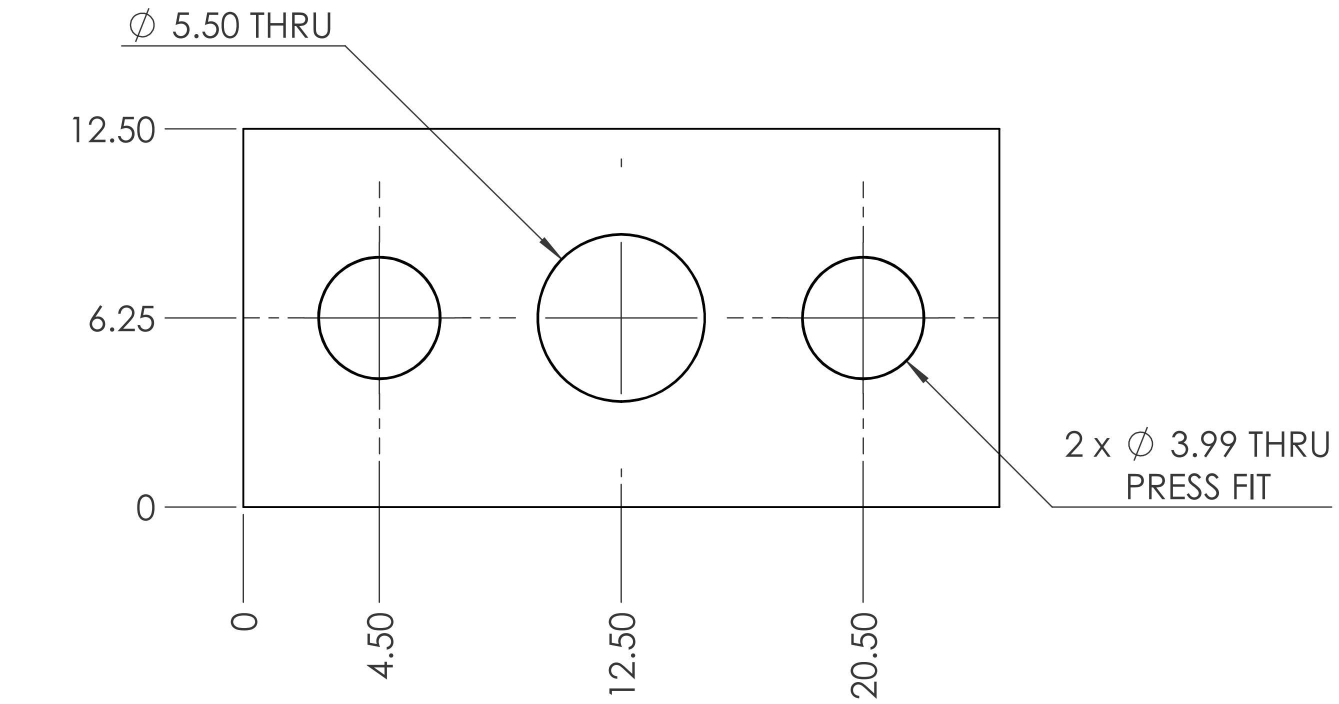

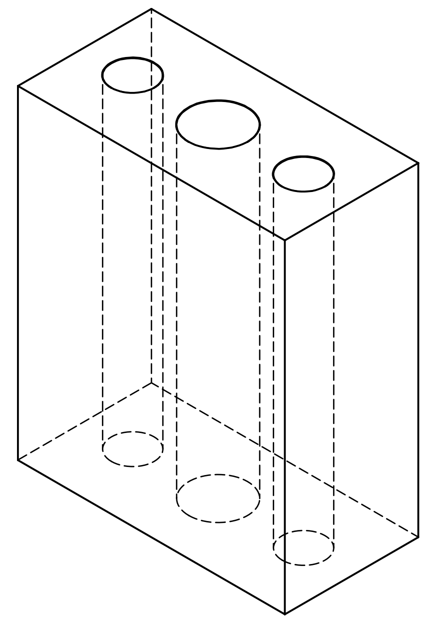

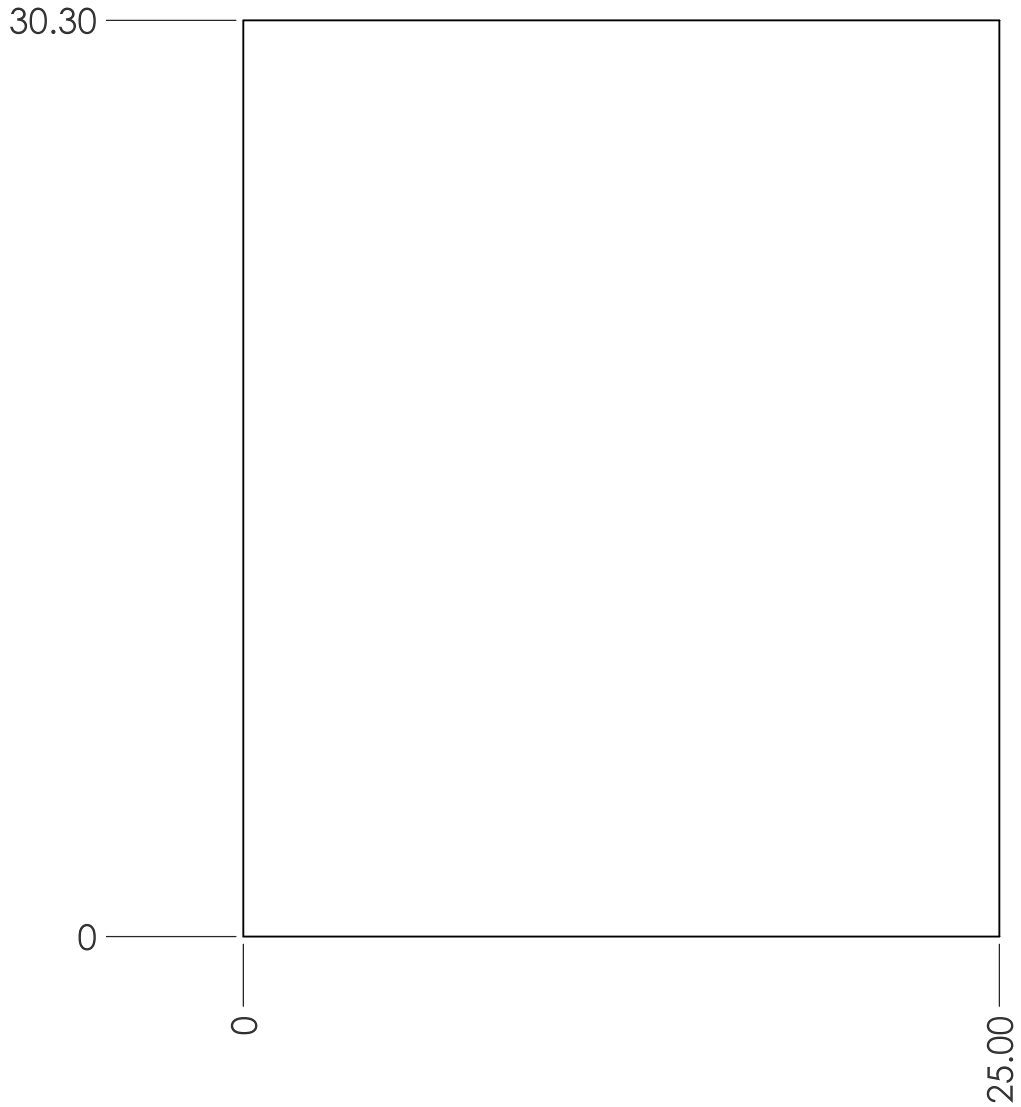

Swoboda, Inc. swoboda 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: A2 Tool Steel	HEAT TREAT: 56-54	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO			REV: 0
QTY: 2	PART NUMBER: A40-1400-11-018-002		PART NAME: Washer Upright	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 4:1	SHEET: 1 OF 1

SIZE A3

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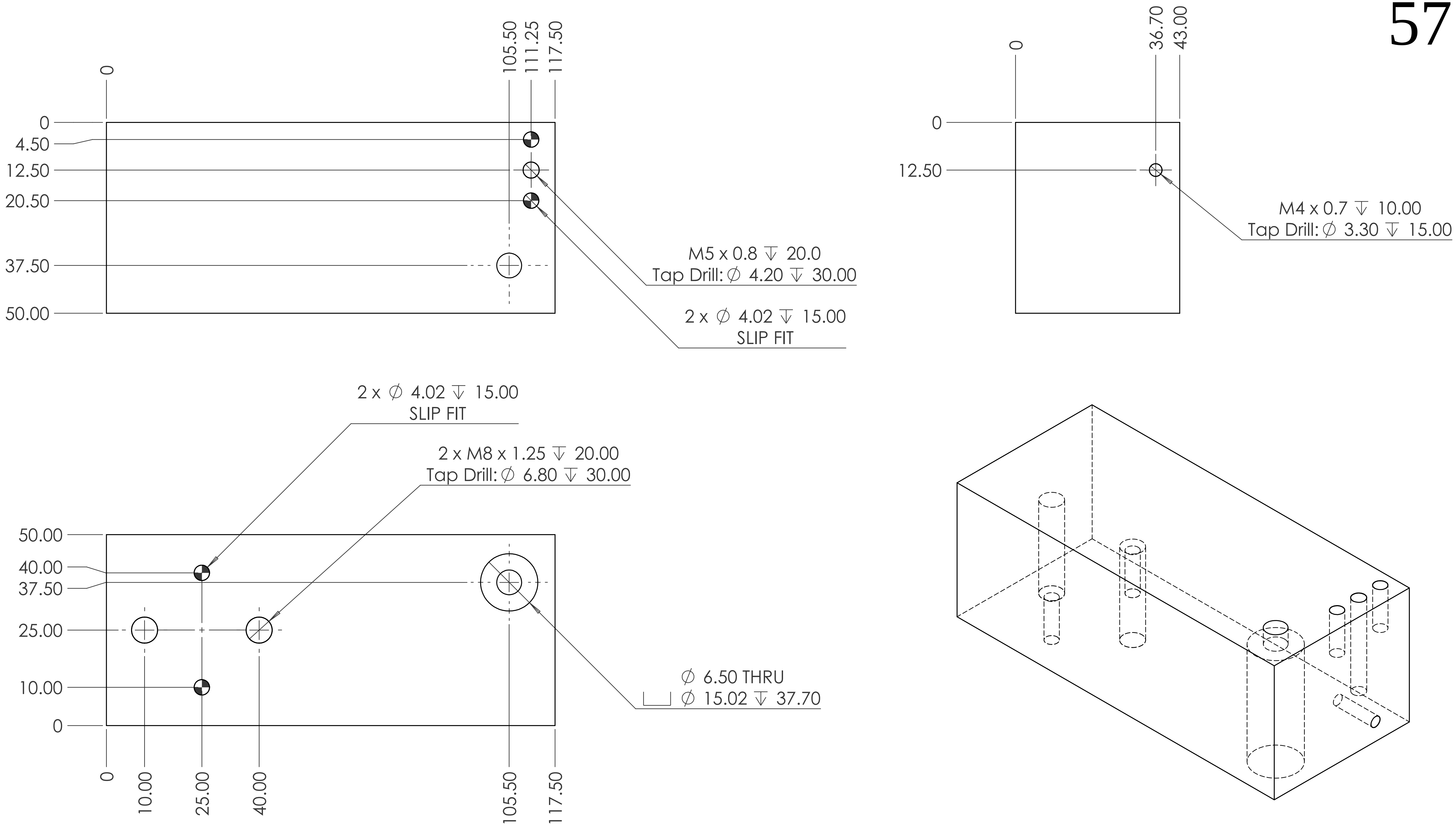

Swoboda, Inc. swoboda 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: ALUMINUM	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 1		PART NUMBER: A40-1400-11-018-003	PART NAME: Stop Block Left	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

SIZE A3

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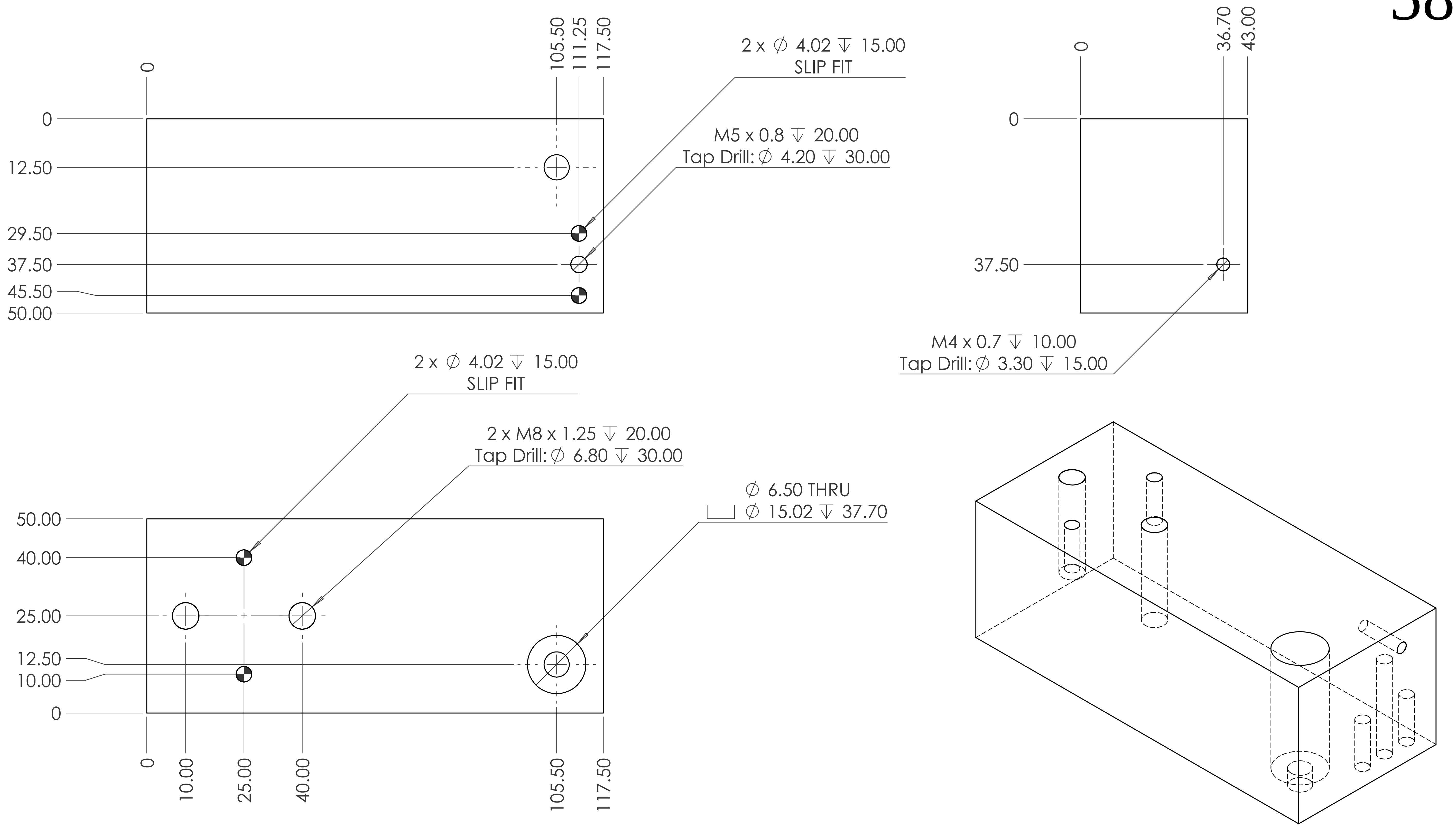

Swoboda, Inc.
4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093
swoboda

3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
	GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: ALUMINUM	HEAT TREAT: NO
ALL DIMENSIONS IN MM			
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO		REV: 0
QTY: 1	PART NUMBER: A40-1400-11-018-004	PART NAME: Stop Block Right	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1
SHEET: 1 OF 1			

SIZE A3

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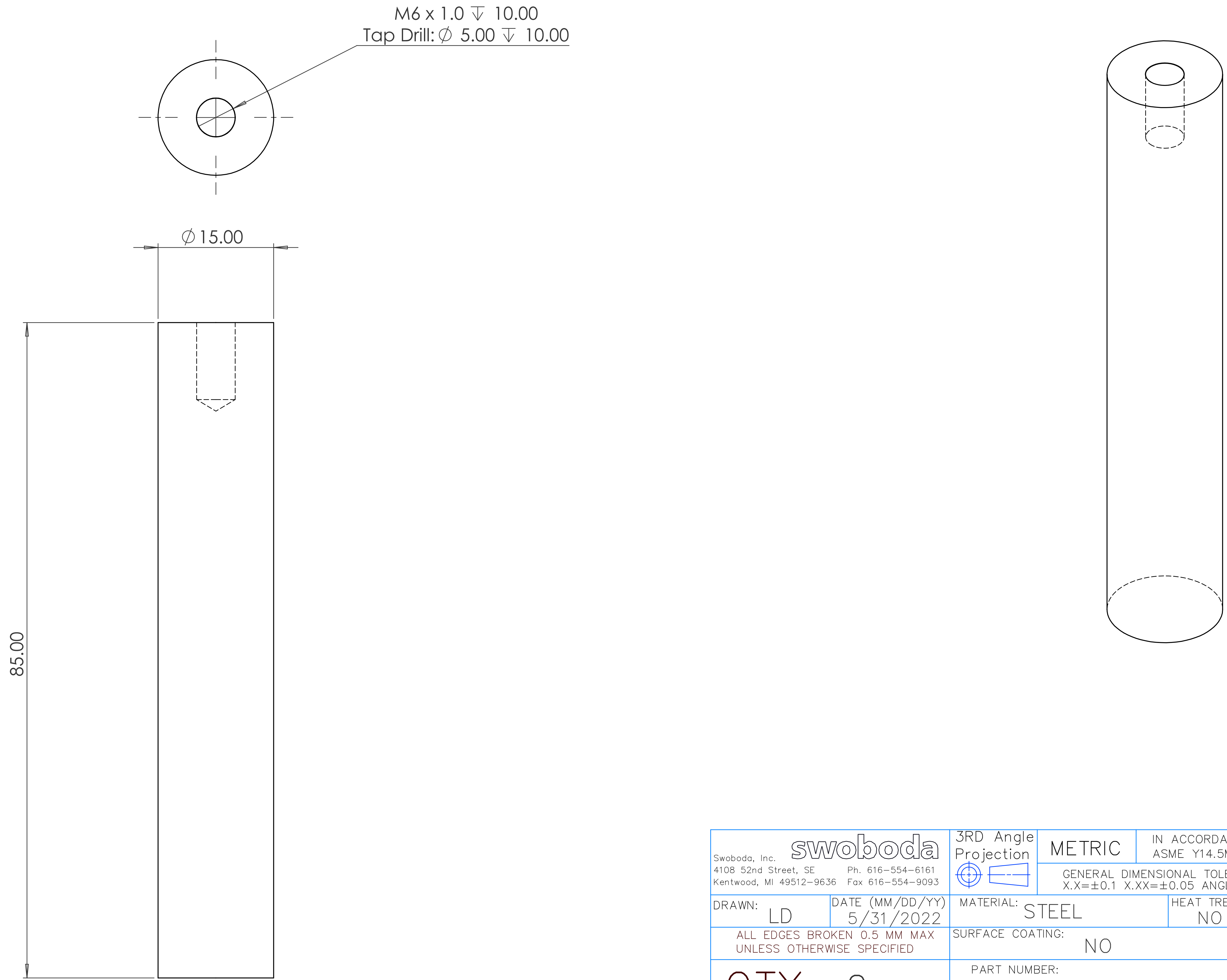

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Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

MASTER

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: STEEL

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-018-005

PART NAME: Stop Pin

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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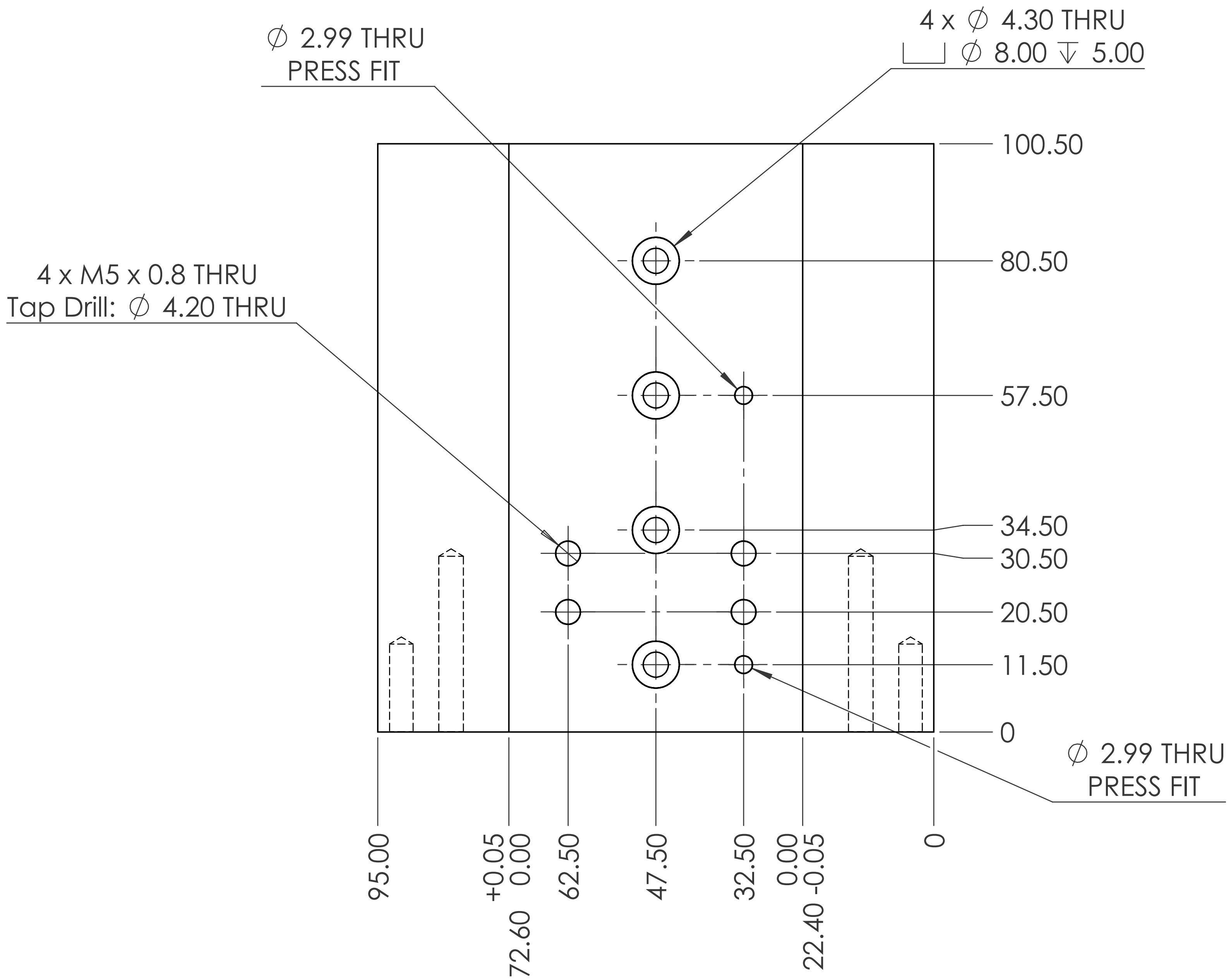

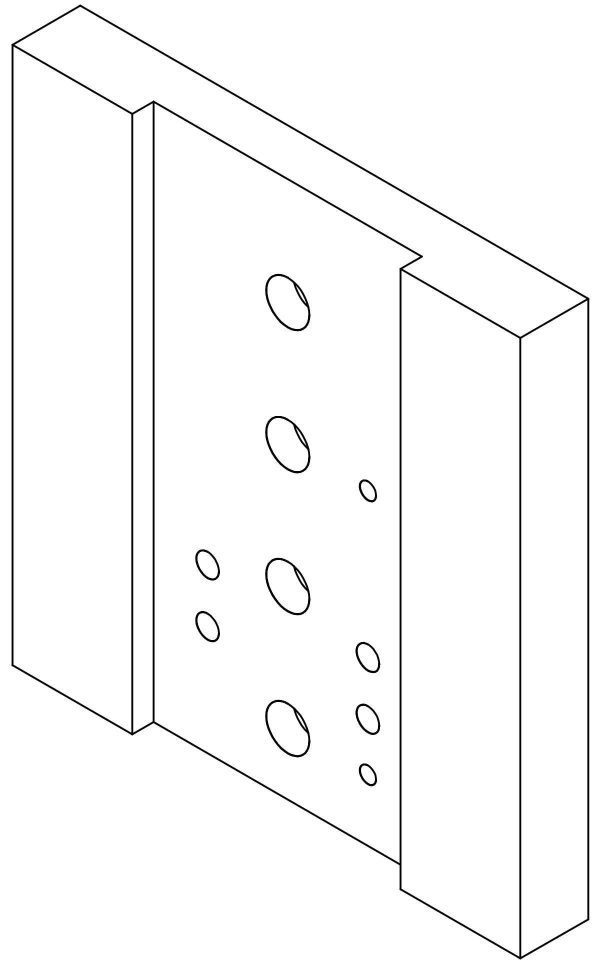

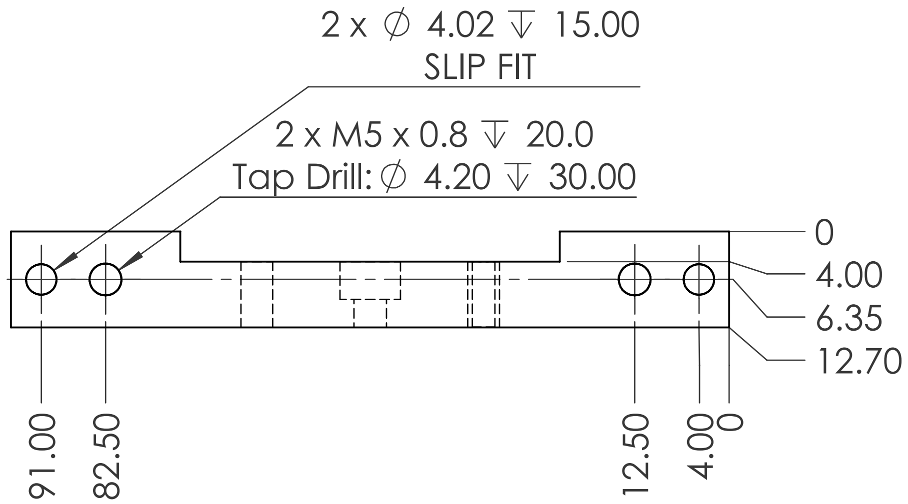

Swoboda, Inc. swoboda
4108 52nd Street, SE Ph. 616-554-6161
Kentwood, MI 49512-9636 Fax 616-554-9093

3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER	
	GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW	
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: MIC 6	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 1		PART NUMBER: A40-1400-11-018-006	PART NAME: Cyl. Support	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

SIZE A3

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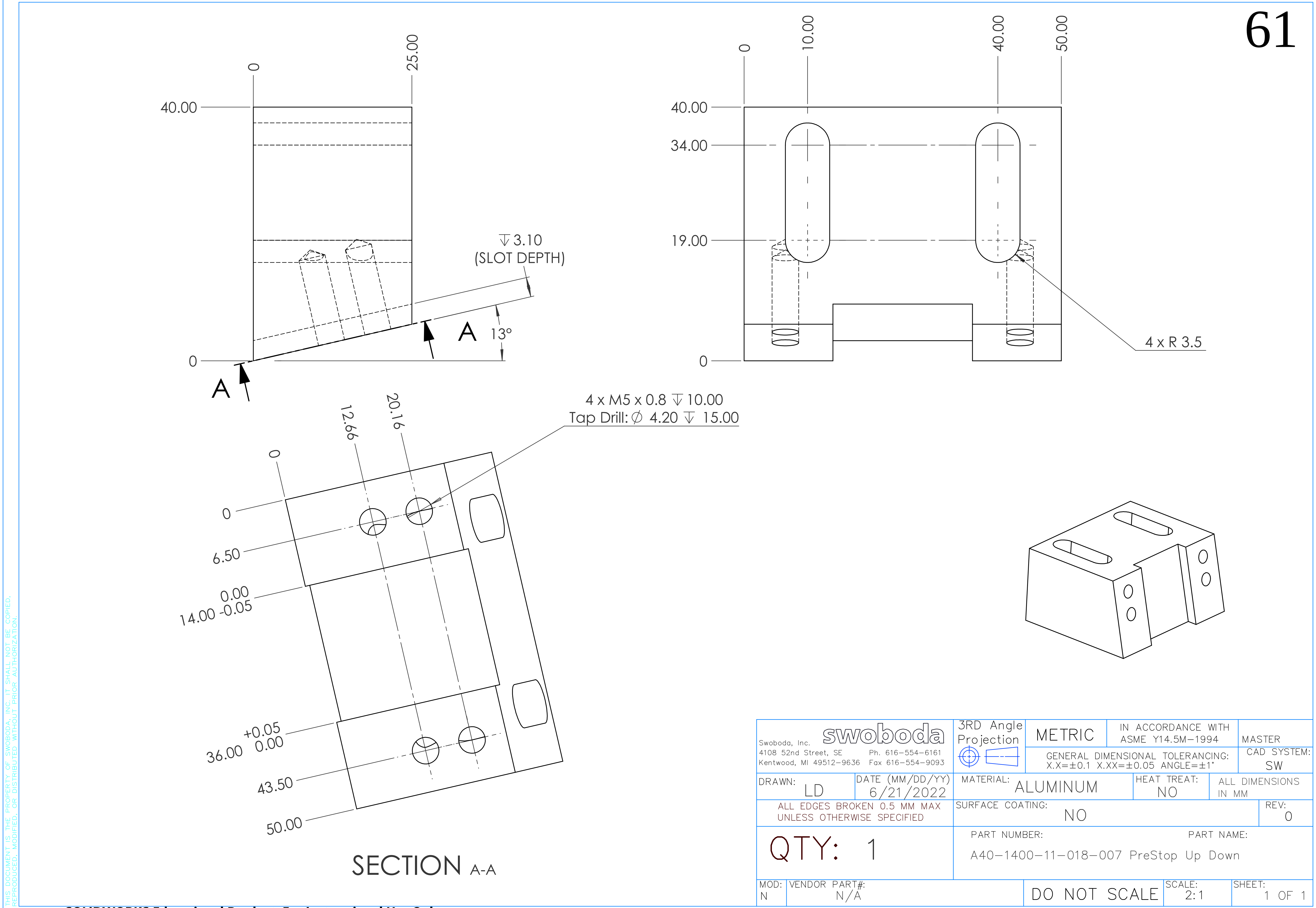

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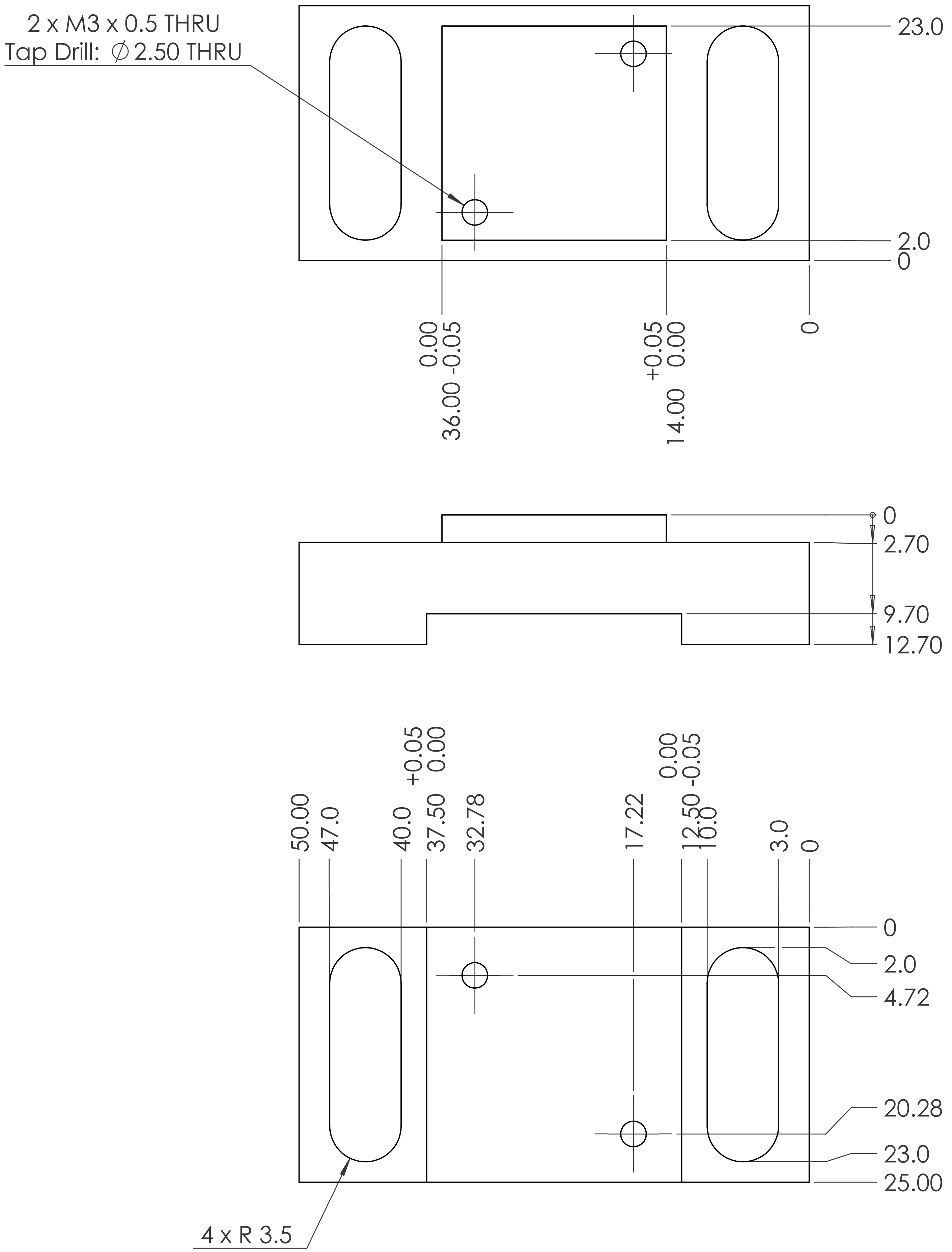

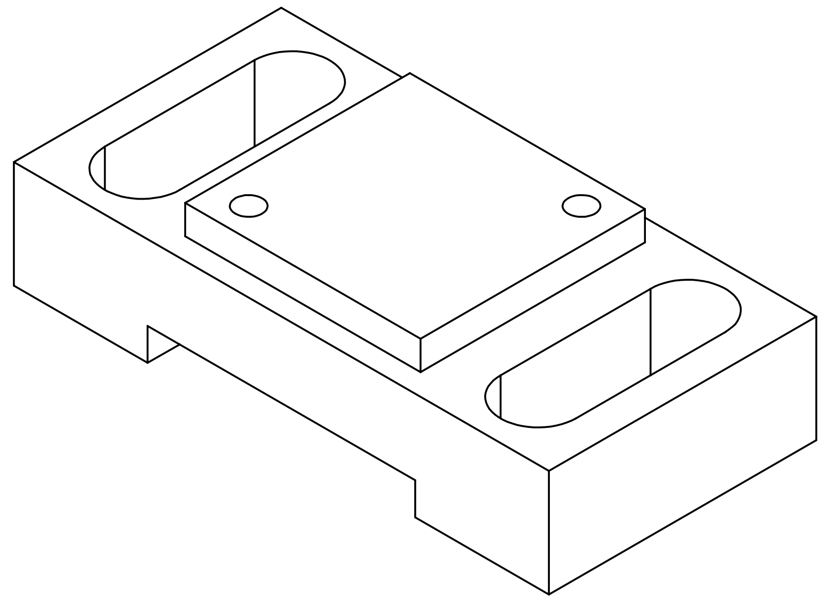

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swoboda
4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: MIC 6

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-018-008

PART NAME: PreStop In Out

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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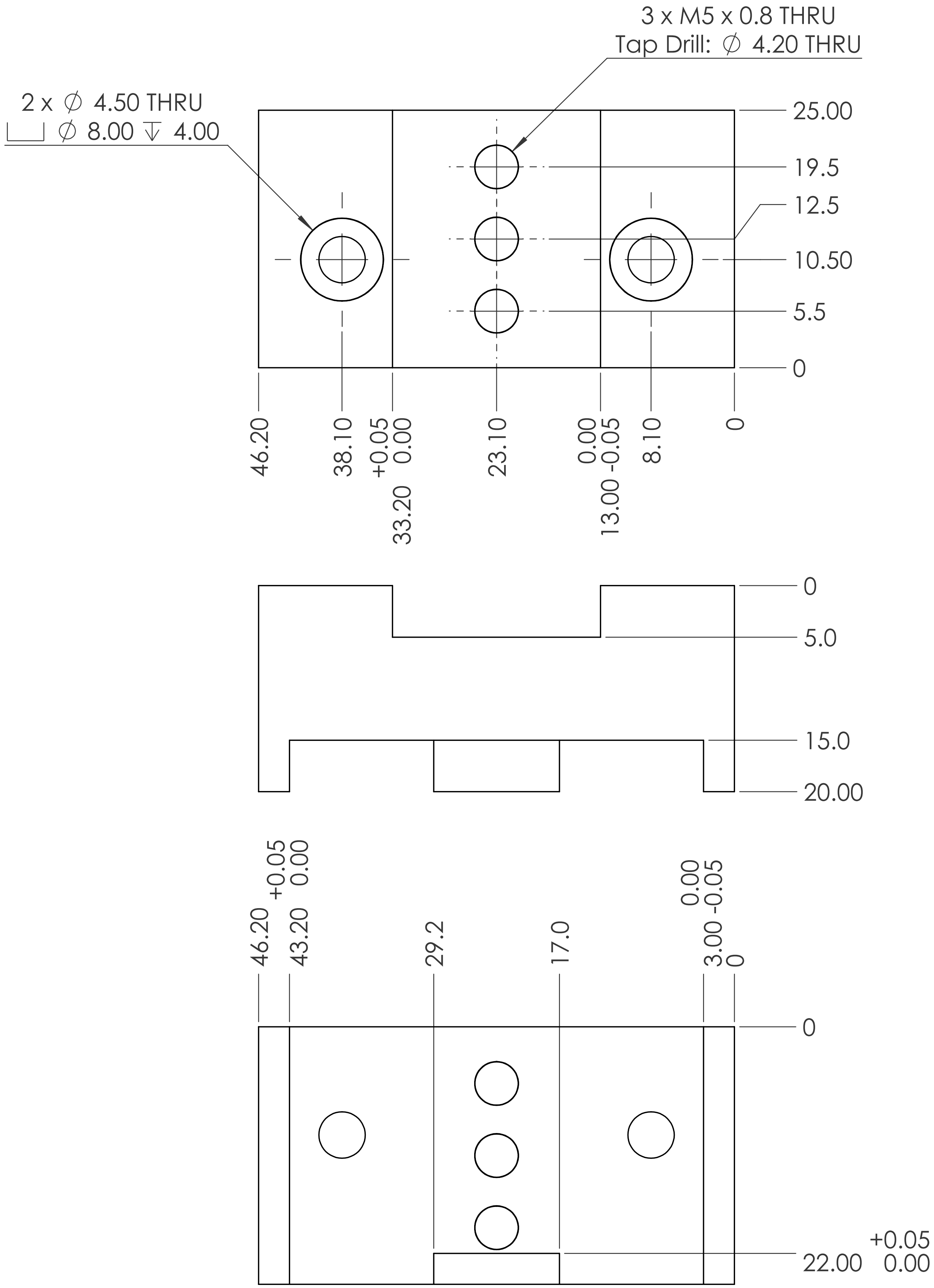

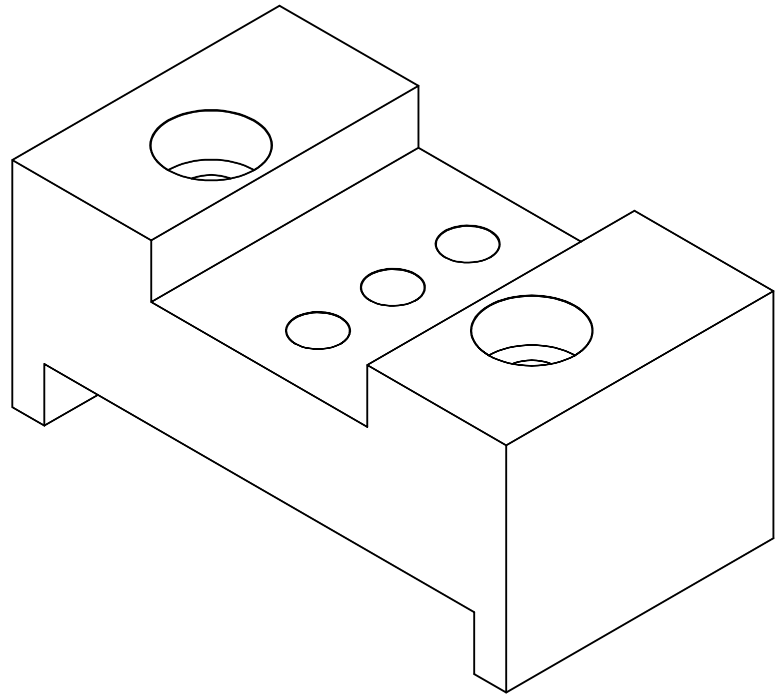

Swoboda, Inc. swoboda 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994 / GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER / CAD SYSTEM: SW
DRAWN: LD / DATE (MM/DD/YY) 5/31/2022	MATERIAL: ALUMINUM		HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO			REV: 0
QTY: 1	PART NUMBER: A40-1400-11-018-009		PART NAME: EndStop Base	
MOD: N / VENDOR PART#: N/A	DO NOT SCALE		SCALE: 2:1	SHEET: 1 OF 1

SIZE A3

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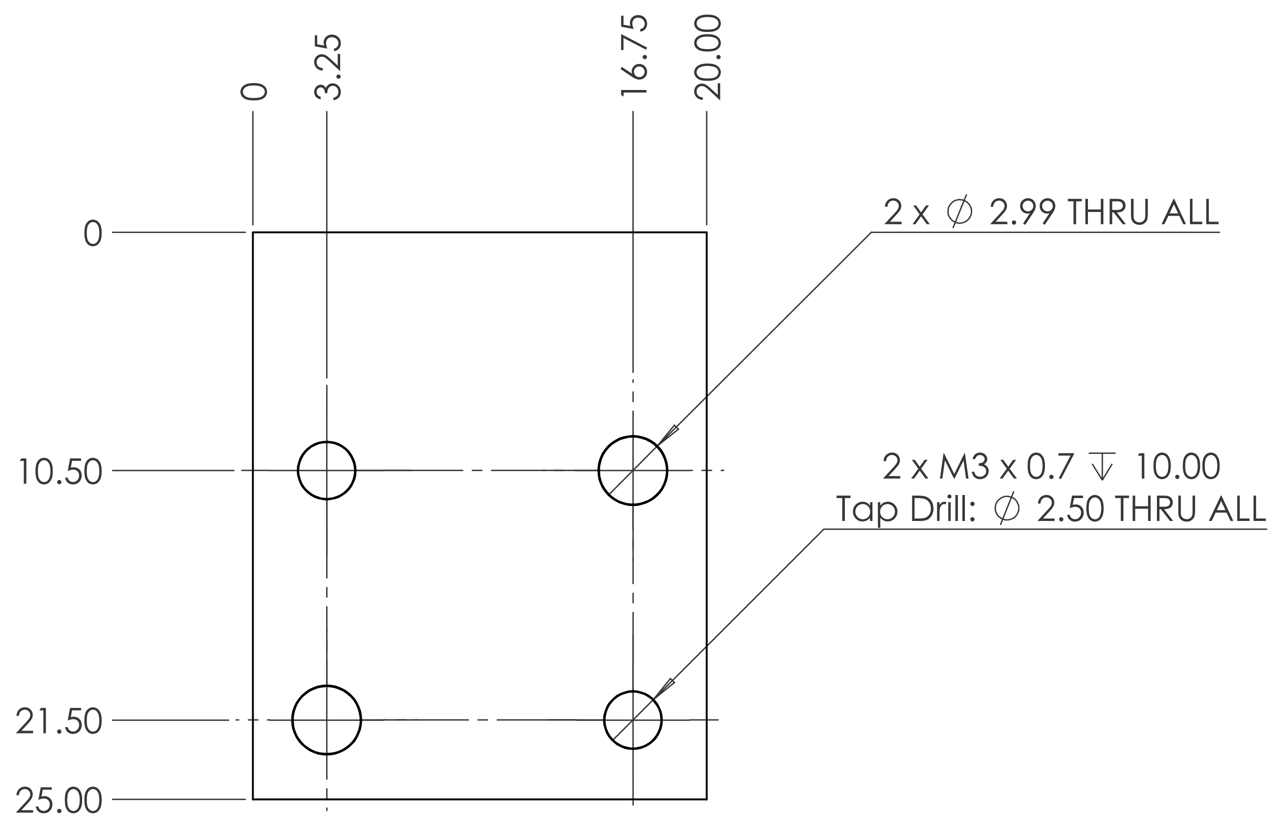

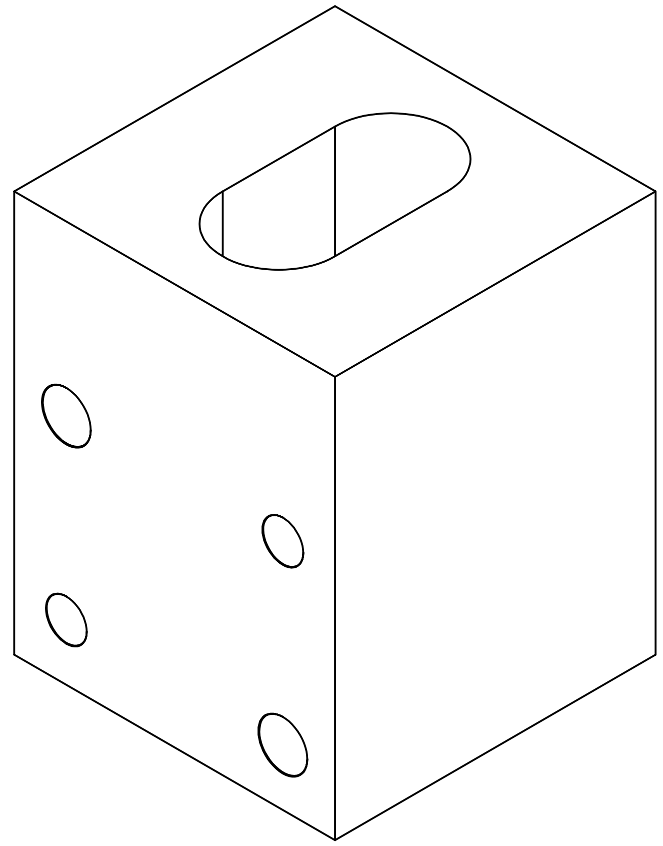

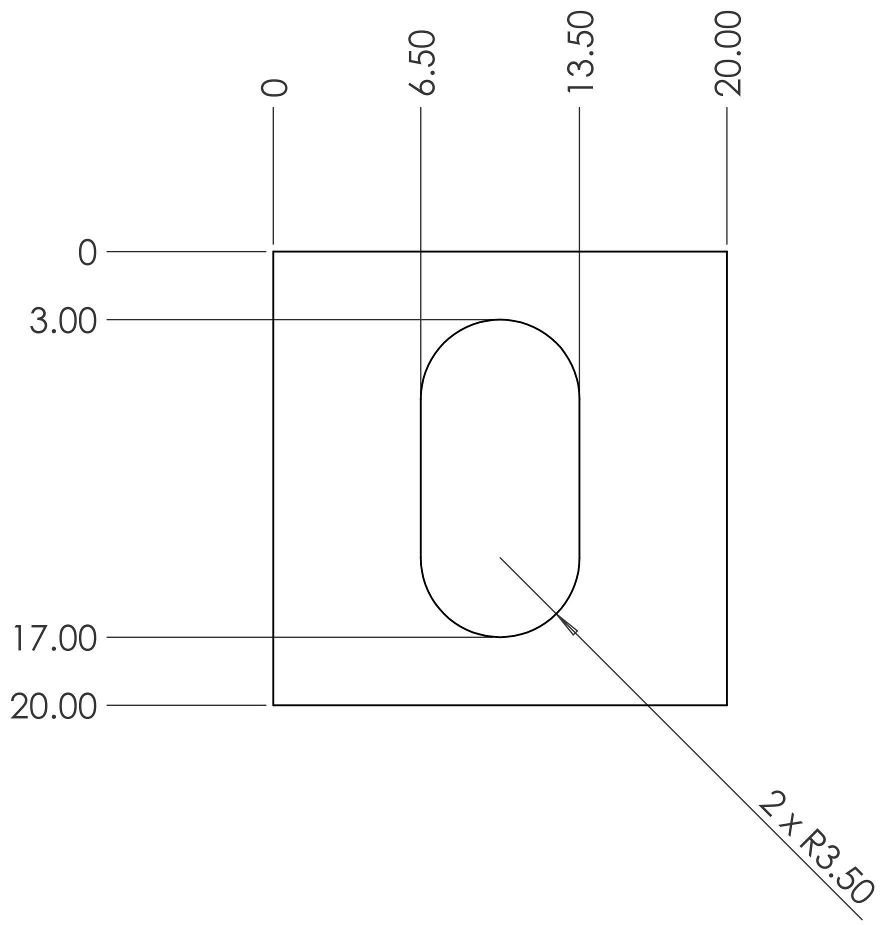

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4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: ALUMINUM

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-018-010

PART NAME: EndStop In Out

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 3:1

SHEET: 1 OF 1

SIZE A3

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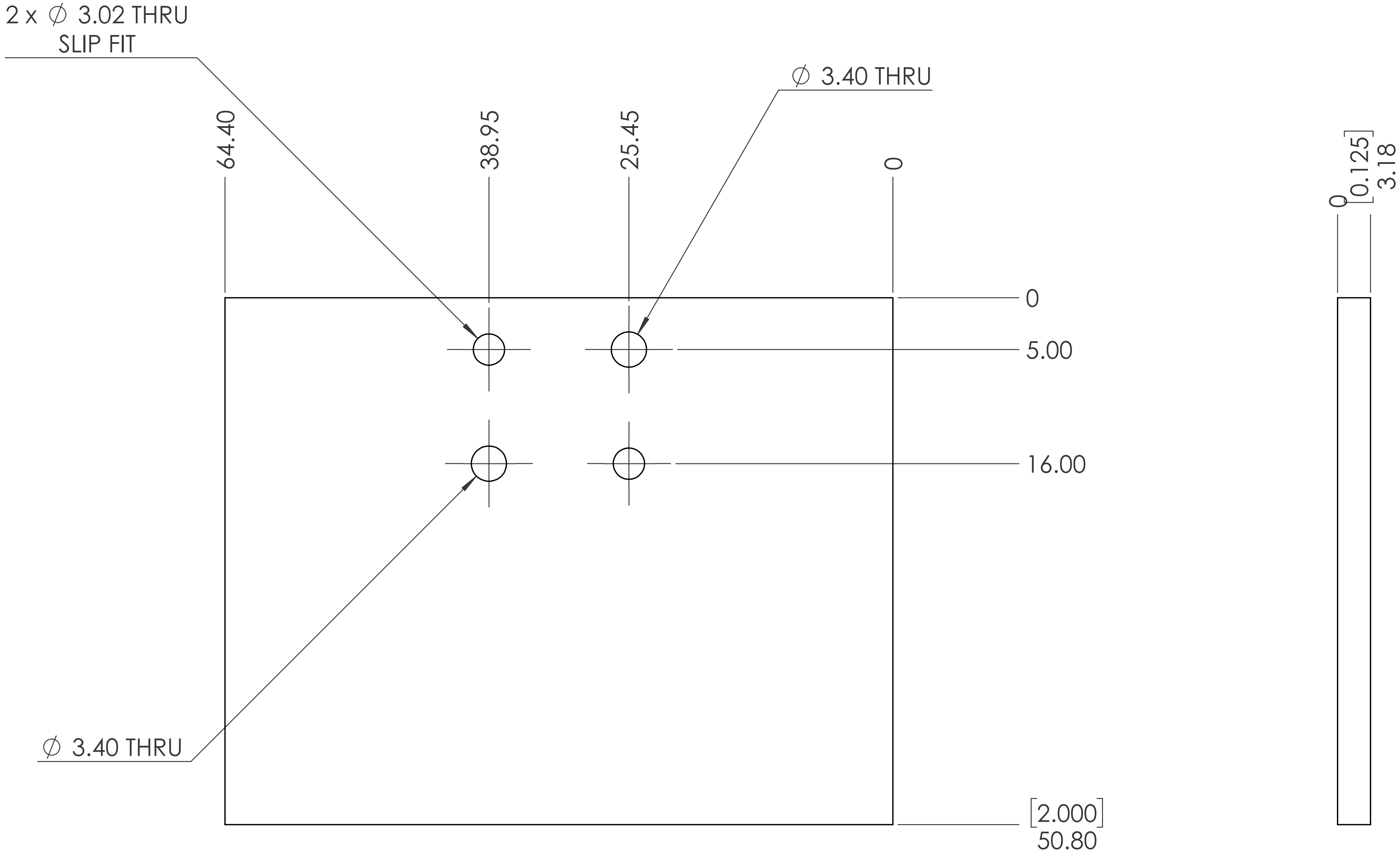

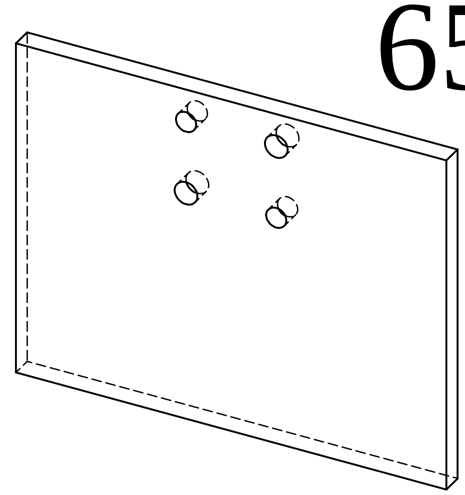

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Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: A2 Tool Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-018-011

PART NAME: EndStop

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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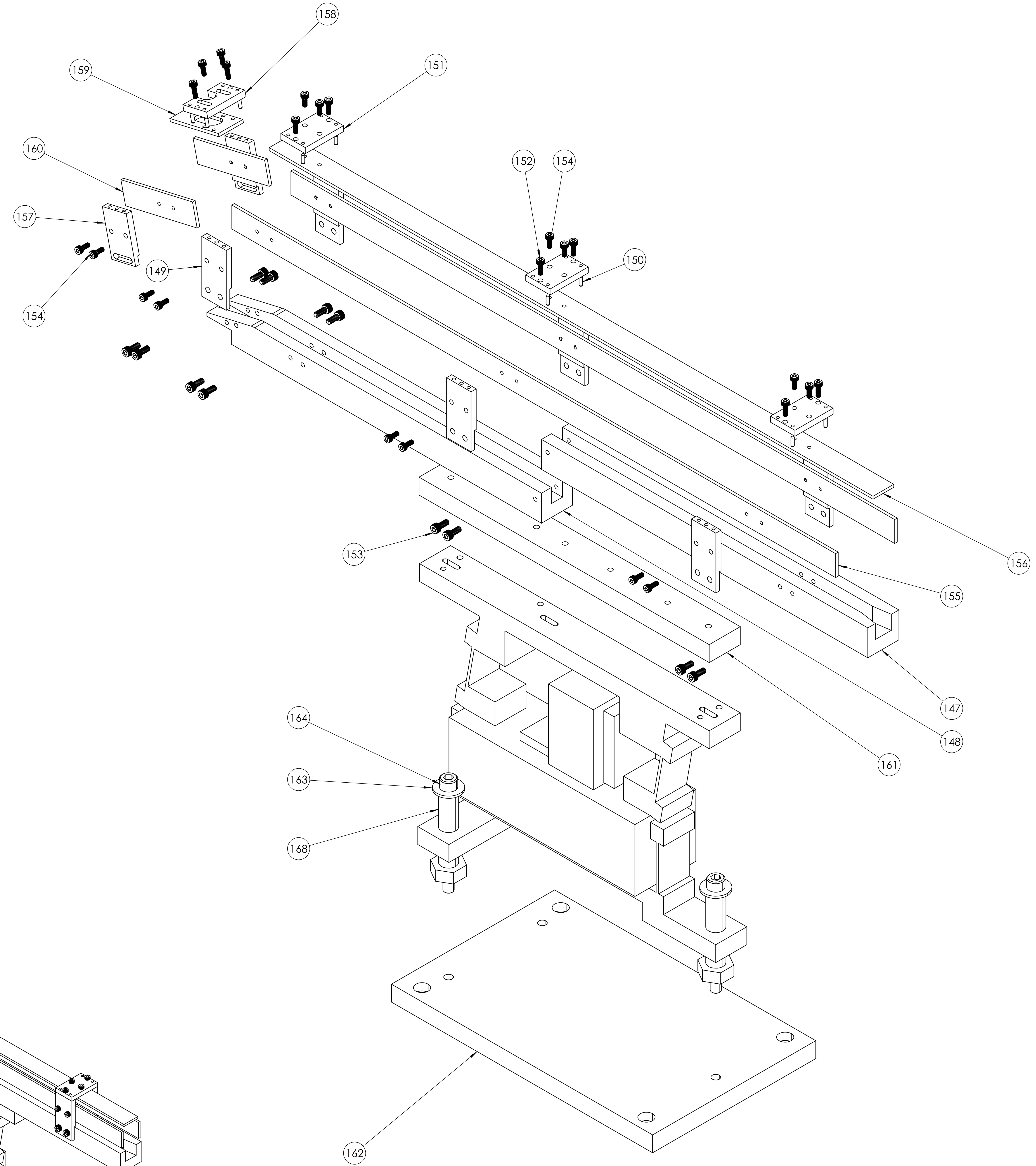

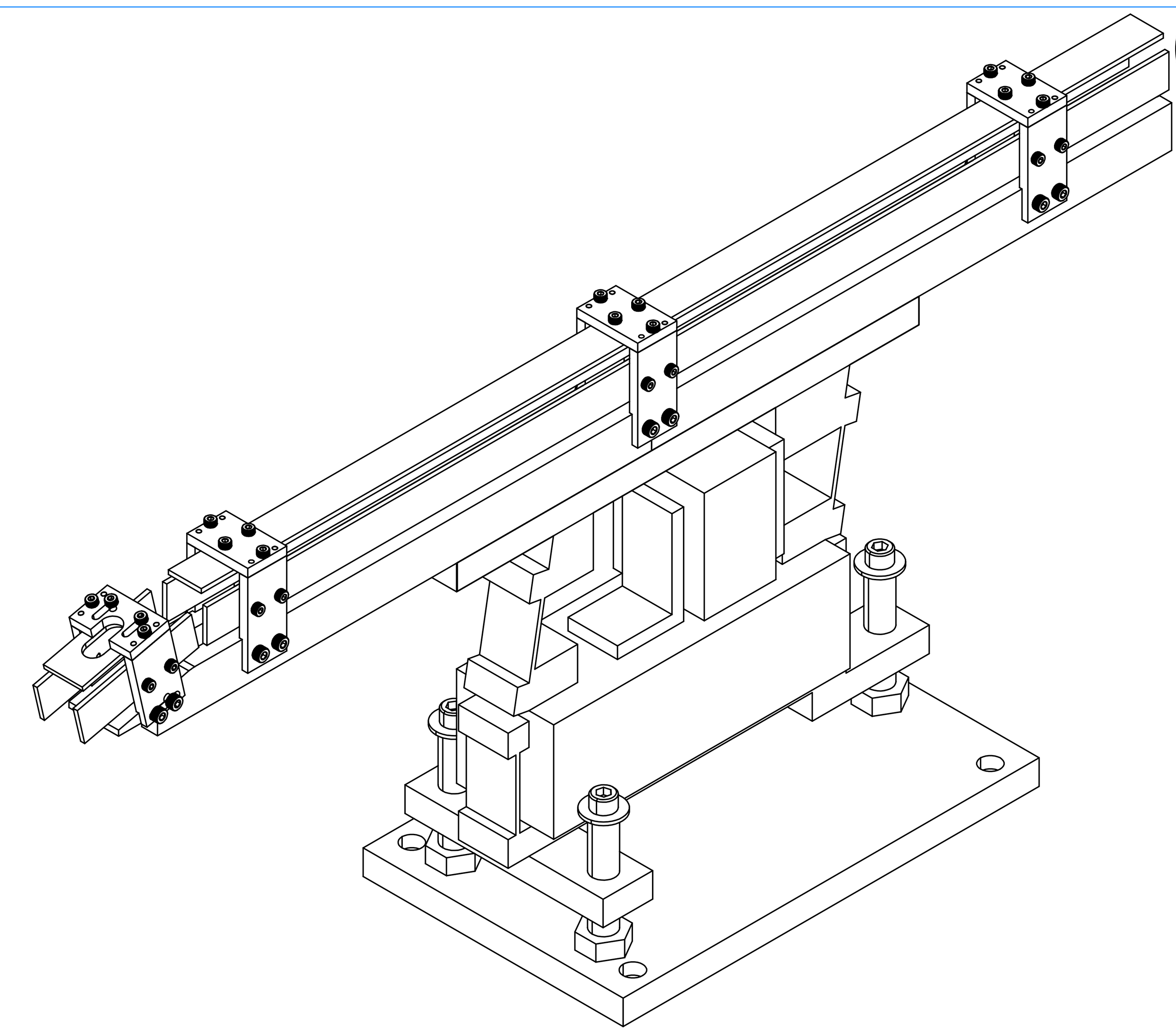

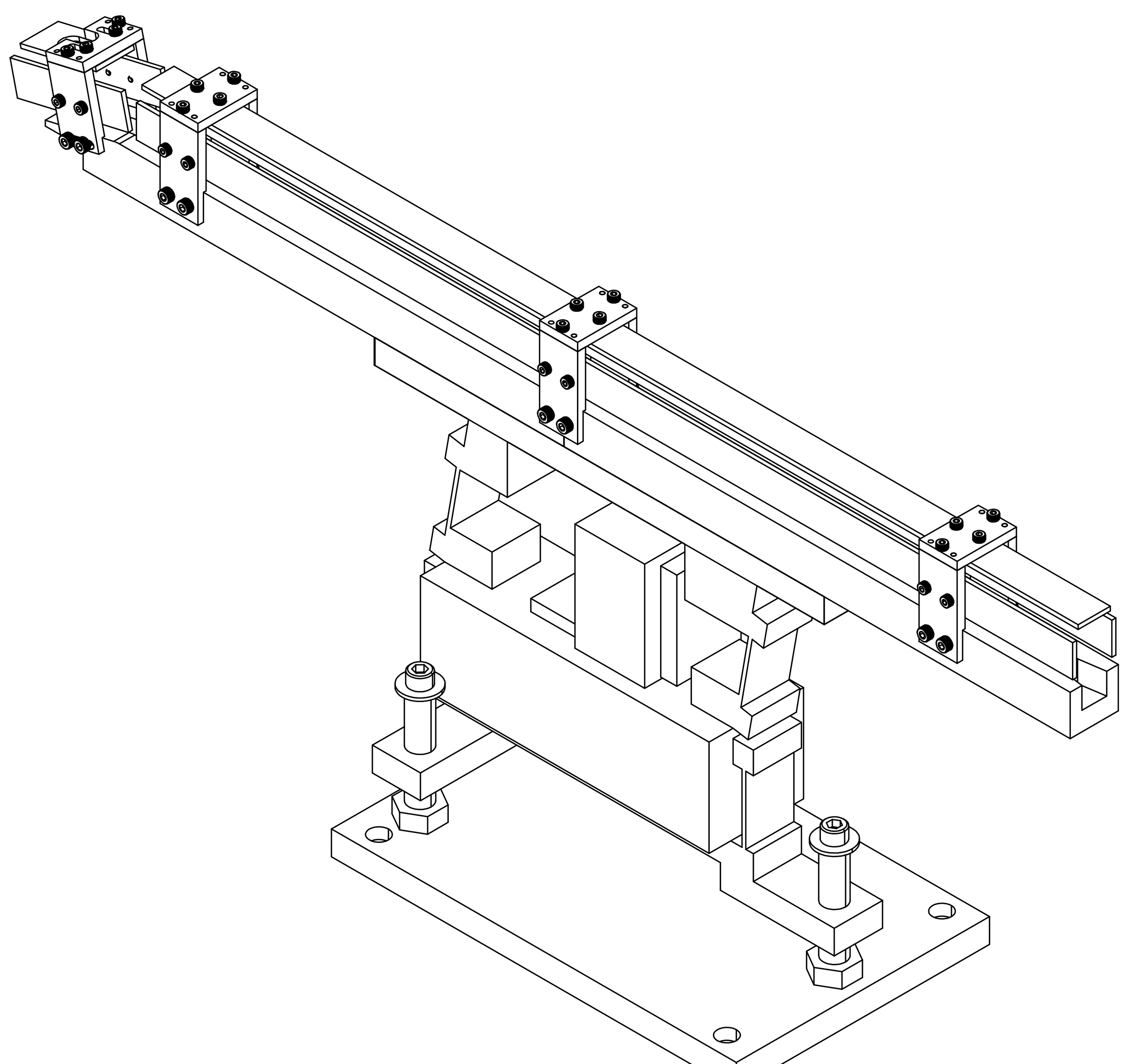

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
147	A40-1400-11-019-002 Rail Base Back		1
148	A40-1400-11-019-001 Rail Base Front		1
149	A40-1400-11-019-003 Srt Bracket side		6
150	91595A108	Dowel Pin	16
151	A40-1400-11-019-004 Srt Bracket Top		3
152	91290A148	Alloy Steel Socket Head Screw	8
153	91290A228	Alloy Steel Socket Head Screw	16
154	91290A144	Alloy Steel Socket Head Screw	24
155	A40-1400-11-019-007 Rail Side		2
156	A40-1400-11-019-008 Rail Top		1
157	A40-1400-11-019-005 Angle Bracket side		2
158	A40-1400-11-019-006 Angeled Bracket Top		1
159	A40-1400-11-019-0010 Top angle Rail		1
160	A40-1400-11-019-009 Side angle Rail		2
161	A40-1400-11-019-011 Vibe_Top_Connector		1
162	A40-1600-04-030-001 Vibe Base.stp.STEP		1
163	plain_washer_m10_r.stp.STEP		3
164	hex_soc_cap_scr_m10_x_110.stp.STEP		3
165	hex_soc_cap_scr_m5_x_25.stp.STEP		3
166	Dowel 5x10.stp.STEP		2
167	Wash 15OD-5.3ID-T3.stp.STEP		3
168	A40-1600-04-030-008 Vibe Gen.stp.STEP		1

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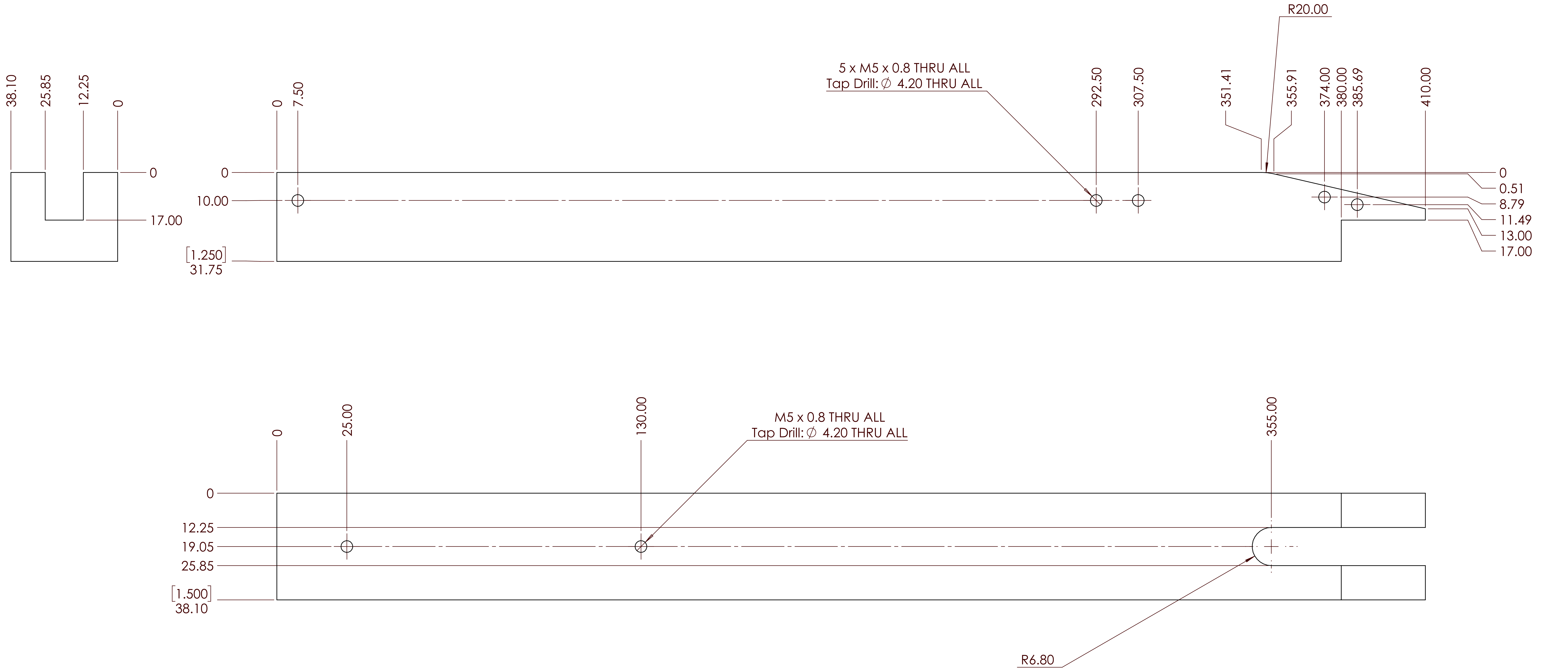
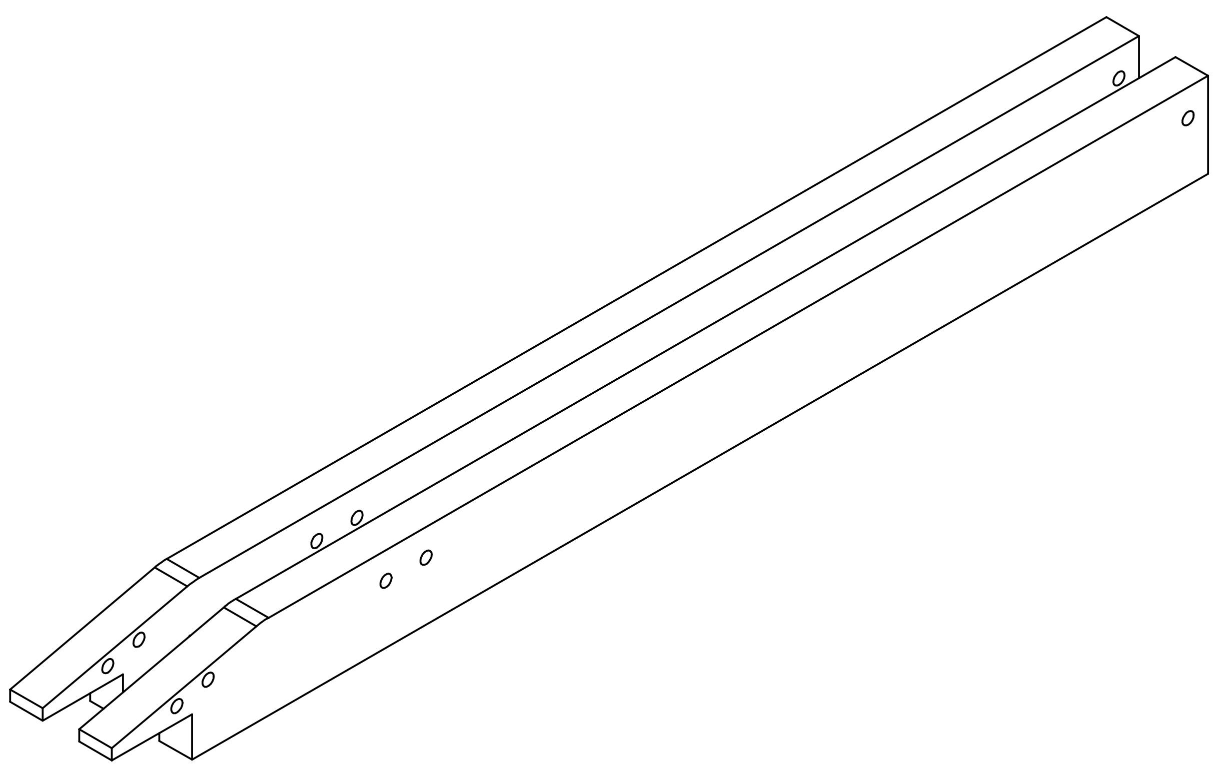
swoboda
Swoboda, Inc.
4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
	GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING NO		REV 0
QTY: 1	PART NUMBER SA-4	PART NAME	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:2
			SHEET 8 OF 11

SIZE A1





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swoboda
Swoboda, Inc.
4108 52nd Street, SE Ph. 616-554-6161
Kentwood, MI 49512-9636 Fax 616-554-9093

3RD ANGLE PROJECTION

METRIC
ALL DIMENSION IN MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM SW

DRAWN LAD

DATE (MM/DD/YY) 5/31/2022

MATERIAL A2 Tool Steel

HEAT TREAT 54-56

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING NO

REV 0

QTY: 1

PART NUMBER A40-1400-11-019-001

PART NAME Rail Base Front

MOD N

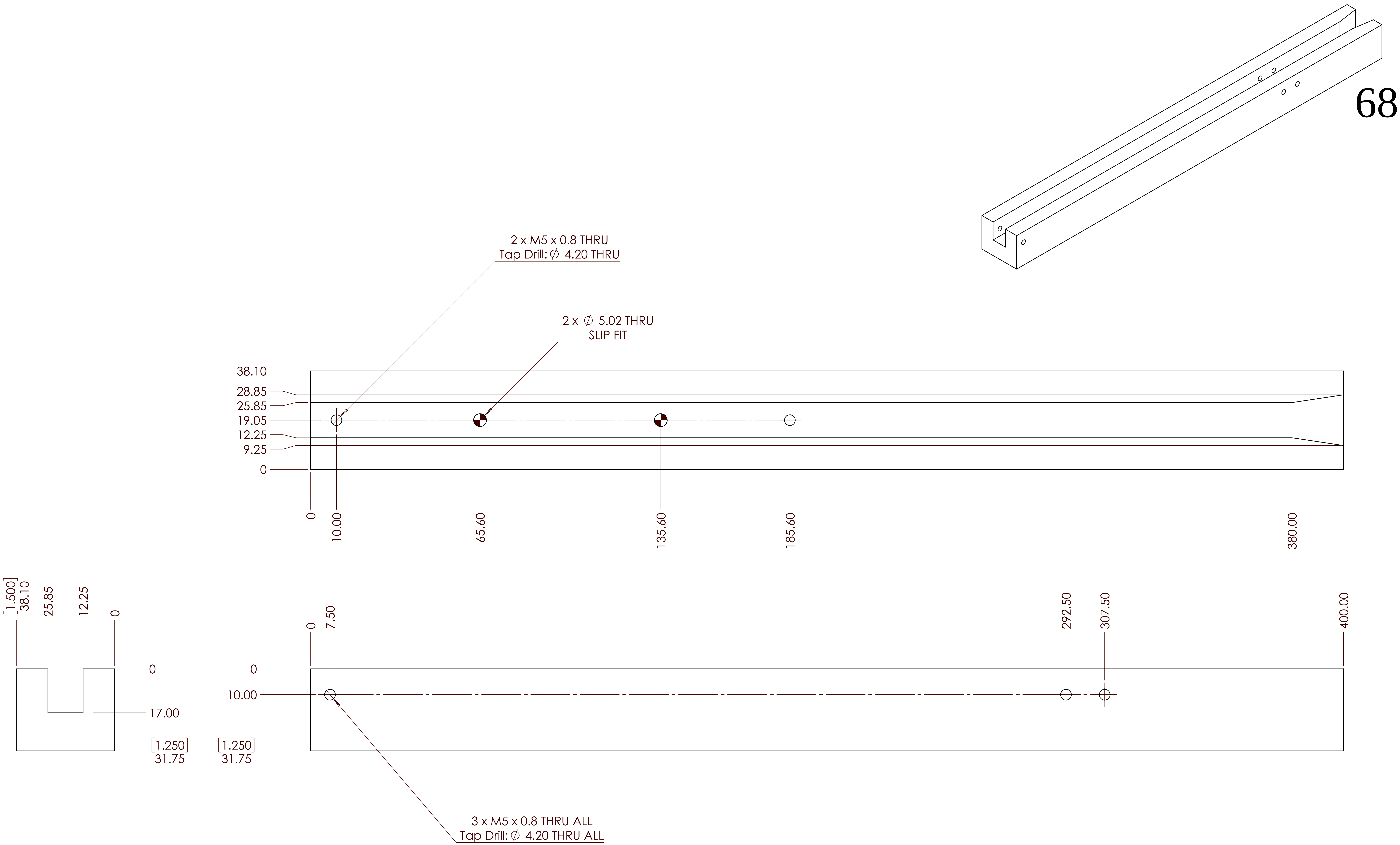
VENDOR PART# N/A

DO NOT SCALE

SCALE 1:1

SHEET 1 OF 1

SIZE A2



swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL A2 Tool Steel	HEAT TREAT 54-56	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-019-002	PART NAME Rail Base Back	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 1

SIZE A2

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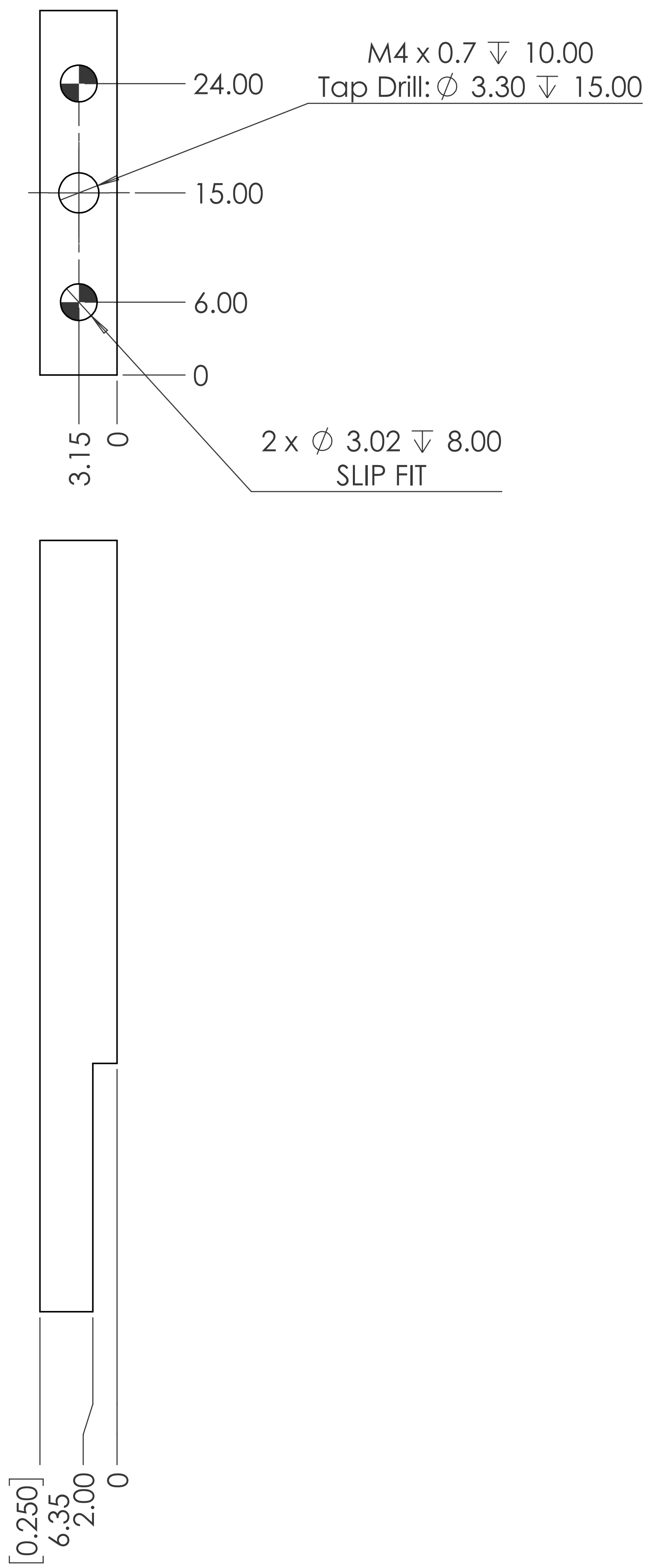

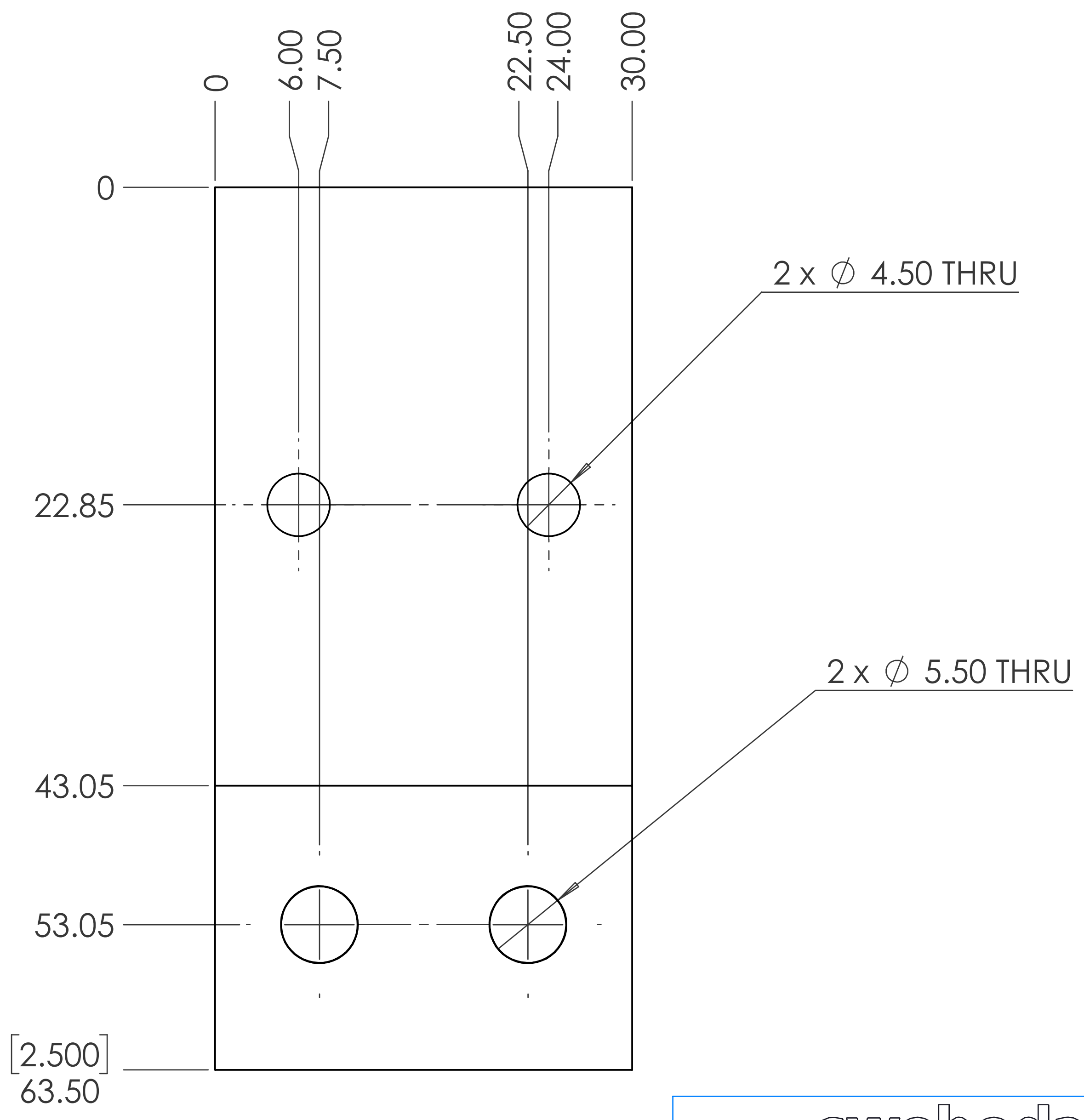

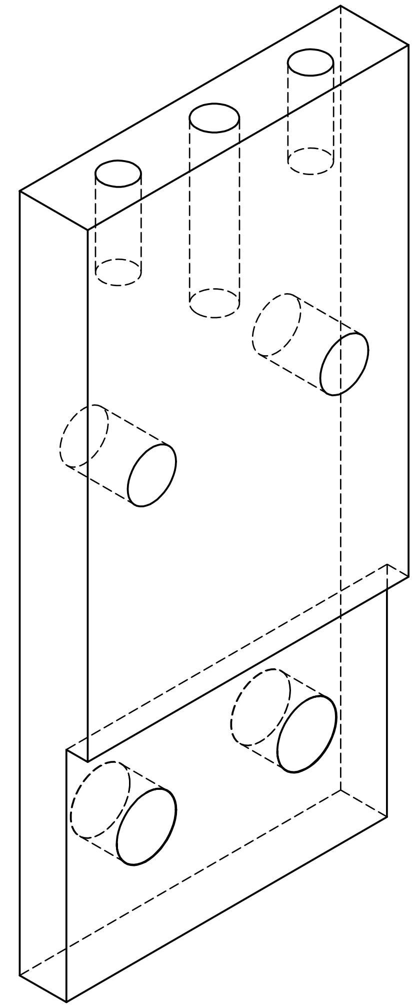

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: 1018 CRS	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: Black Oxide		REV: 0
QTY: 6		PART NUMBER: A40-1400-11-019-003	PART NAME: Srt Bracket side	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 2:1	SHEET: 1 OF 1

SIZE A3

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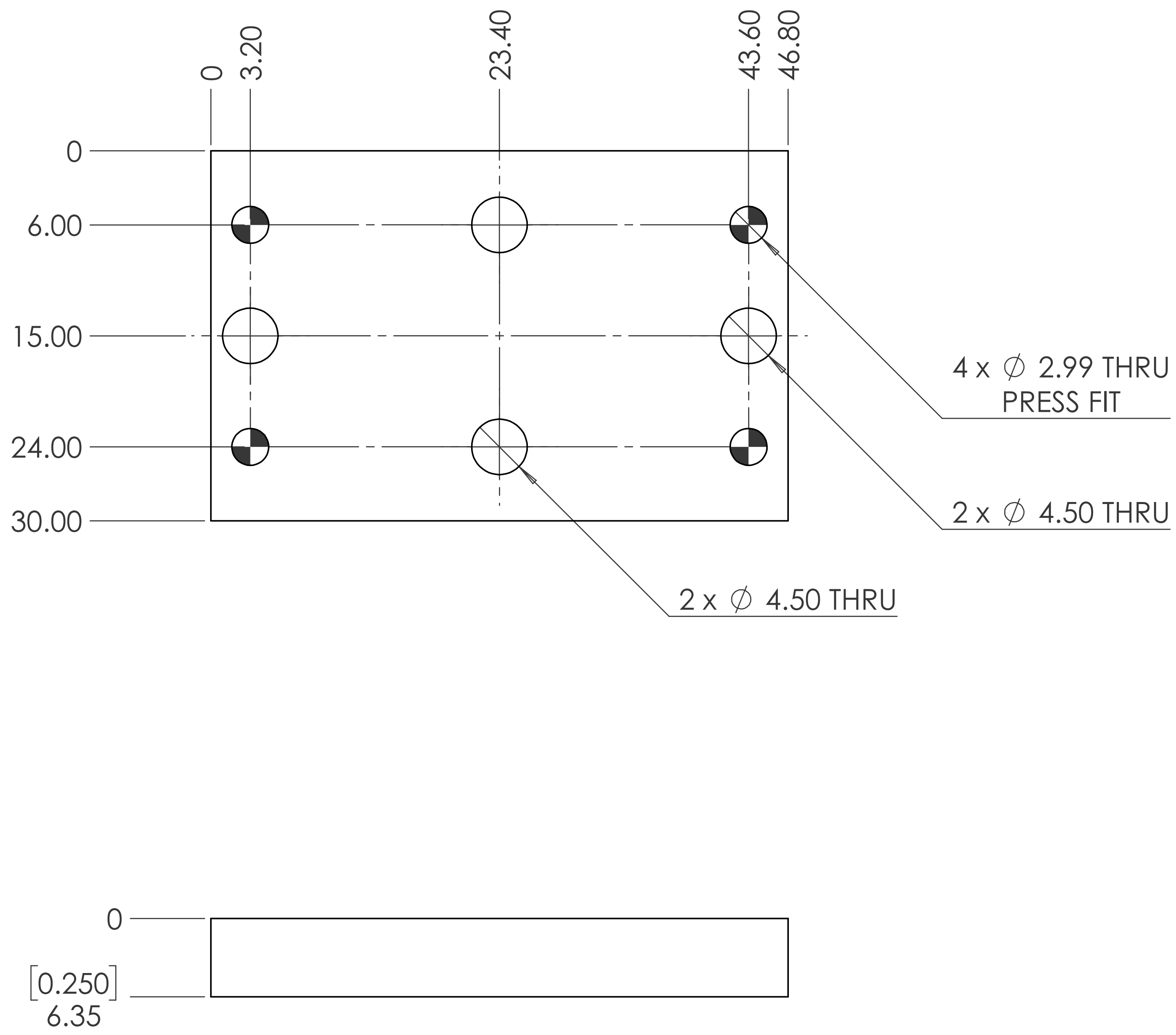

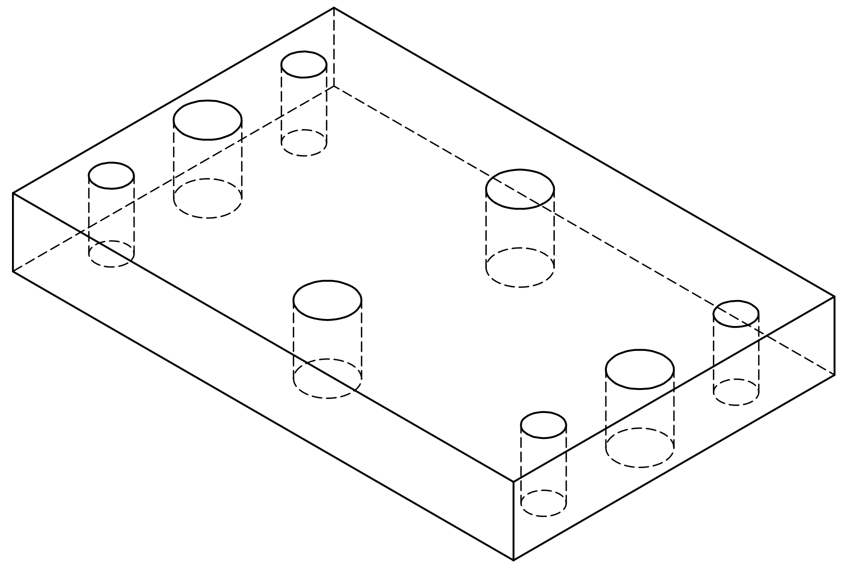

Swoboda, Inc. swoboda
4108 52nd Street, SE Ph. 616-554-6161
Kentwood, MI 49512-9636 Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: 1018 CRS

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 3

PART NUMBER: A40-1400-11-019-004

PART NAME: Srt Bracket Top

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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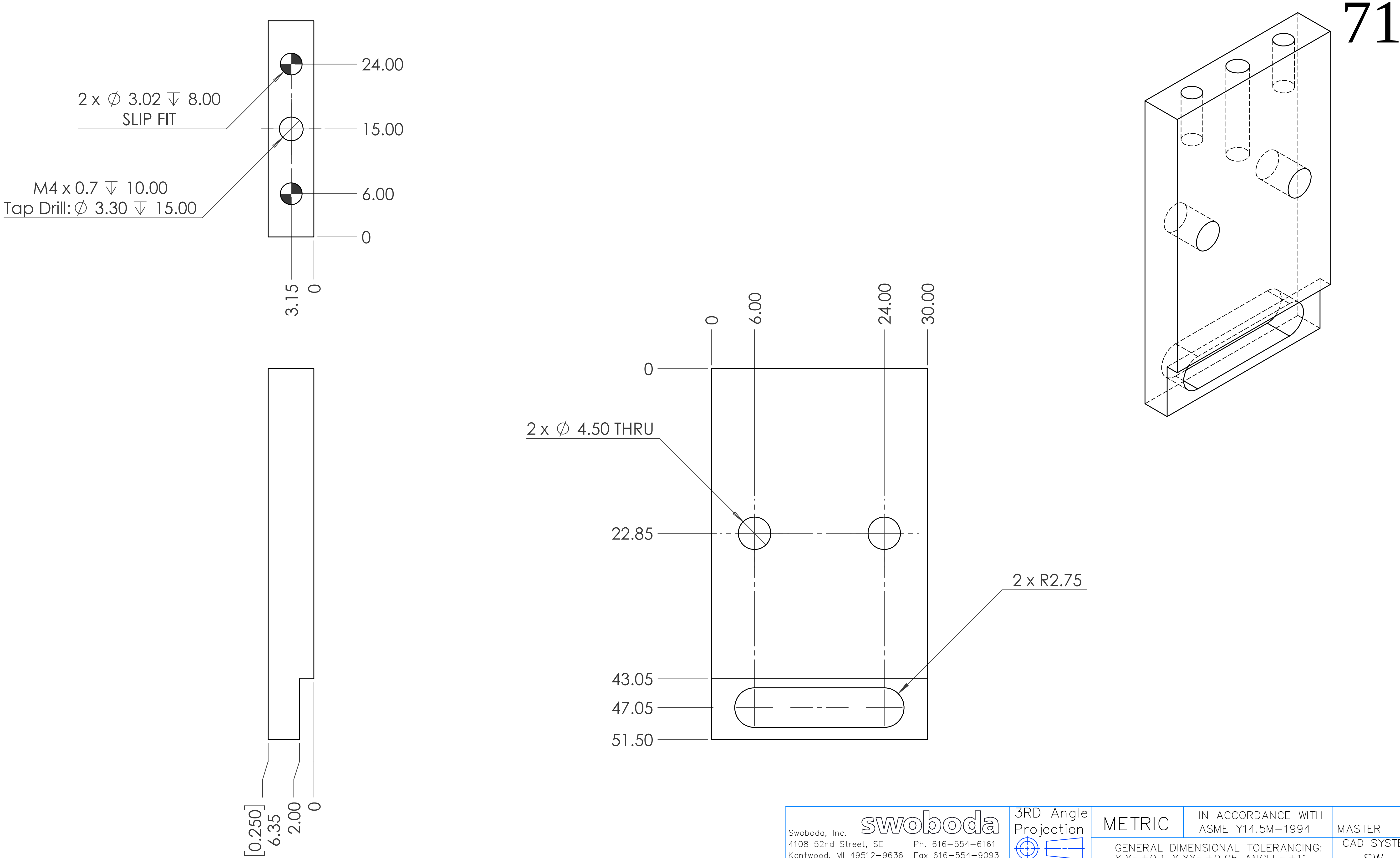

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616–554–6161 Kentwood, MI 49512–9636 Fax 616–554–9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M–1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: 1018 CRS	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: Black Oxide			REV: 0
QTY: 2	PART NUMBER: A40–1400–11–019–005	PART NAME: Angle Bracket side		
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 2:1	SHEET: 1 OF 1

SIZE A3

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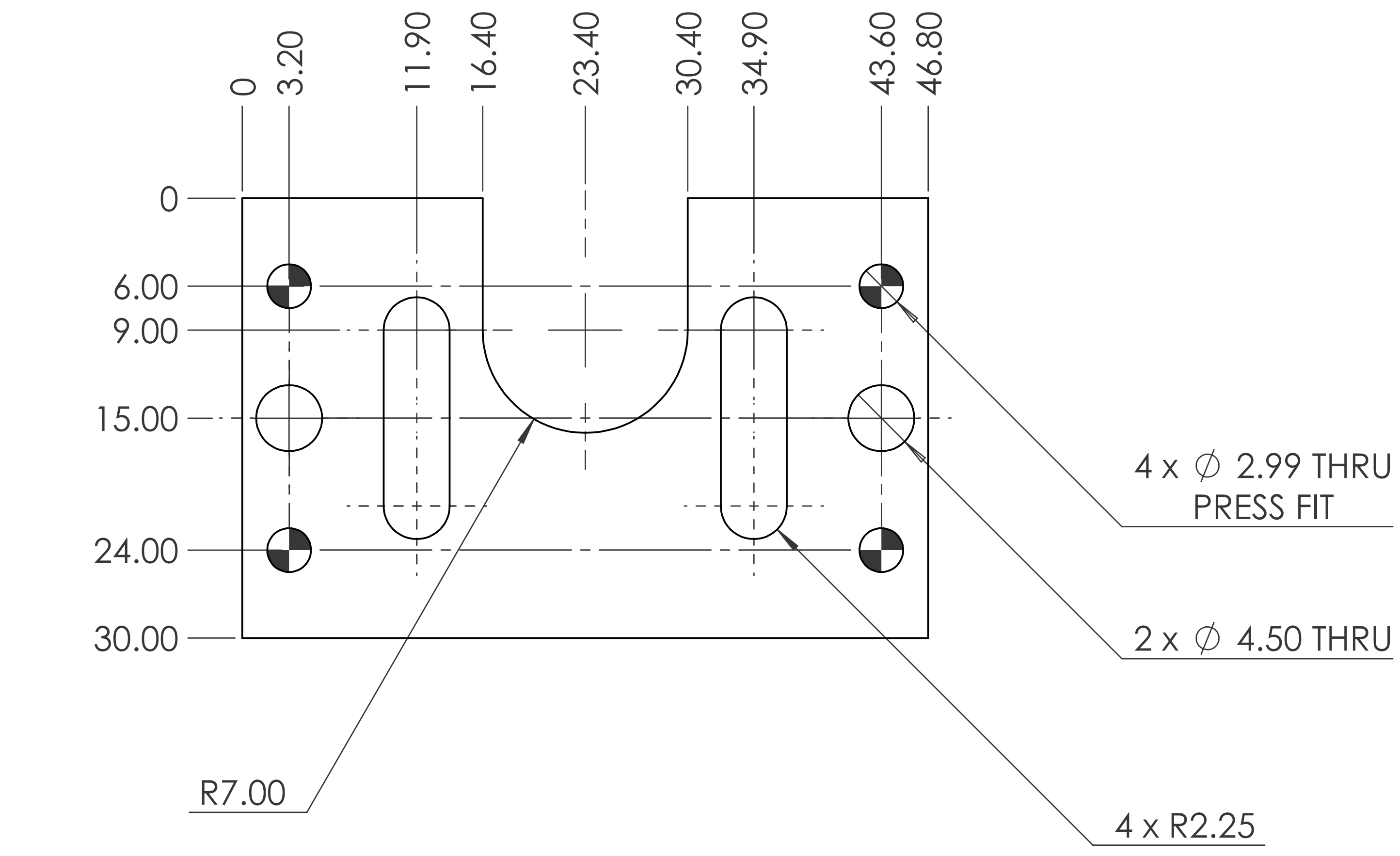

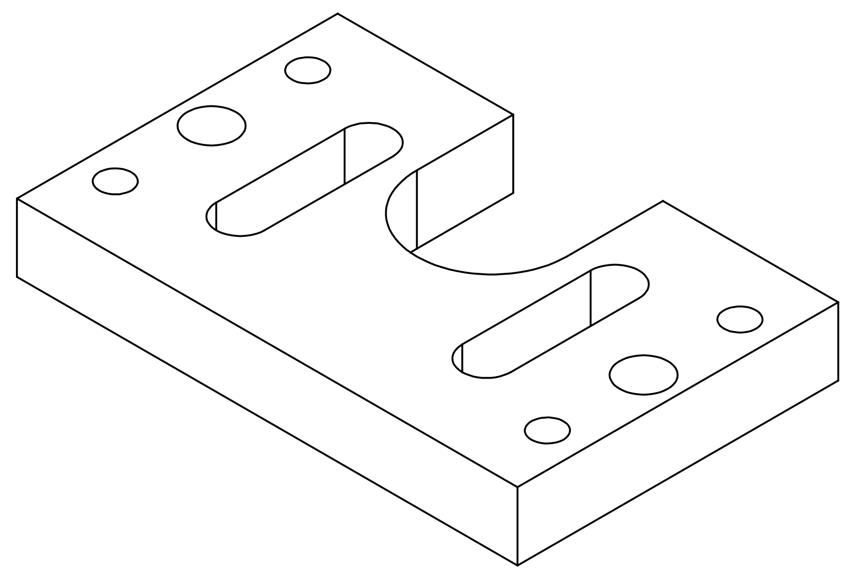

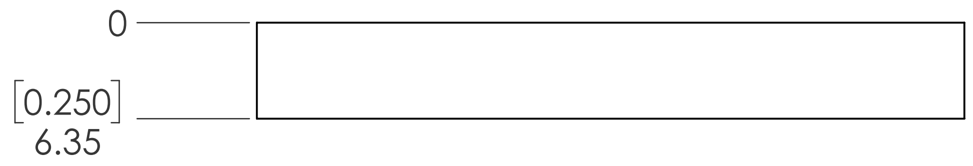

Swoboda, Inc.
4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

MASTER

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: 1018 CRS

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: Black Oxide

REV: 0

QTY: 1

PART NUMBER: A40-1400-11-019-006

PART NAME: Angeled Bracket Top

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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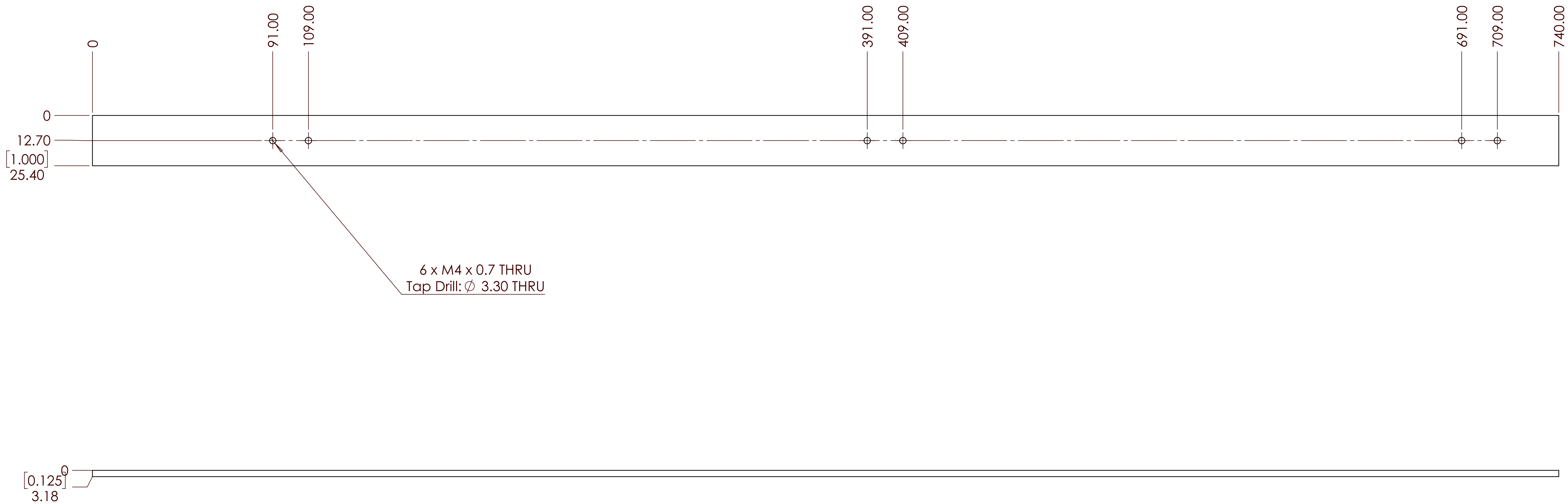

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LAD	DATE (MM/DD/YY) 5/31/2022	MATERIAL A2 Tool Steel	HEAT TREAT 54-56	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 3		PART NUMBER A40-1400-11-019-007	PART NAME Rail Side	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1.5	SHEET 1 OF 1

SIZE A2

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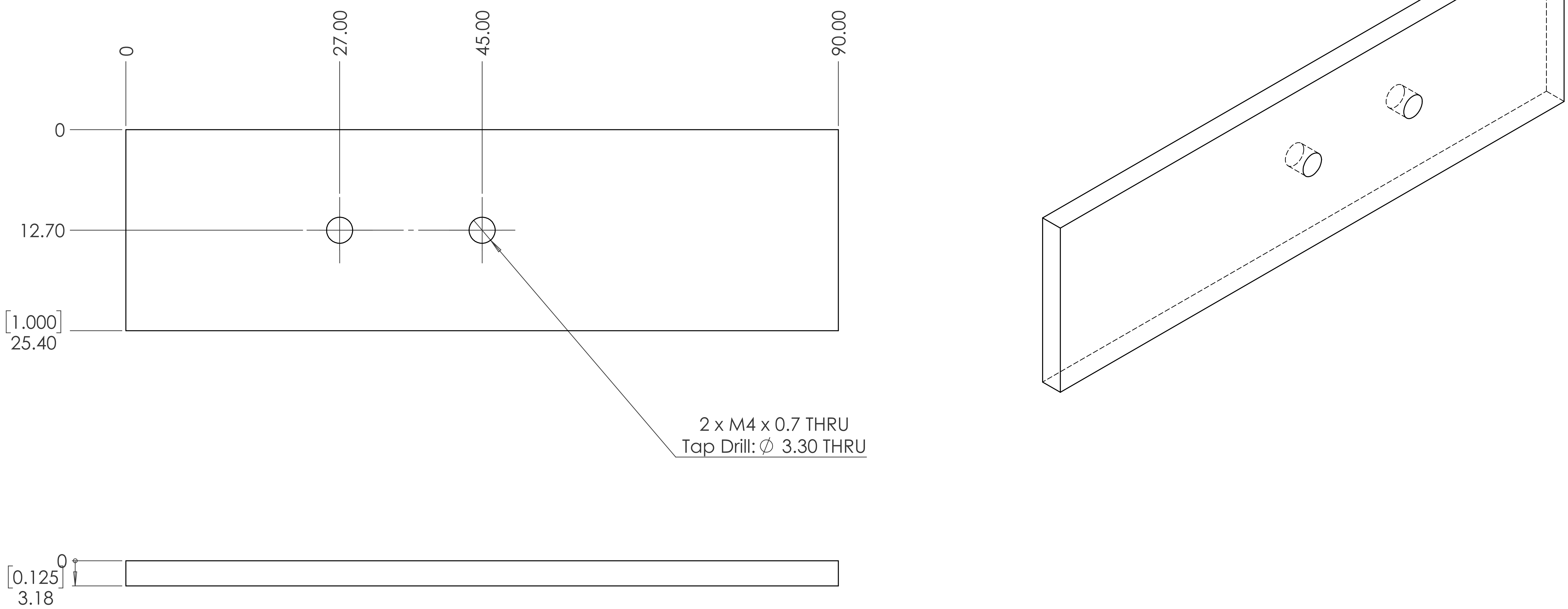

Swoboda, Inc. swoboda 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: A2 Tool Steel	HEAT TREAT: 54-56	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 2		PART NUMBER: A40-1400-11-019-009	PART NAME: Side angle Rail	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 2:1	SHEET: 1 OF 1

SIZE A3

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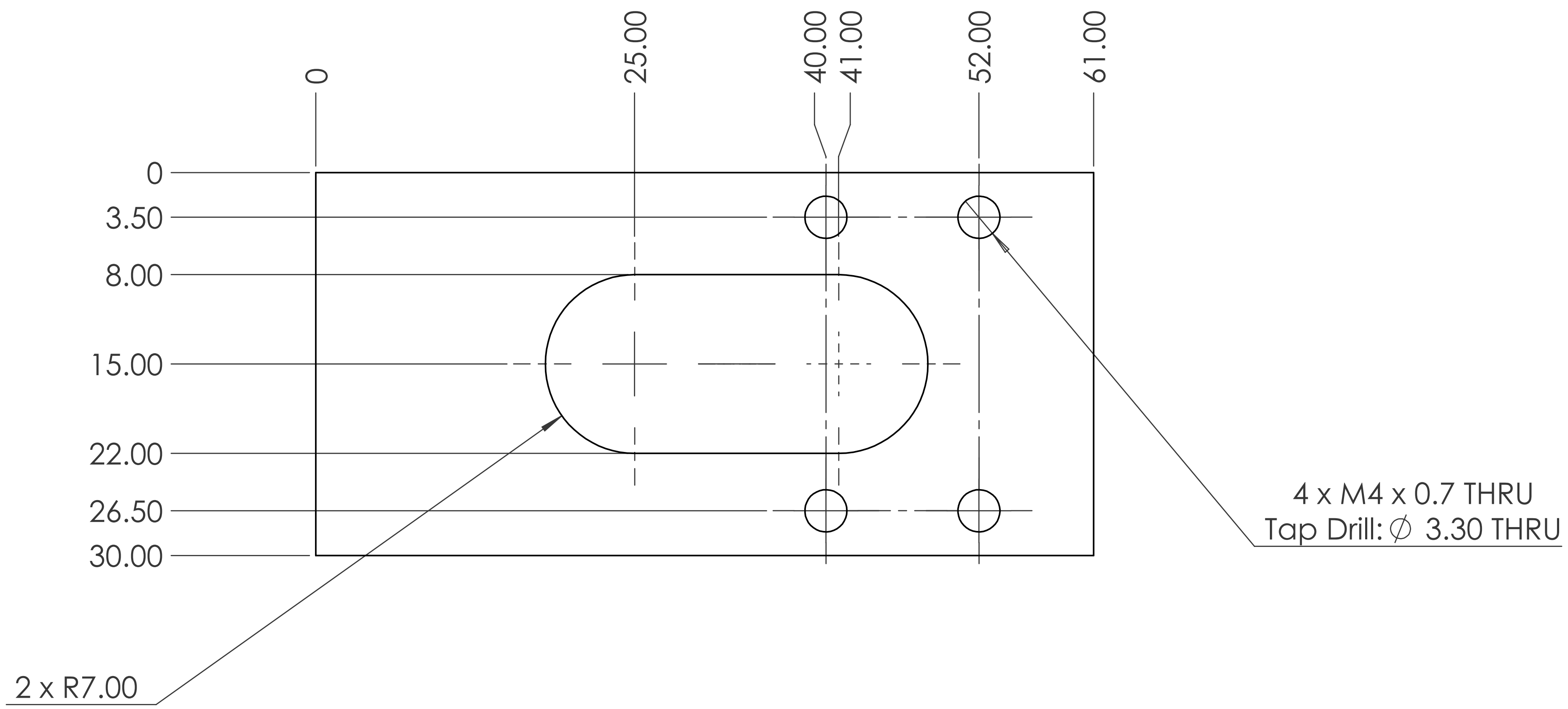

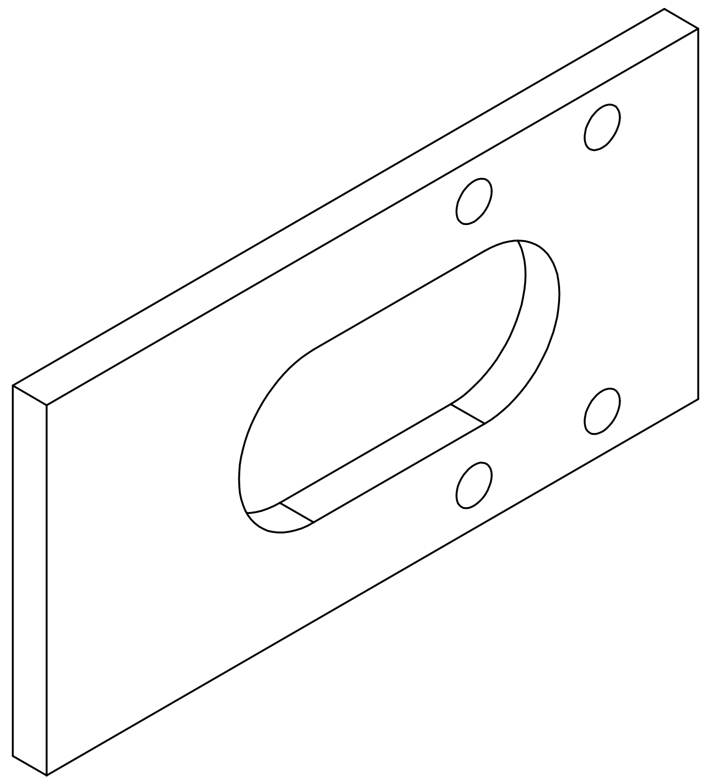

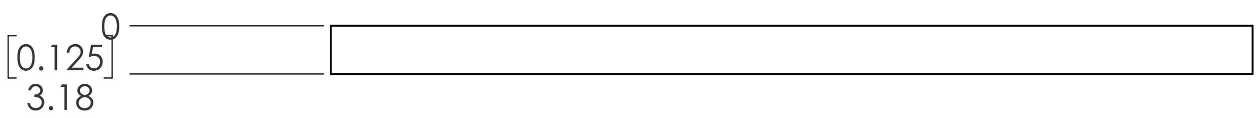

Swoboda, Inc. swoboda 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 5/31/2022	MATERIAL: A2 Tool Steel	HEAT TREAT: 54-56	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 1		PART NUMBER: A40-1400-11-019-0010	PART NAME: Top angle Rail	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 2:1	SHEET: 1 OF 1

SIZE A3

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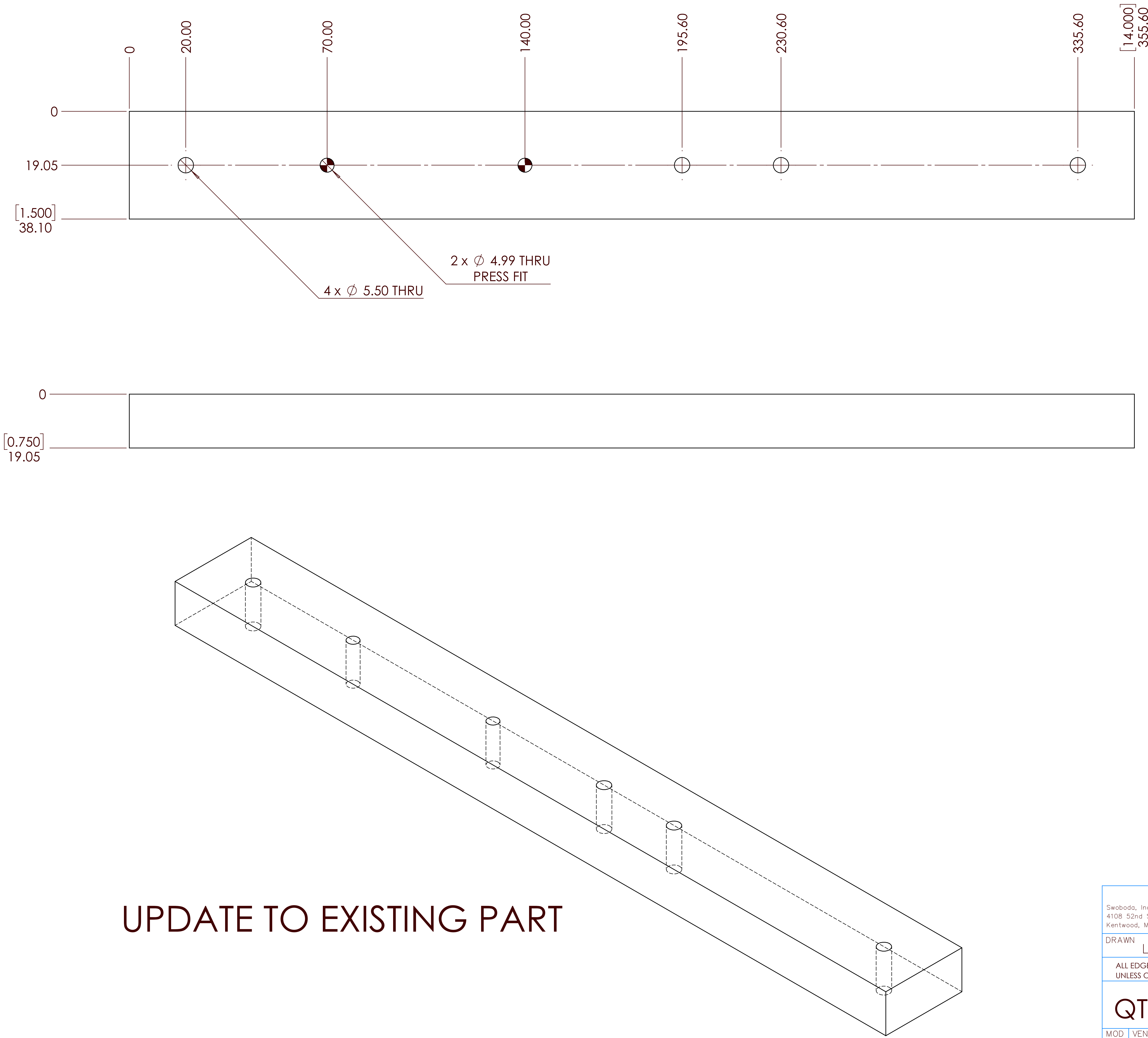

swoboda
Swoboda, Inc.
4108 52nd Street, SE Ph. 616-554-6161
Kentwood, MI 49512-9636 Fax 616-554-9093

3RD ANGLE PROJECTION

METRIC
ALL DIMENSION IN MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM NX

DRAWN LAD
DATE (MM/DD/YY) 5/31/2022
MATERIAL Aluminum
HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING NO
REV 0

QTY: 1

PART NUMBER A40-1400-11-019-011
PART NAME Vibe_Top_Connector

MOD N
VENDOR PART# N/A
DO NOT SCALE
SCALE 1:1
SHEET 1 OF 1
SIZE A2

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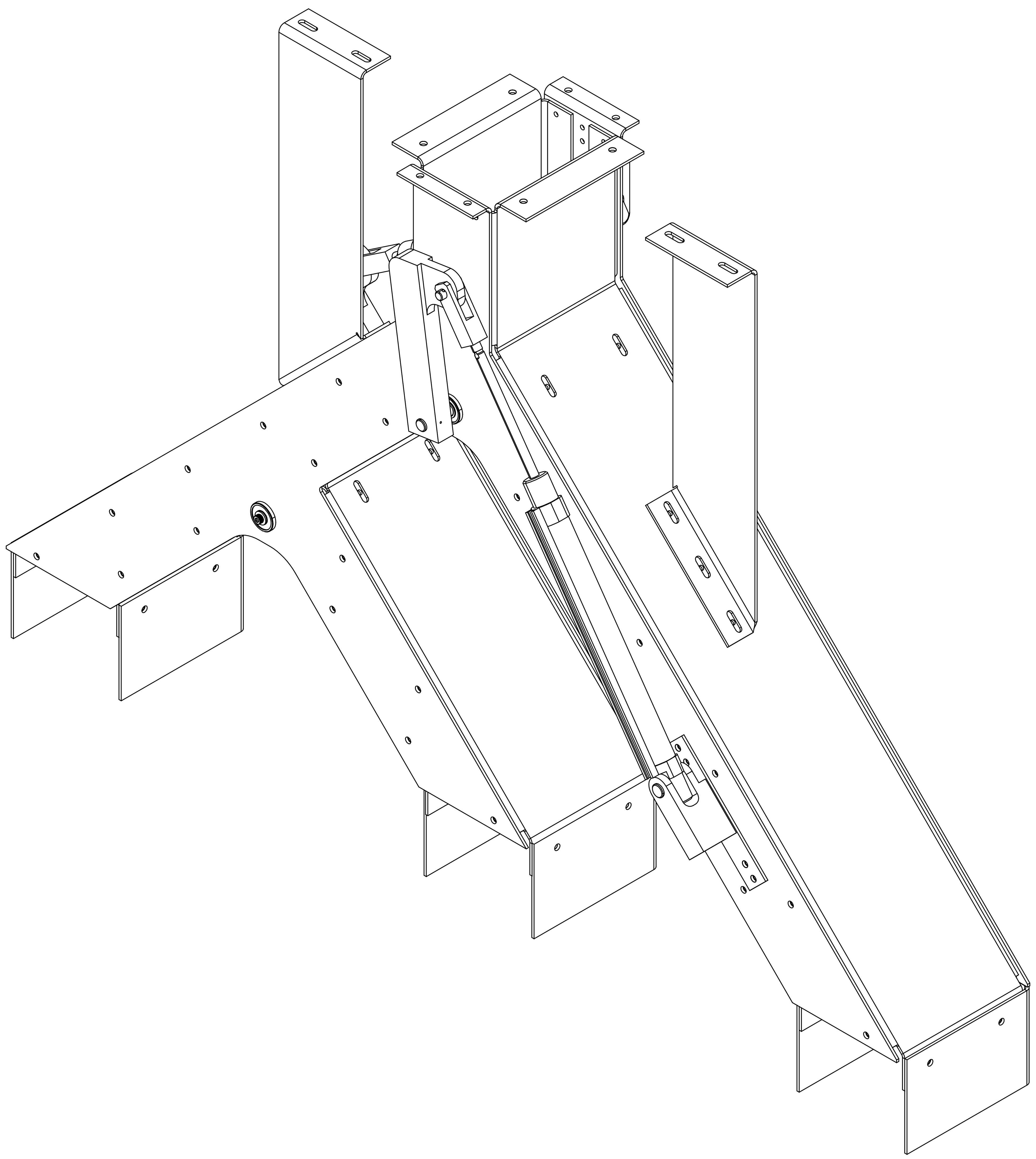
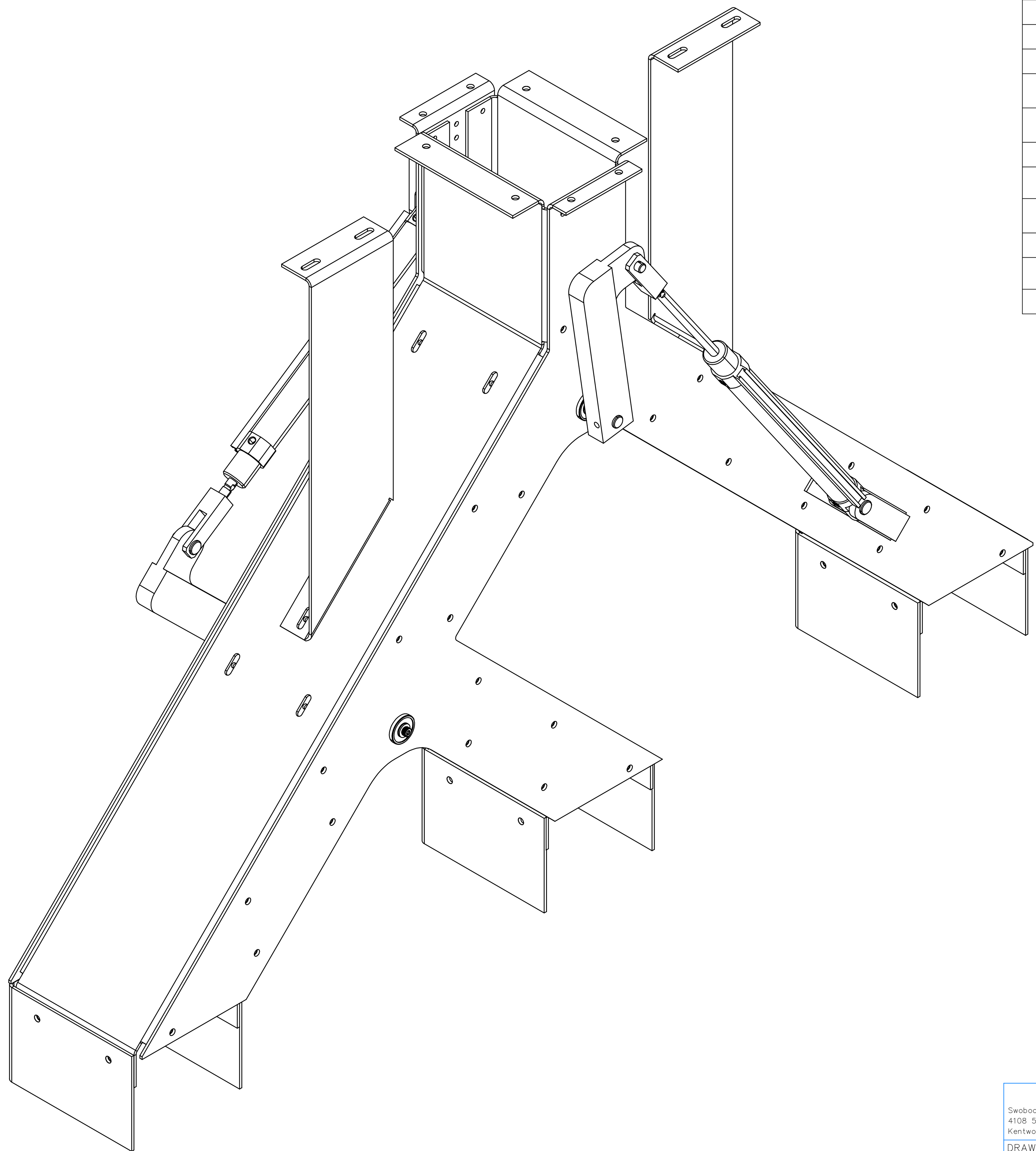
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
169	A40-1400-11-030-001 back panel		1
170	A40-1400-11-030-002 outside panel		1
171	A40-1400-11-030-005 short straight panel		2
172	SFLC698ZZ	ID:8 OD19 Flanged Bearing	2
173	A40-1400-11-030-007 Front Panel		1
174	SFLC626ZZ	ID:6 OD19: Flanged bearing	2
175	A40-1400-11-030-016 Trap Door Shaft	PSFGG8-135-F6-P6-M3	2
176	A40-1400-11-030-006 Trap Door		2
177	92981A142	Alloy Steel Shoulder Screws	4
178	A40-1400-11-030-010 lever arm		2
179	92981A743	Alloy Steel Shoulder Screws	1
180	92981A143	Alloy Steel Shoulder Screws	1
181	A40-1400-11-030-003 ninety degree panel		1
182	A40-1400-11-030-012 chute extension		4
183	A40-1400-11-030-004 Long Straight Panel		1
184	A40-1400-11-030-013 door shroud		4
185	91294A128	Black-Oxide Alloy Steel Hex Drive Flat Head Screw	24
186	A40-1400-11-030-014 outside panel		1
187	A40-1400-11-030-011 vertical support		2
188	FNTS6_1_0_D6_B6_U20 (clevis)		2
189	CD85N16_125_A(shaft)		2
190	CD85N16_125_A		2
191	HCLGN6_12		2
192	HCLGN6_22		2
193	A40-1400-11-030-008 Cyl clevis		2
194	A40-1400-11-030-009 Cyl clevis support		2
195	91290A138	Alloy Steel Socket Head Screw	80
196	91116A120	18-8 Stainless Steel Oversized Washer	2
197	91290A115	Black-Oxide Alloy Steel Socket Head Screw	2
198	91239A136	Button Head Hex Drive Screw	8
199	A40-1400-11-030-015 Chute Bottom		3
200	91290A140	Alloy Steel Socket Head Screw	8





swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO	REV 0
QTY: 1		PART NUMBER SA-6	PART NAME
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:2
			SHEET 10 OF 11
			SIZE A1

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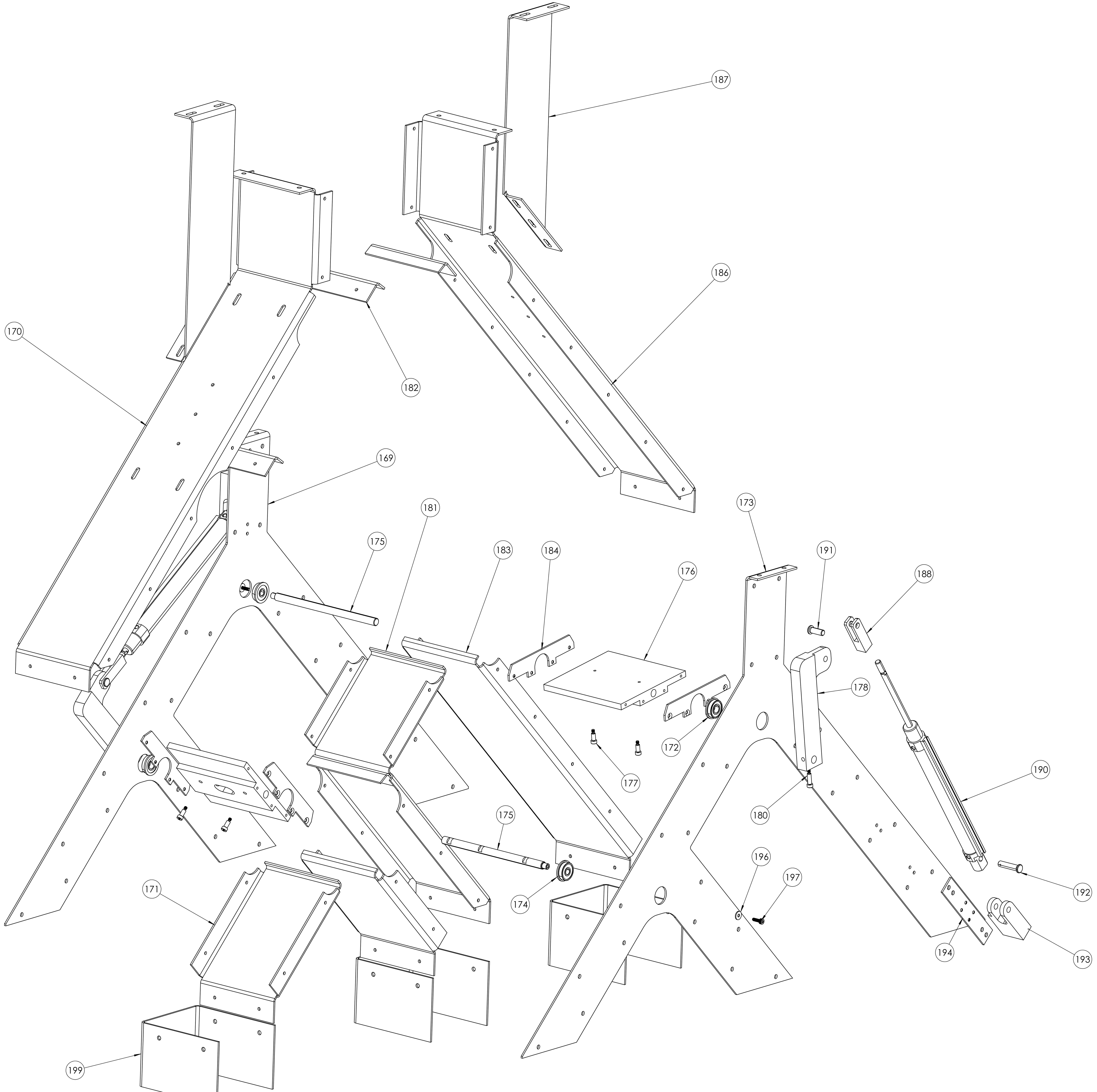

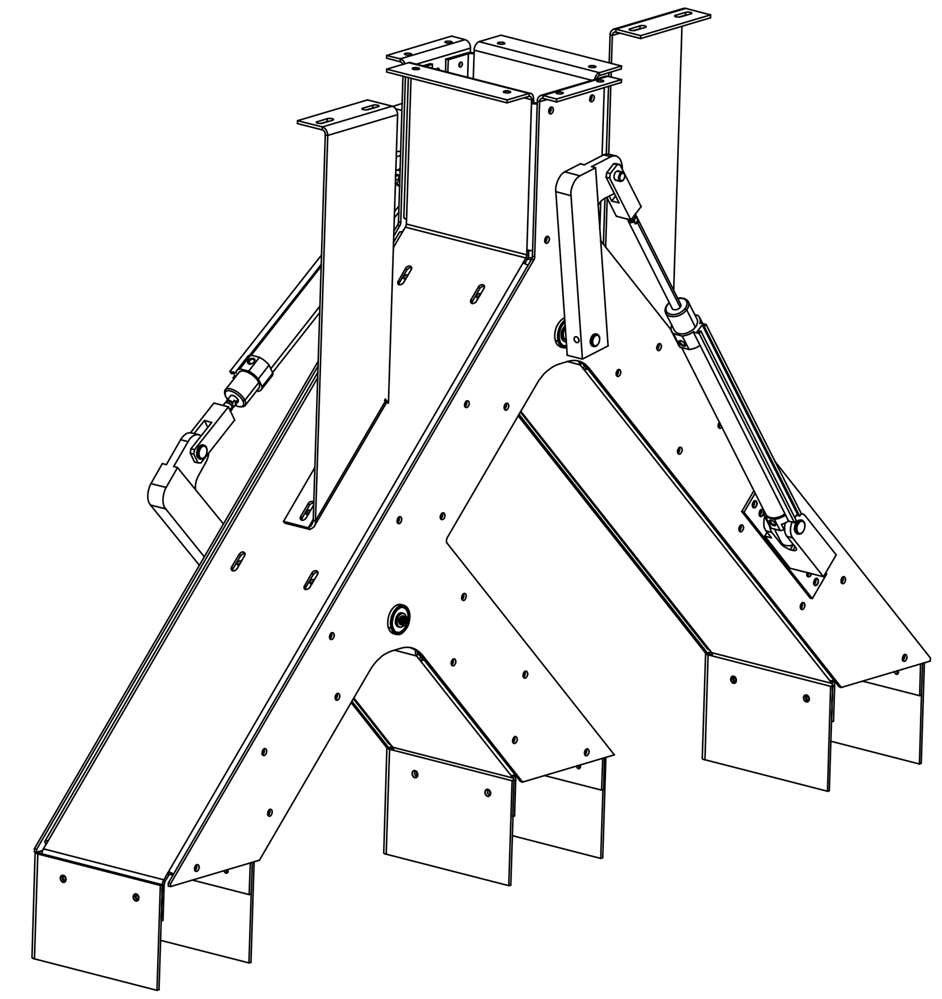

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
169	A40-1400-11-030-001 back panel		1
170	A40-1400-11-030-002 outside panel		1
171	A40-1400-11-030-005 short straight panel		2
172	SFLC698ZZ	ID:8 OD19 Flanged Bearing	2
173	A40-1400-11-030-007 Front Panel		1
174	SFLC626ZZ	ID:6 OD19: Flanged bearing	2
175	A40-1400-11-030-016 Trap Door Shaft	PSFGG8-135-F6-P6-M3	2
176	A40-1400-11-030-006 Trap Door		2
177	92981A142	Alloy Steel Shoulder Screws	4
178	A40-1400-11-030-010 lever arm		2
179	92981A743	Alloy Steel Shoulder Screws	1
180	92981A143	Alloy Steel Shoulder Screws	1
181	A40-1400-11-030-003 ninety degree panel		1
182	A40-1400-11-030-012 chute extension		4
183	A40-1400-11-030-004 Long Straight Panel		1
184	A40-1400-11-030-013 door shroud		4
185	91294A128	Black-Oxide Alloy Steel Hex Drive Flat Head Screw	24
186	A40-1400-11-030-014 outside panel		1
187	A40-1400-11-030-011 vertical support		2
188	FNTS6_1_0_D6_B6_U20 (clevis)		2
189	CD85N16_125_A(shaft)		2
190	CD85N16_125_A		2
191	HCLGN6_12		2
192	HCLGN6_22		2
193	A40-1400-11-030-008 Cyl clevis		2
194	A40-1400-11-030-009 Cyl clevis support		2
195	91290A138	Alloy Steel Socket Head Screw	80
196	91116A120	18-8 Stainless Steel Oversized Washer	2
197	91290A115	Black-Oxide Alloy Steel Socket Head Screw	2
198	91239A136	Button Head Hex Drive Screw	8
199	A40-1400-11-030-015 Chute Bottom		3
200	91290A140	Alloy Steel Socket Head Screw	8

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swoboda
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4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994		CAD DATA IS MASTER
	GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°			CAD SYSTEM SW
DRAWN LD	DATE (MM/DD/YY) 8/9/2022	MATERIAL N/A	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER SA-6	PART NAME	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:2	SHEET 11 OF 11

SIZE A1

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Kentwood, MI 49512-9636
Ph. 616-554-6161
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3RD ANGLE PROJECTION

METRIC
All Dimensions in MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM NX

DRAWN CRK

DATE (MM/DD/YY) 6/2/2022

MATERIAL 14 Gauge Stainless Steel Sheet

HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING NO

REV 0

QTY: 1

PART NUMBER A40-1400-11-030-001

PART NAME Back Panel

MOD N

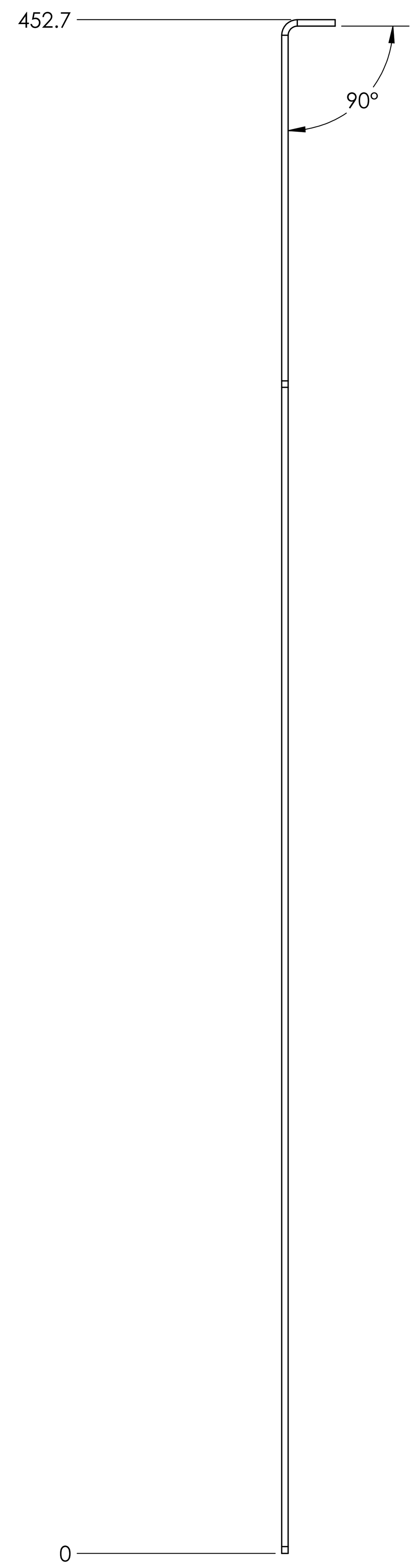
VENDOR PART# N/A

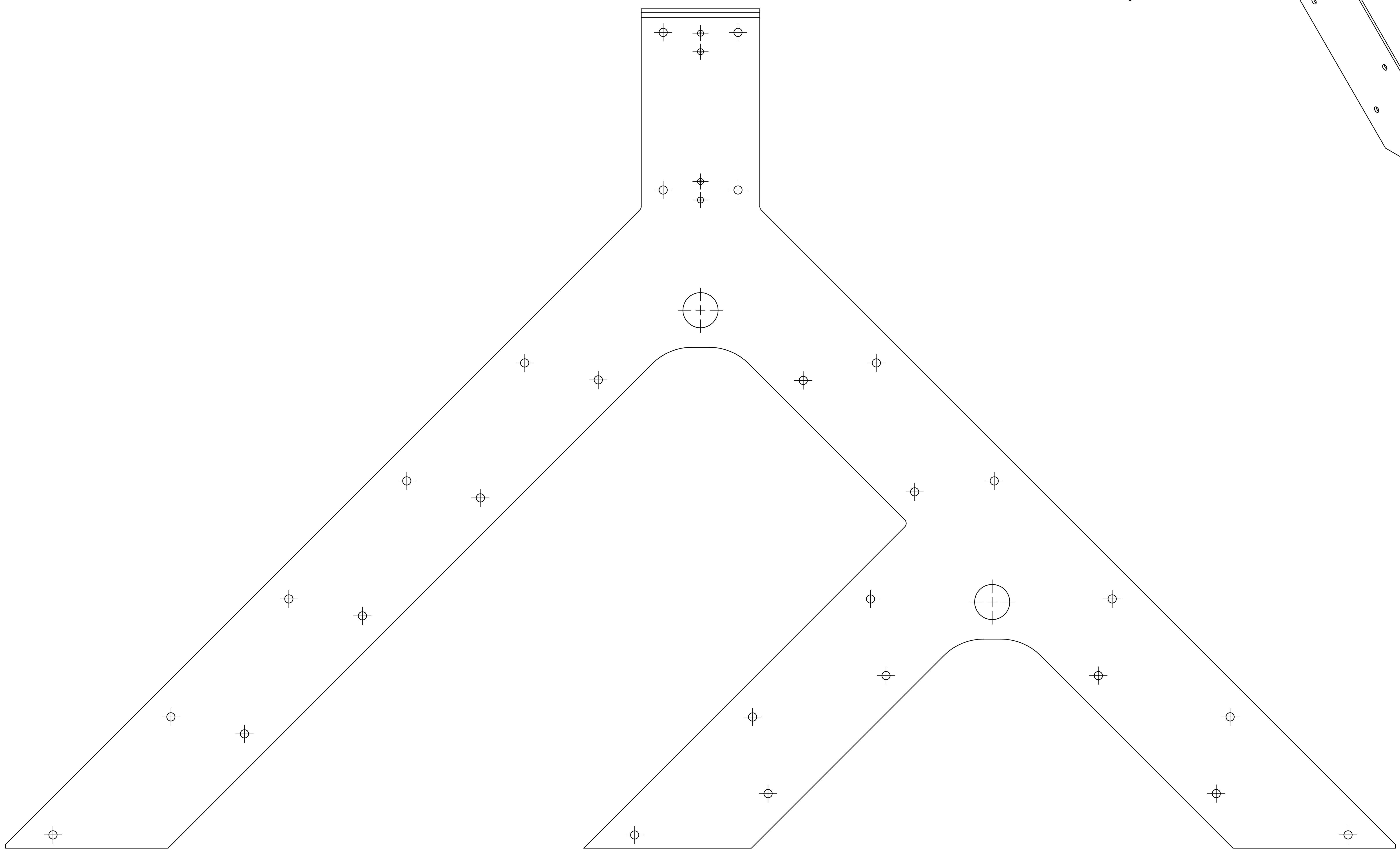
DO NOT SCALE

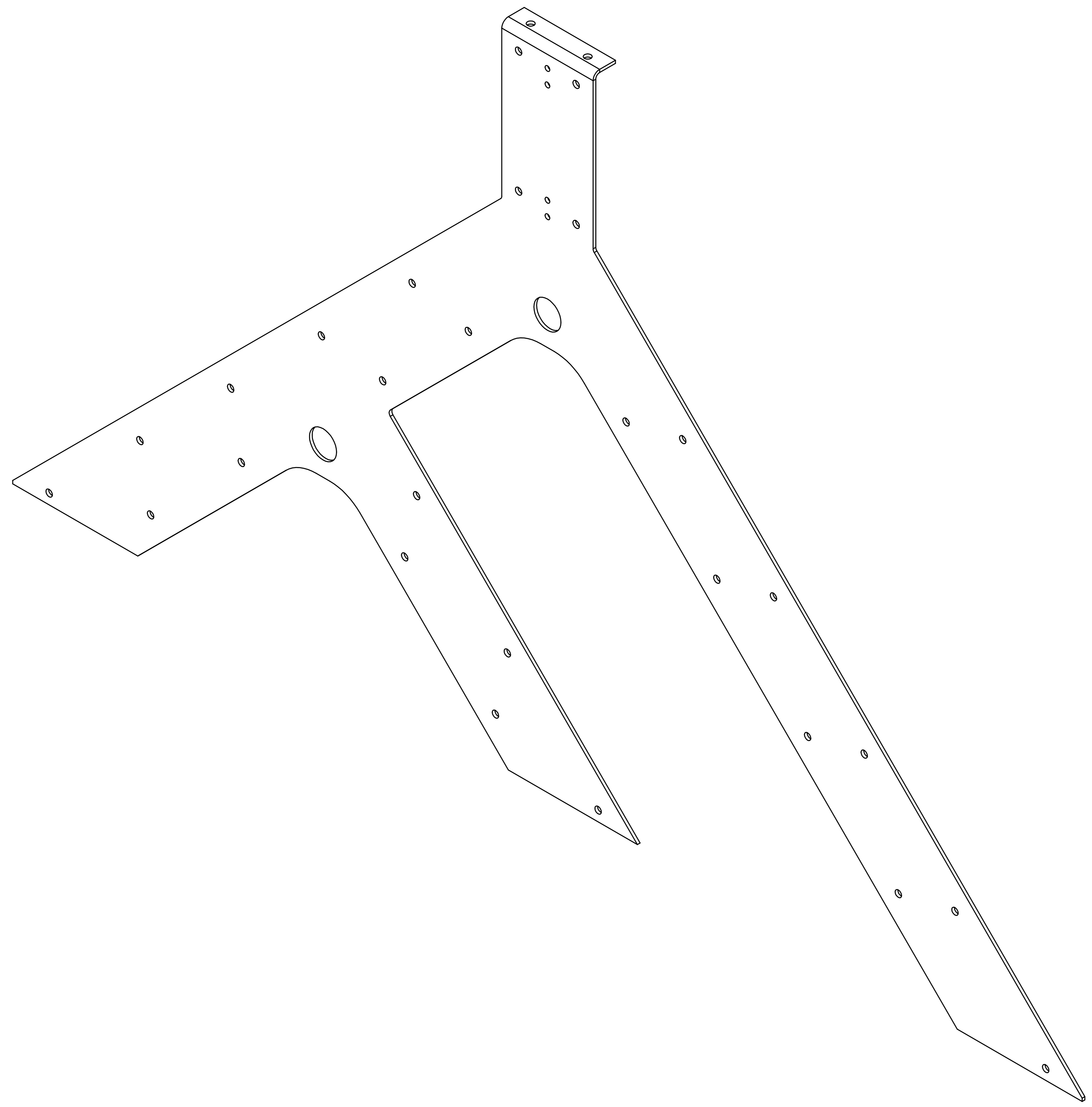
SCALE 1:1

SHEET 1 OF 2

SIZE A1







swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512–9636 Ph. 616–554–6161 Fax 616–554–9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M–1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40–1400–11–030–001	PART NAME Back Panel	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1.5	SHEET 2 OF 2

SIZE A1

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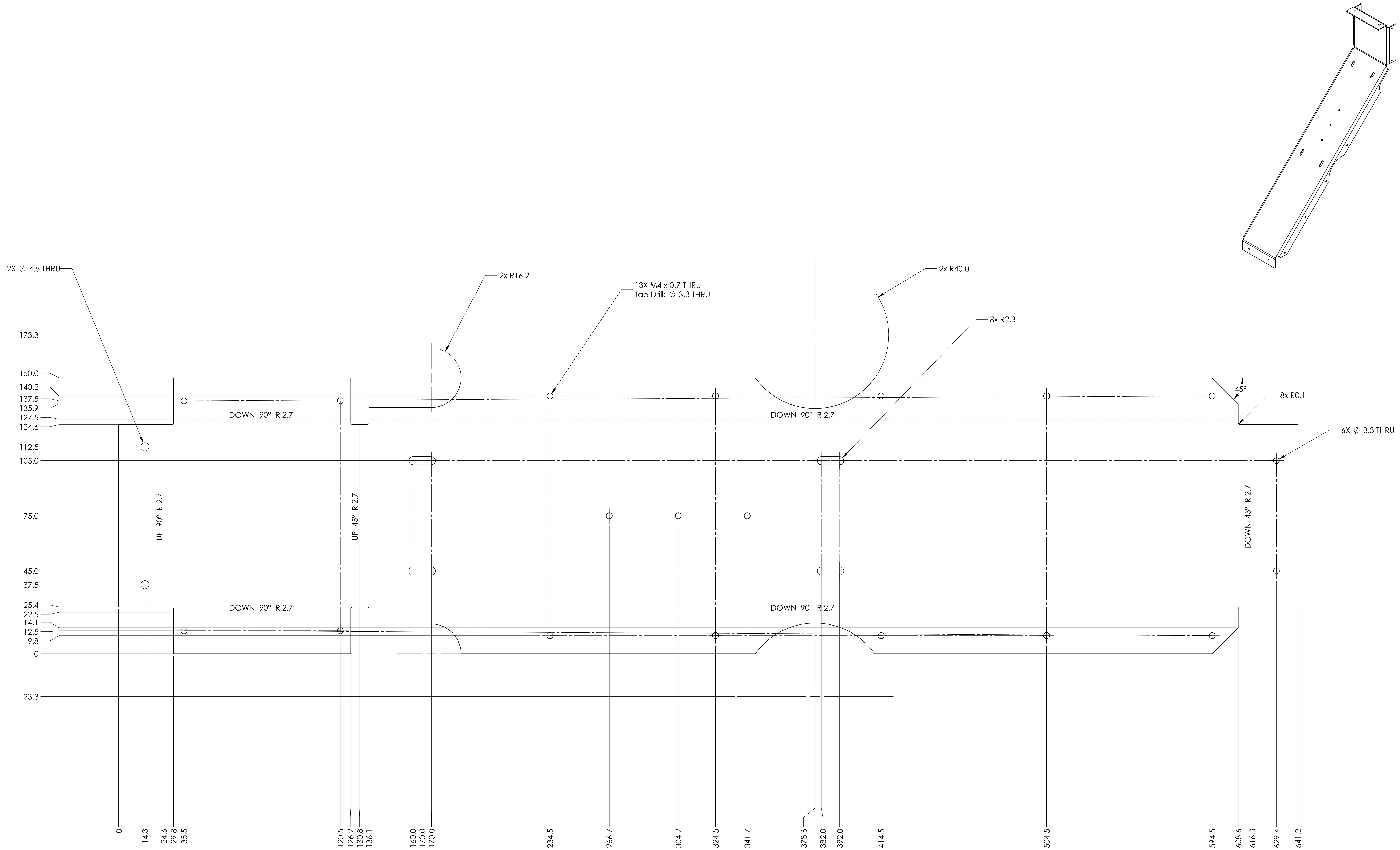
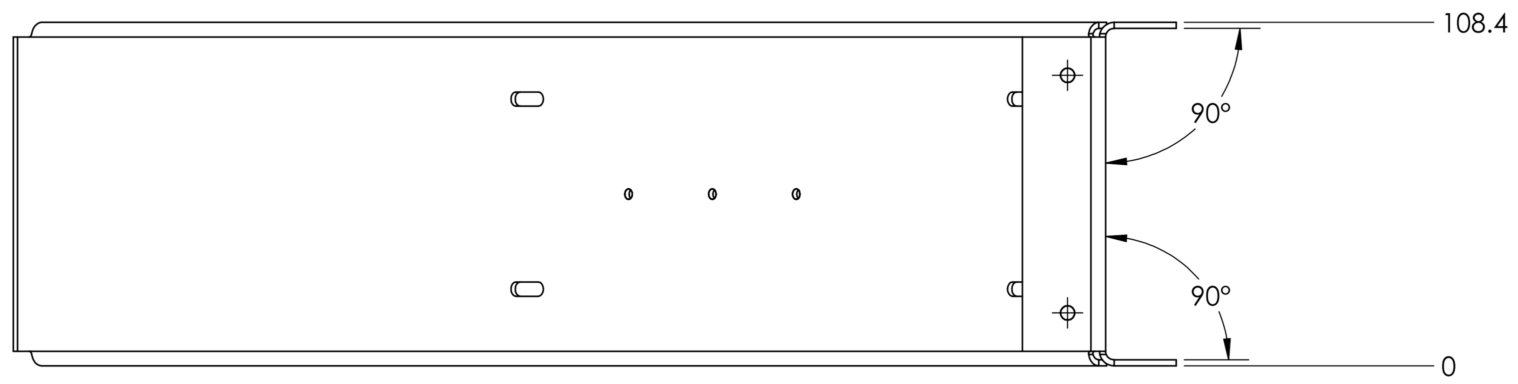
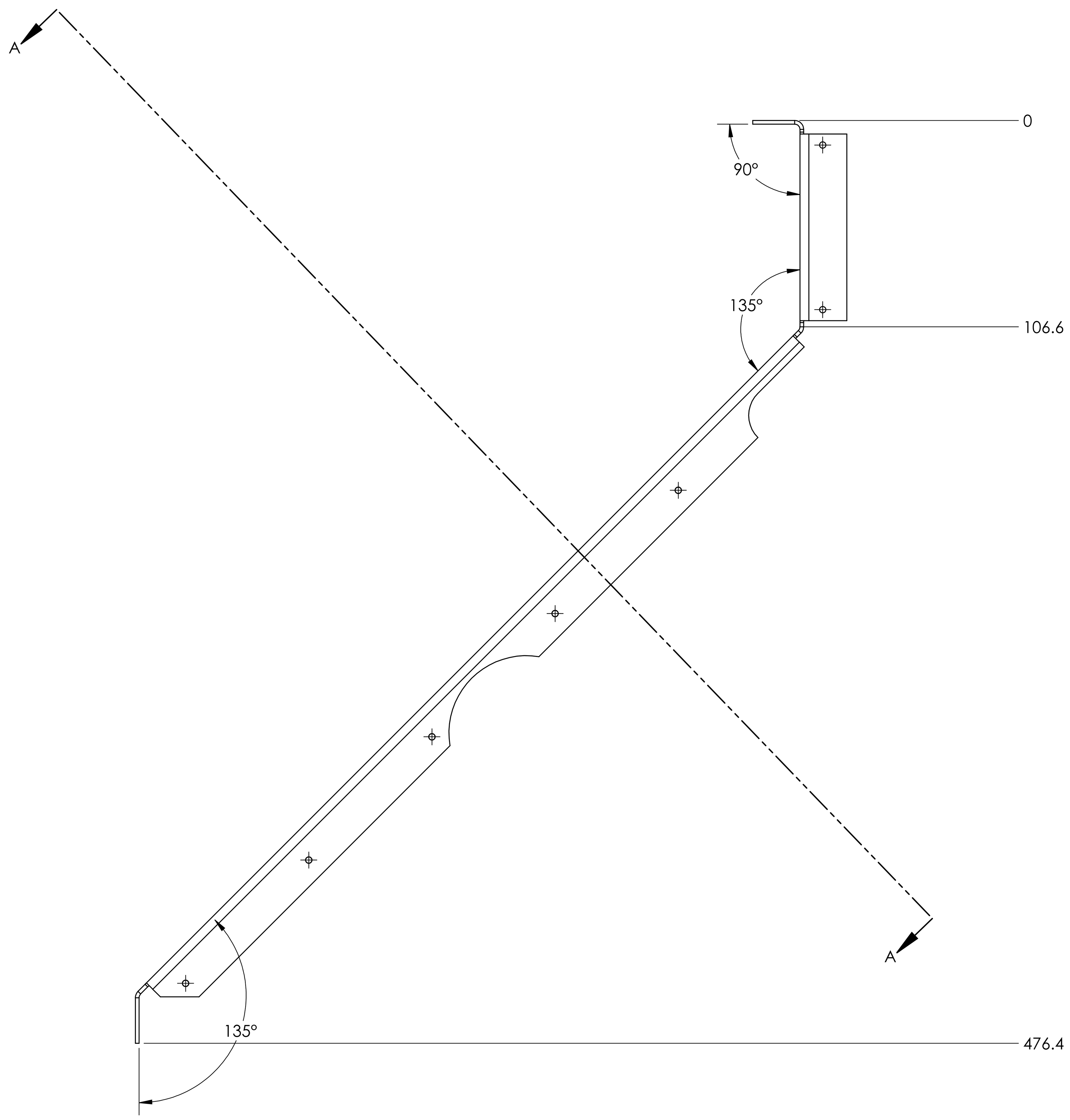
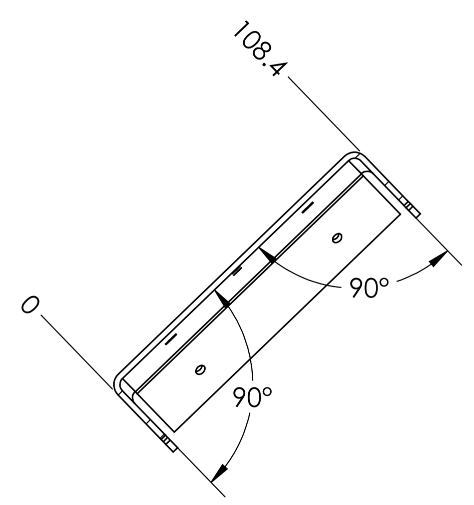


swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO	REV 0
QTY: 1		PART NUMBER A40-1400-11-030-002	PART NAME Outside Panel
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1 SHEET 1 OF 2

SIZE A1



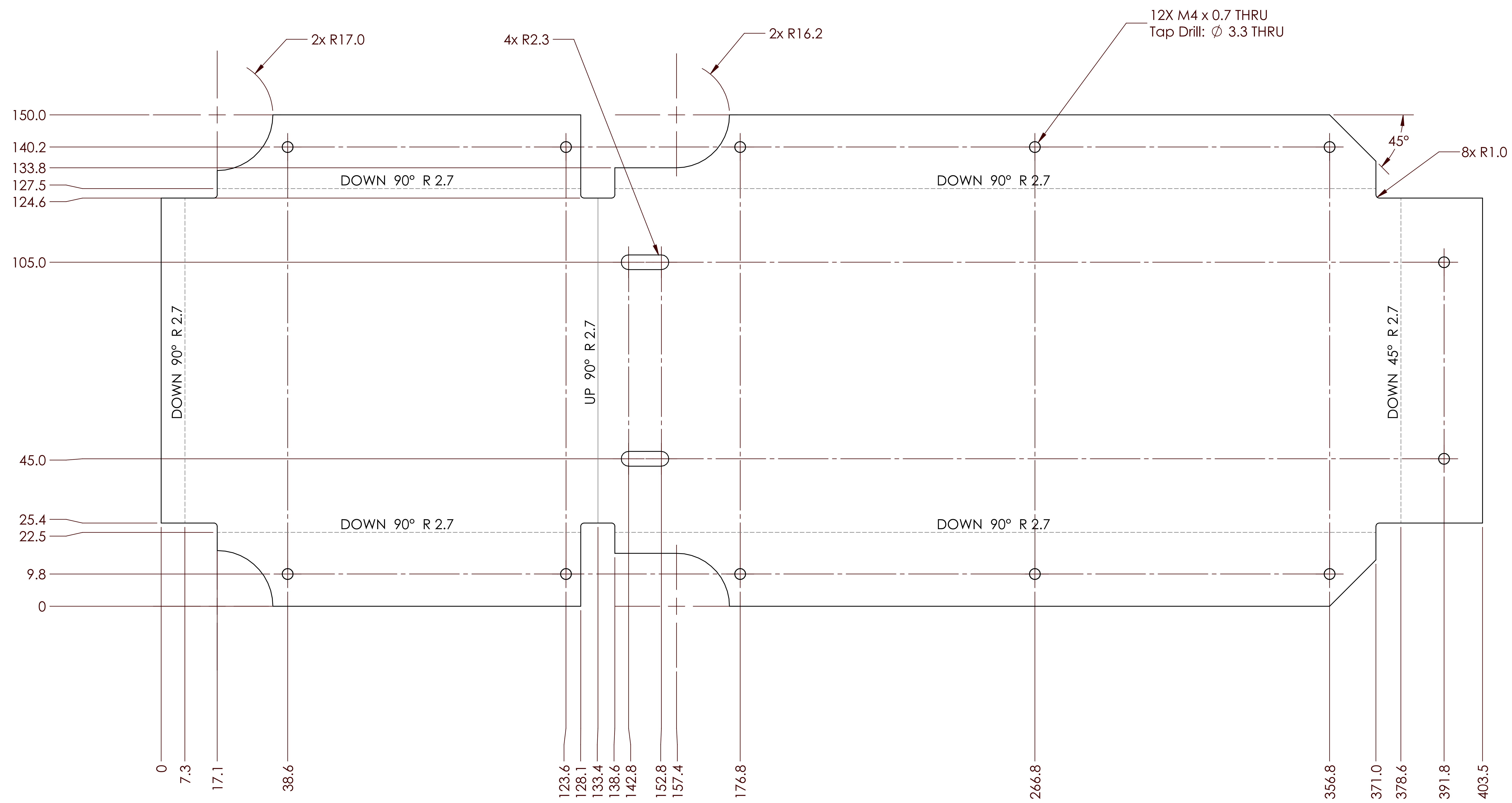


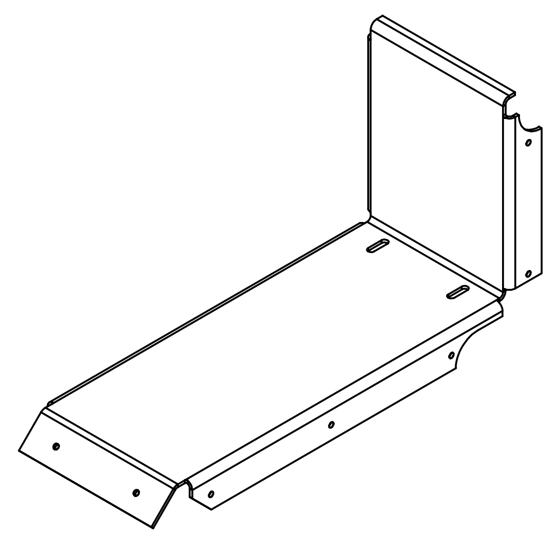


SECTION A-A

swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel		HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-030-002	PART NAME Outside Panel	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:2	SHEET 2 OF 2

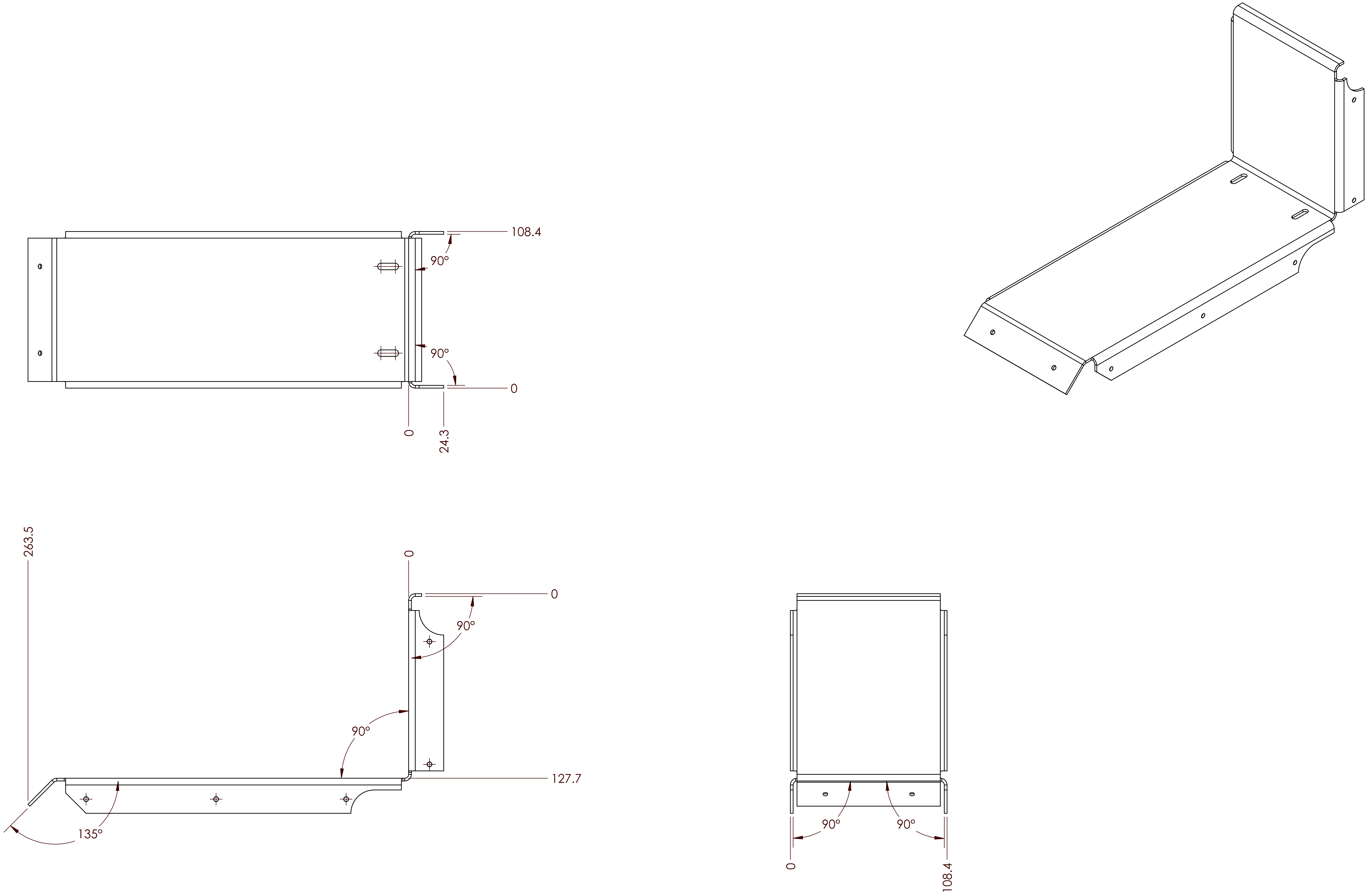
SIZE A1





swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/3/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-030-003	PART NAME Ninety Degree Panel	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 2

SIZE A2



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3RD ANGLE PROJECTION

METRIC
ALL DIMENSION IN MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM NX

DRAWN CRK

DATE (MM/DD/YY) 6/3/2022

MATERIAL 14 Gauge Stainless Steel

HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING NO

REV 0

QTY: 1

PART NUMBER A40-1400-11-030-003

PART NAME Ninety Degree Panel

MOD N

VENDOR PART# N/A

DO NOT SCALE

SCALE 1:2

SHEET 2 OF 2

SIZE A2

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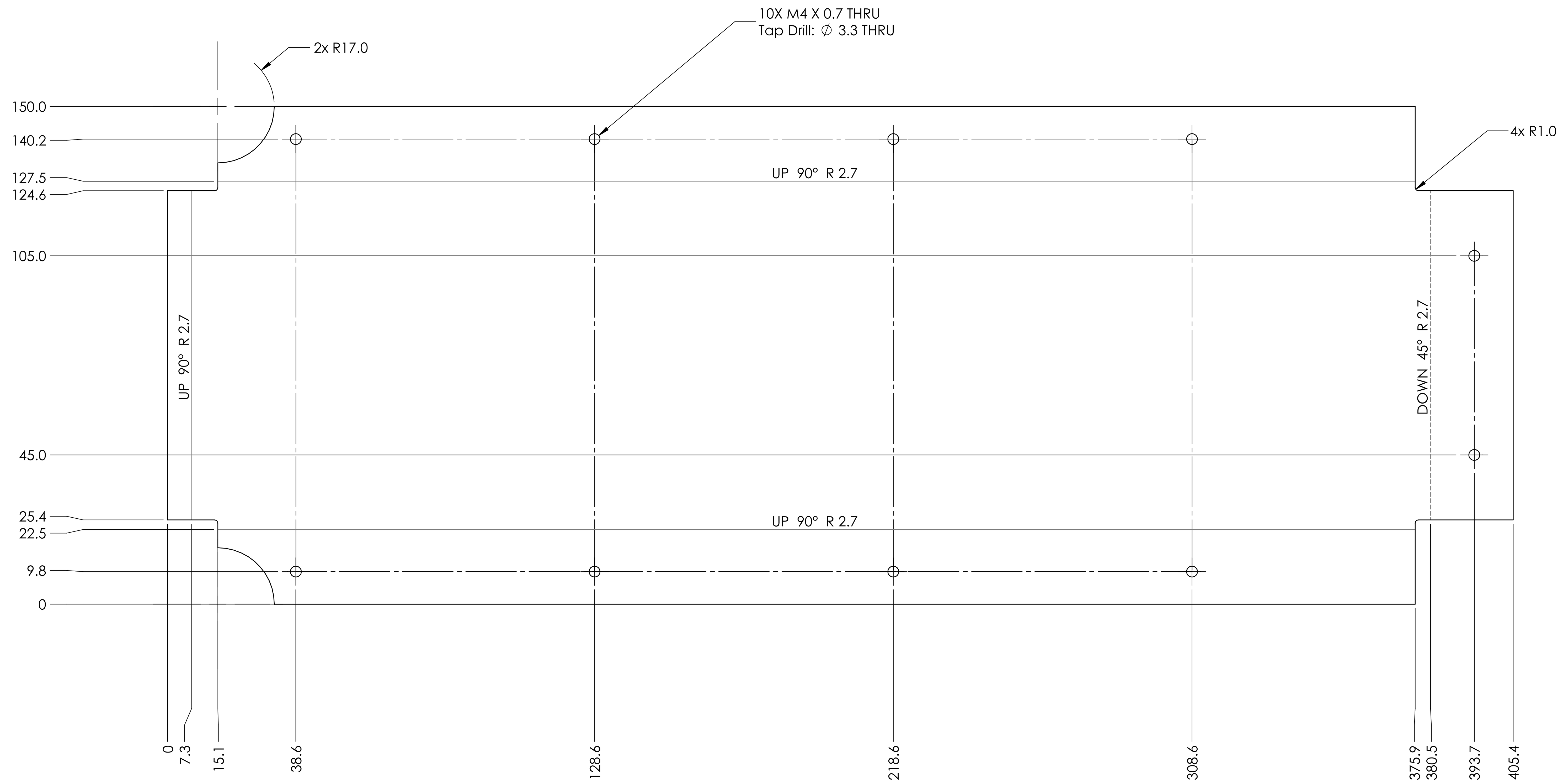
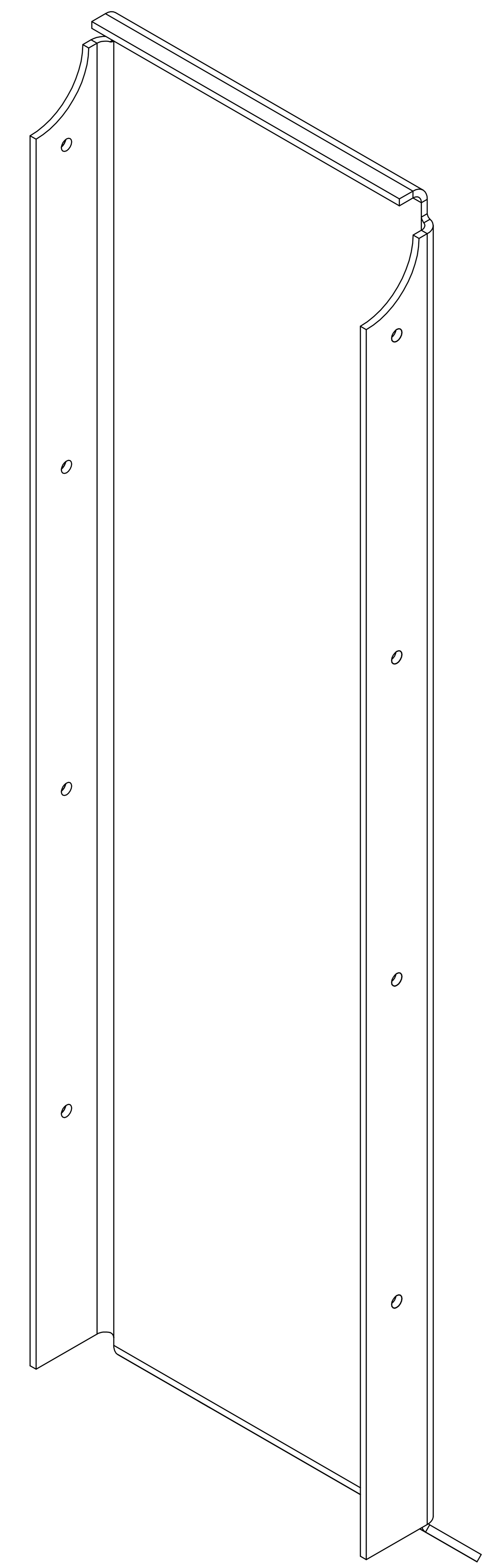
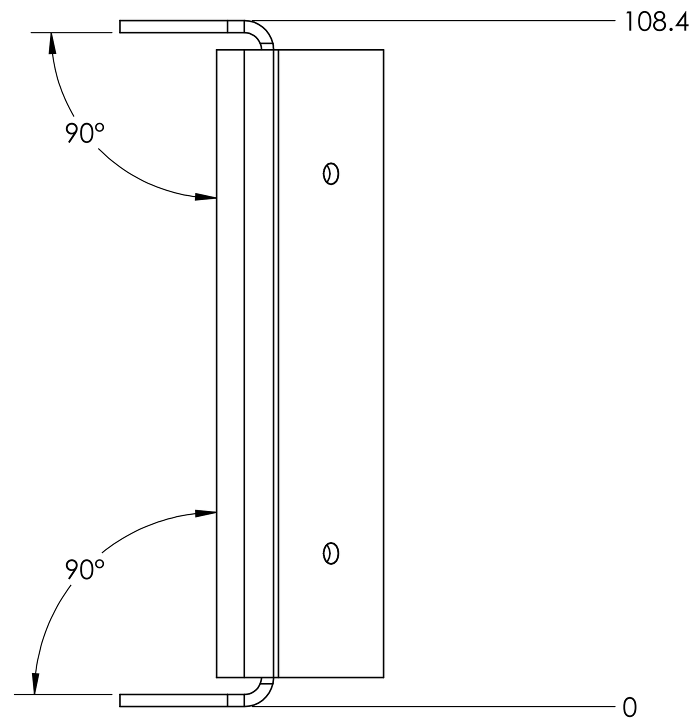
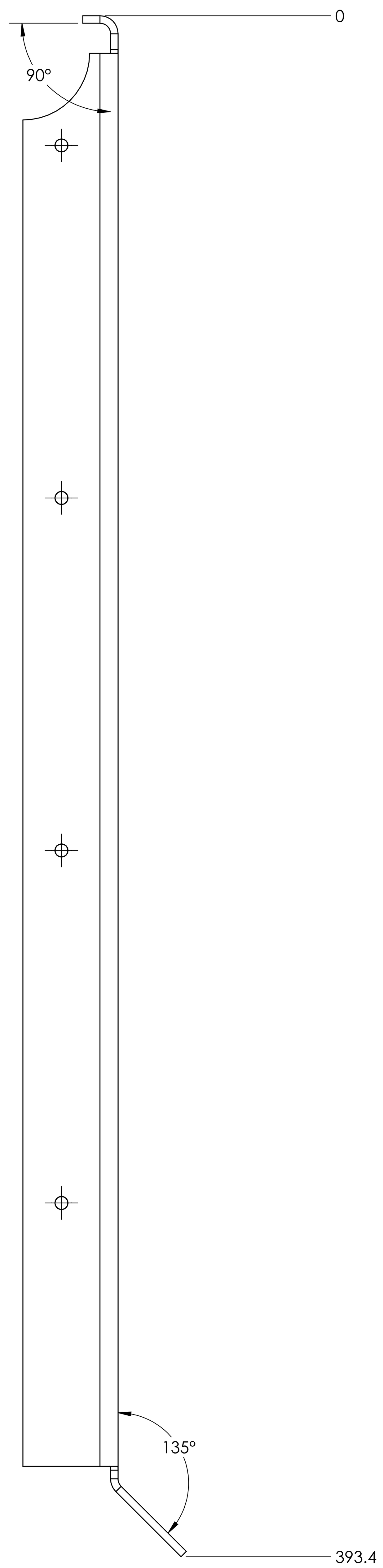


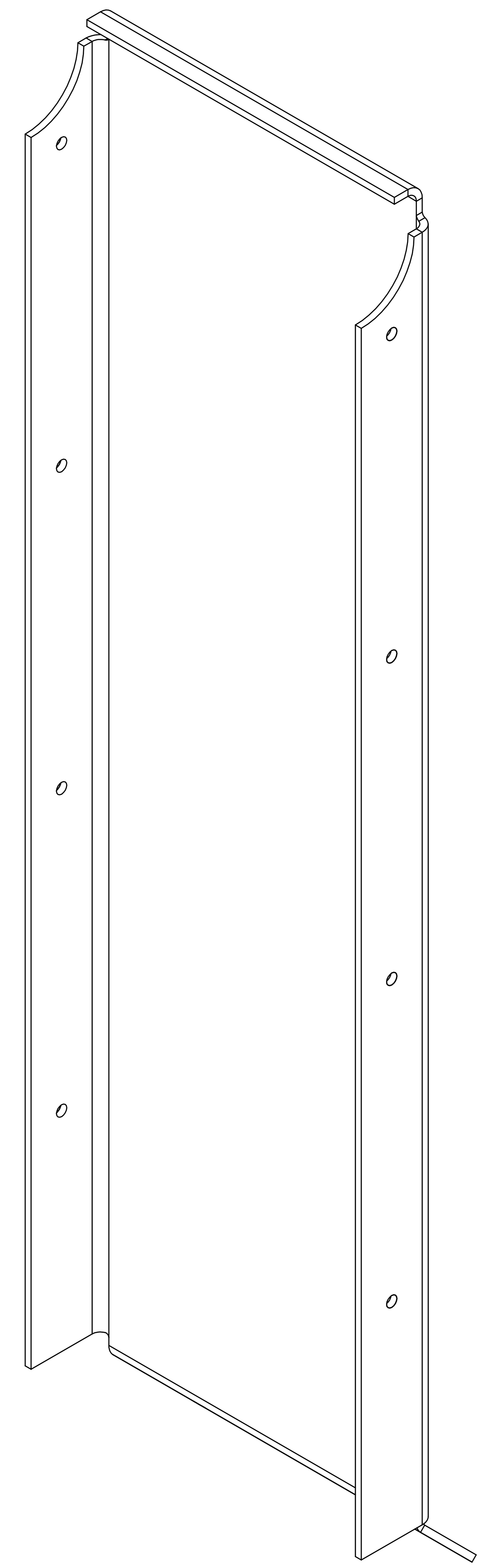


swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-030-004	PART NAME Long Straight Panel	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 2

SIZE A1

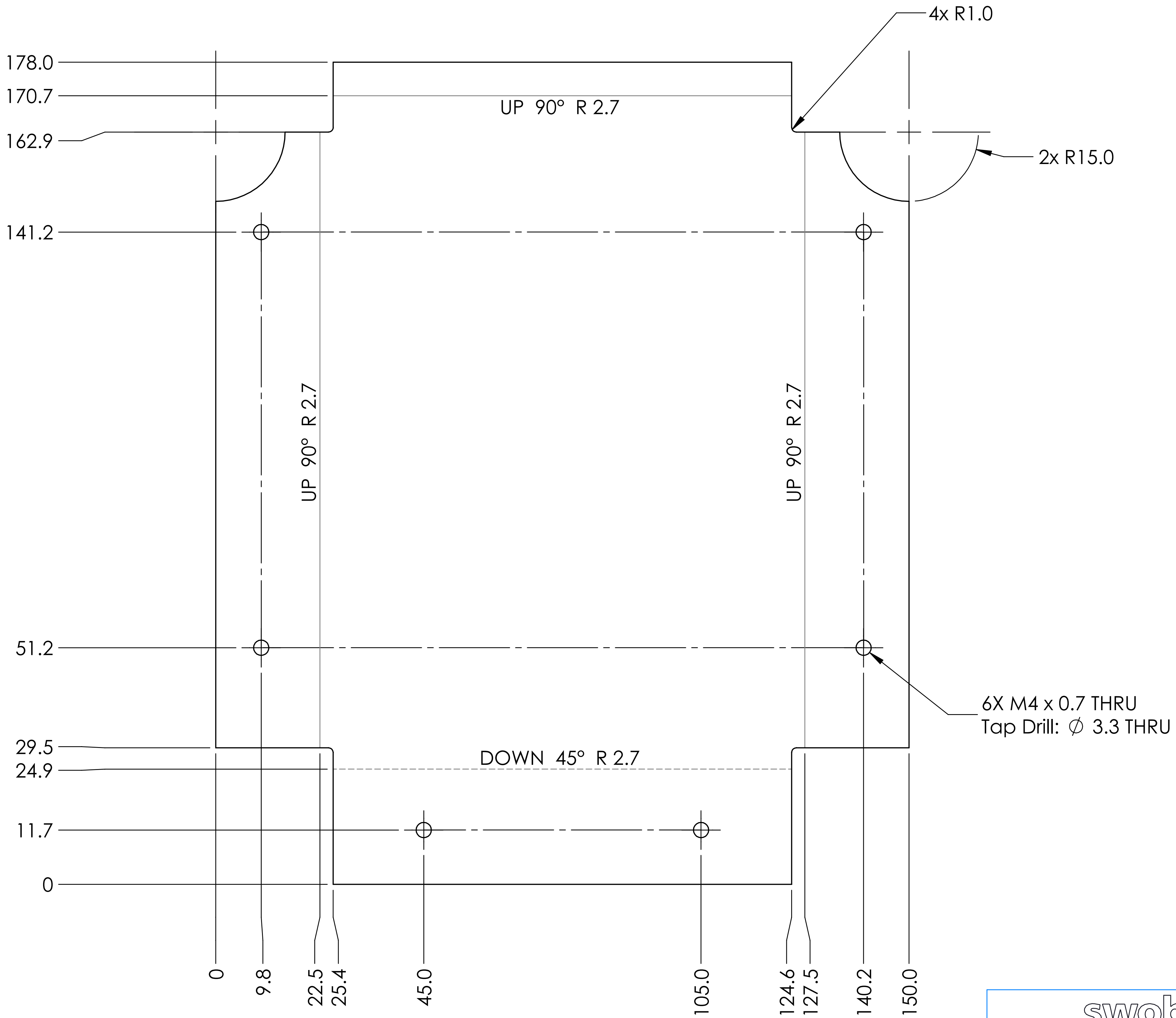


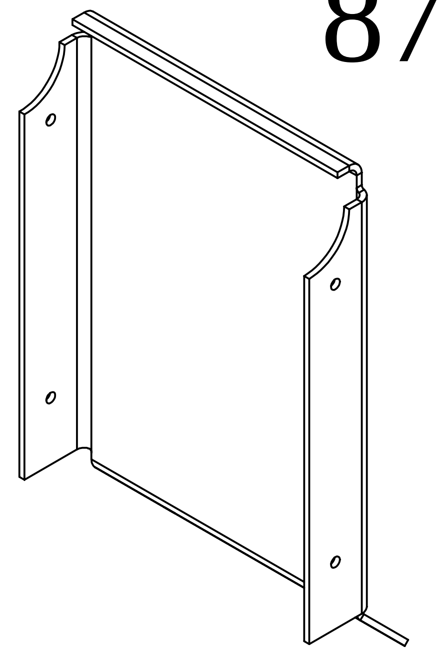




Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512–9636 Ph. 616–554–6161 Fax 616–554–9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M–1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40–1400–11–030–004	PART NAME Long Straight Panel	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 2 OF 2

SIZE A1





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3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
	GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL: 14 Gauge Stainless Steel	HEAT TREAT: NO
ALL DIMENSIONS IN MM			
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO		REV: 0
QTY: 2	PART NUMBER: A40-1400-11-030-005	PART NAME: Short Straight Panel	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1
SHEET: 1 OF 2	SIZE A3		

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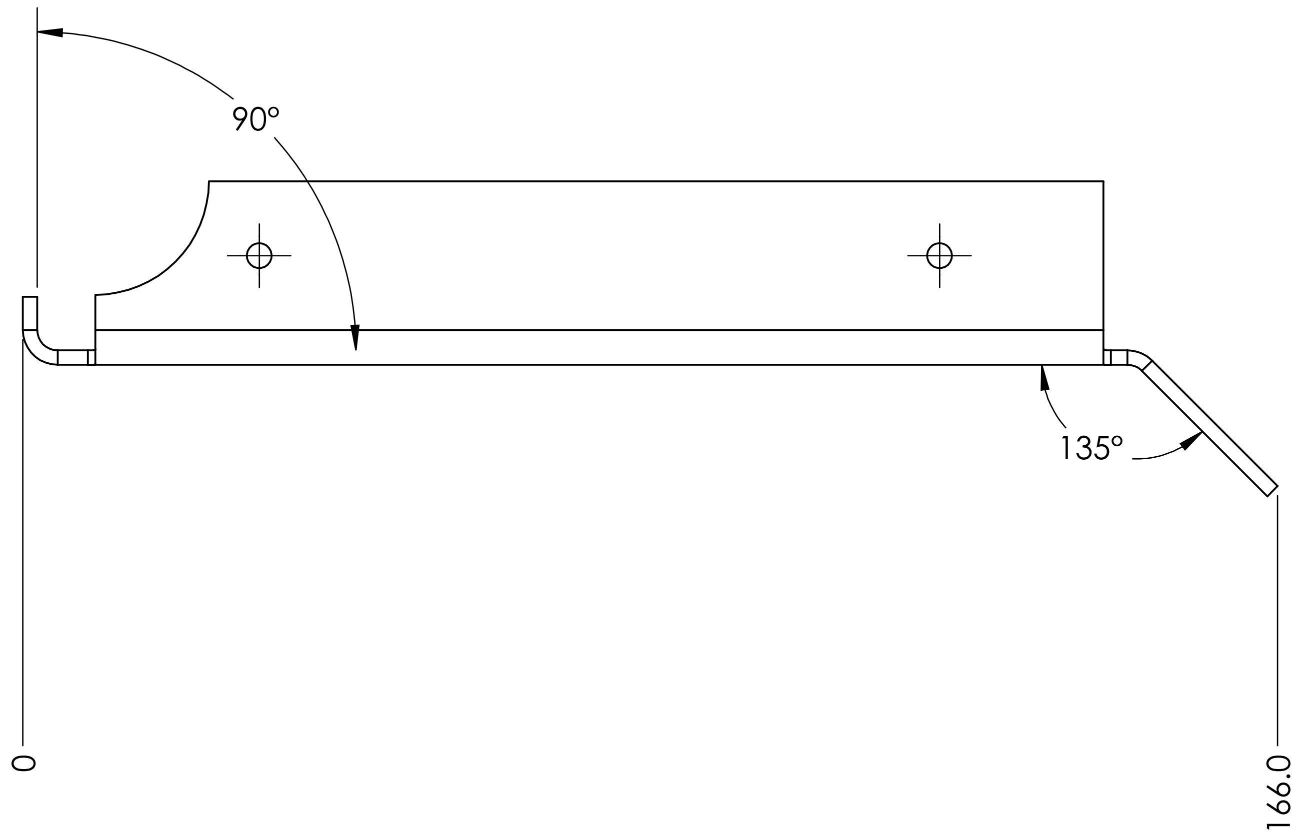

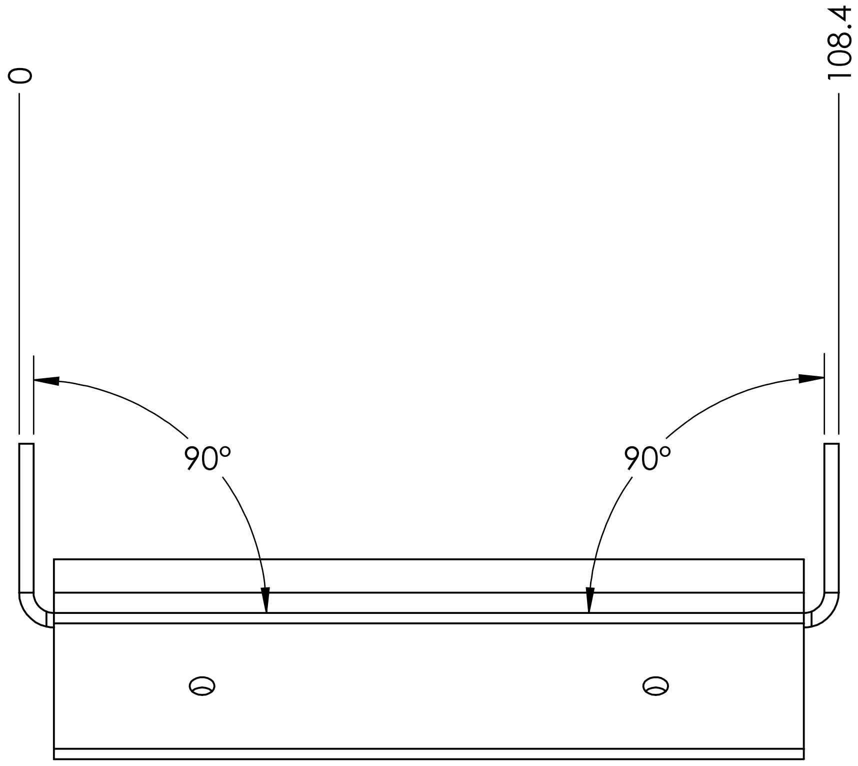

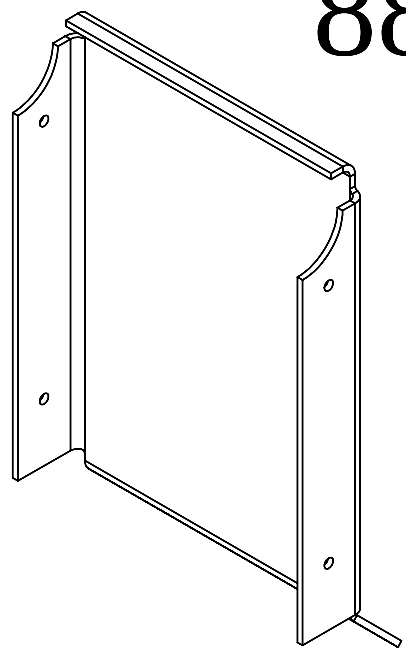

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: CRK

DATE (MM/DD/YY) 6/2/2022

MATERIAL: 14 Gauge Stainless Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-030-005

PART NAME: Short Straight Panel

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 2 OF 2

SIZE A3

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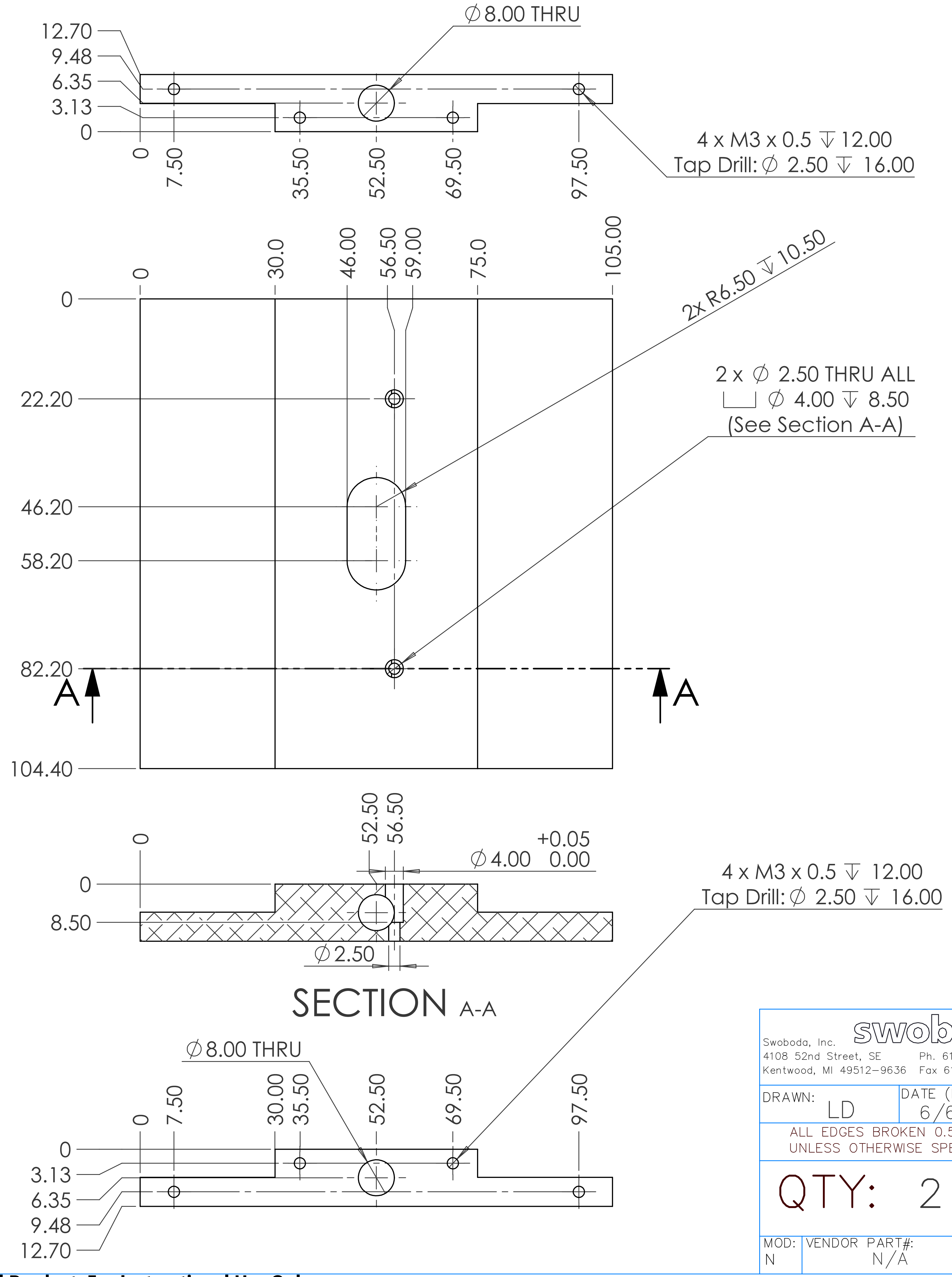

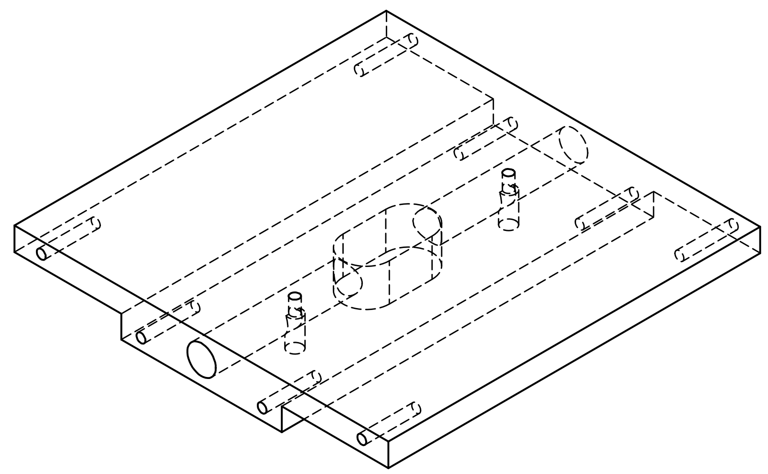

Swoboda, Inc. swoboda 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994	MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM: SW
DRAWN: LD	DATE (MM/DD/YY) 6/6/2022	MATERIAL: MIC 6	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 2		PART NUMBER: A40-1400-11-030-006	PART NAME: Trap Door	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

SIZE A3

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3RD ANGLE PROJECTION

METRIC
All Dimensions in MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM NX

DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING NO

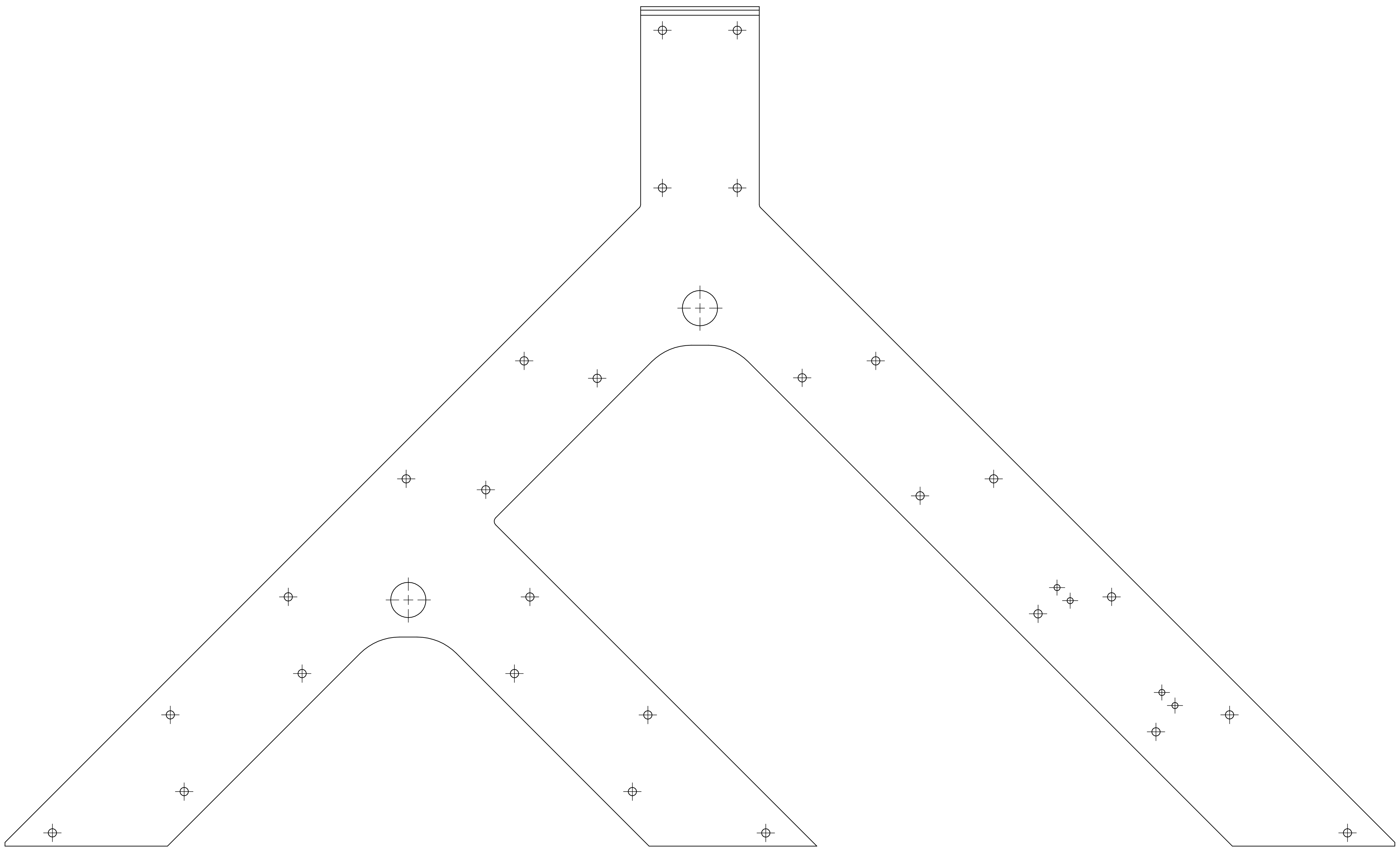
REV 0

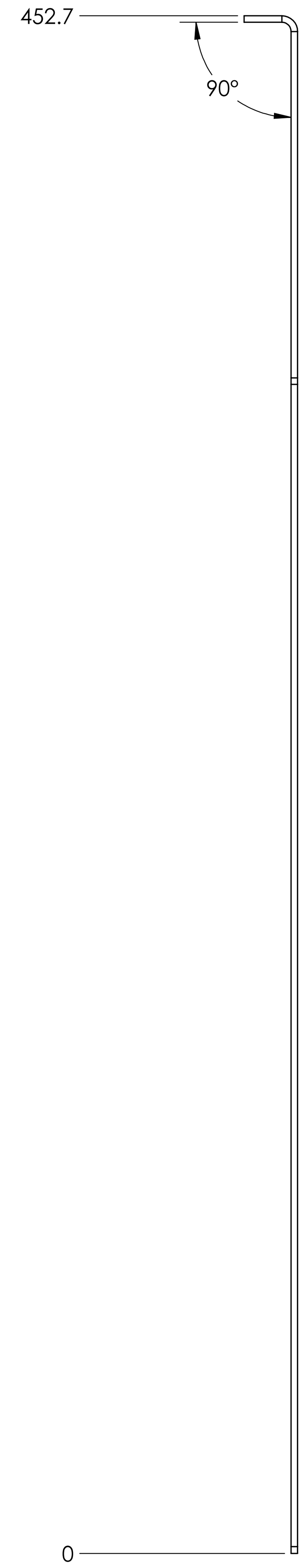
QTY: 1

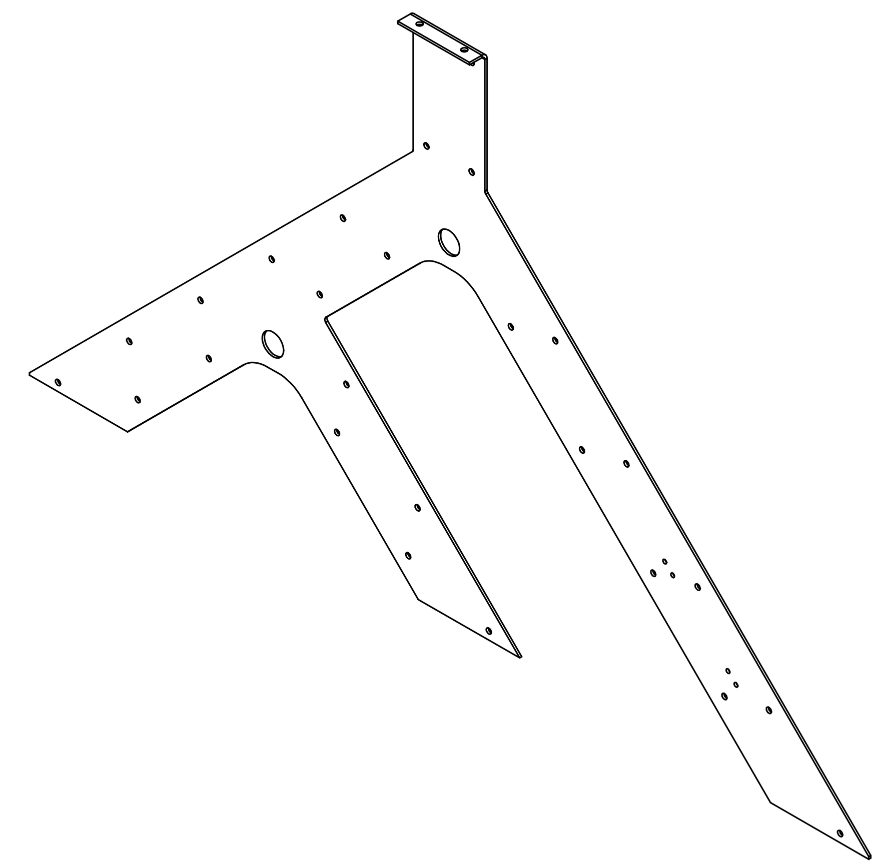
PART NUMBER A40-1400-11-030-007
PART NAME Front Panel

MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 2

SIZE A1

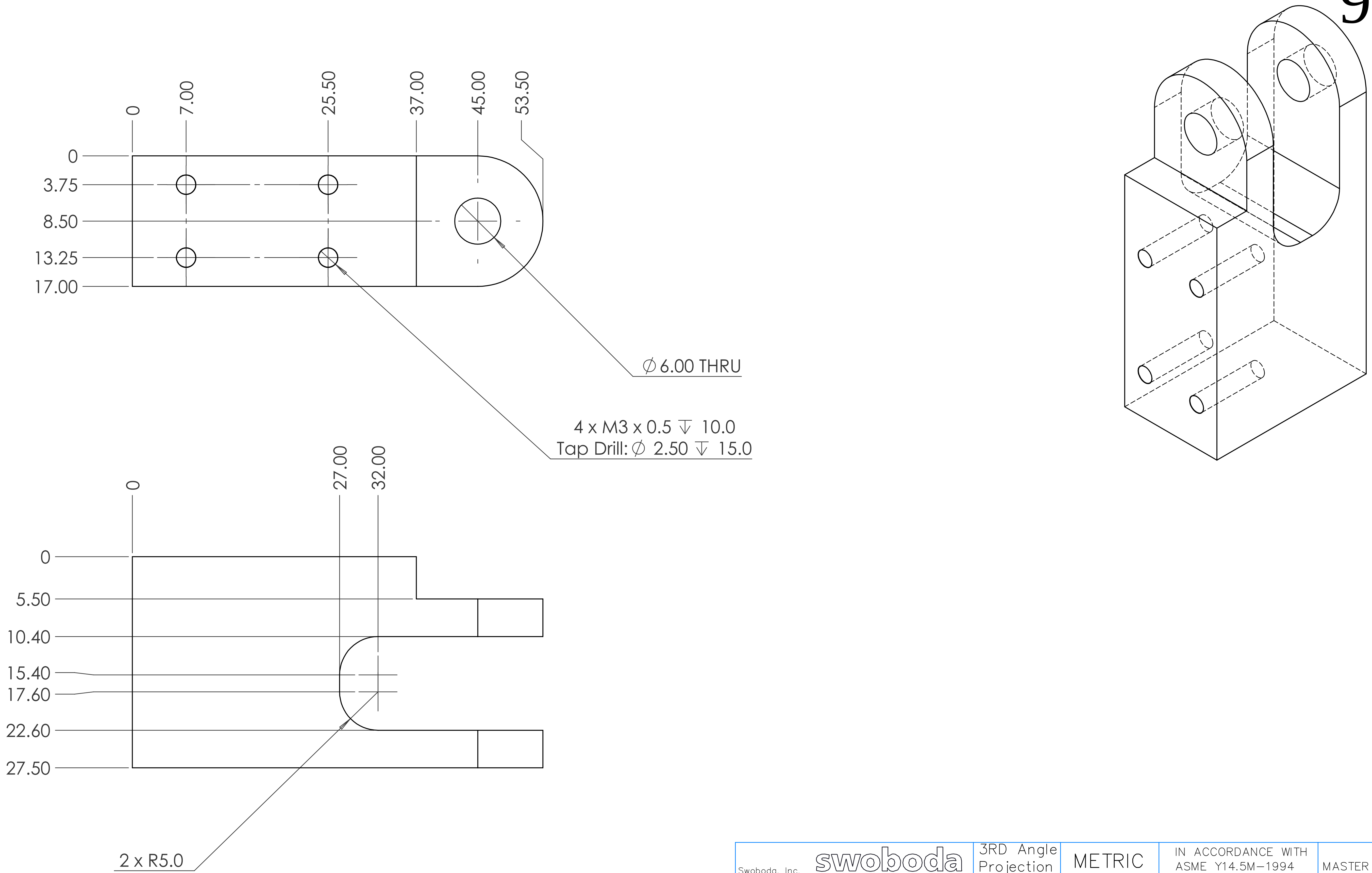






swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-030-007	PART NAME Front Panel	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1.5	SHEET 2 OF 2

SIZE A1



Swoboda, Inc.
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Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: ALUMINUM

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-030-008

PART NAME: Cyl clevis

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 2:1

SHEET: 1 OF 1

SIZE A3

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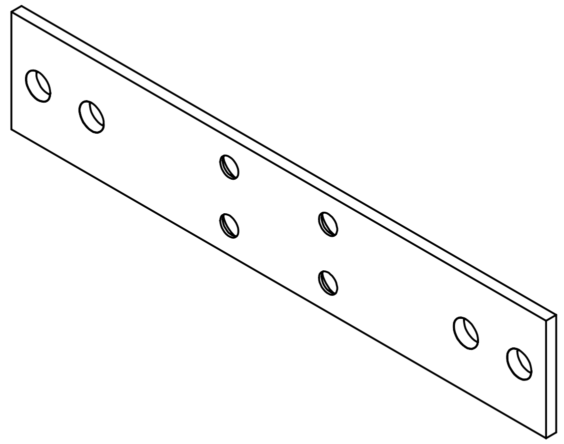

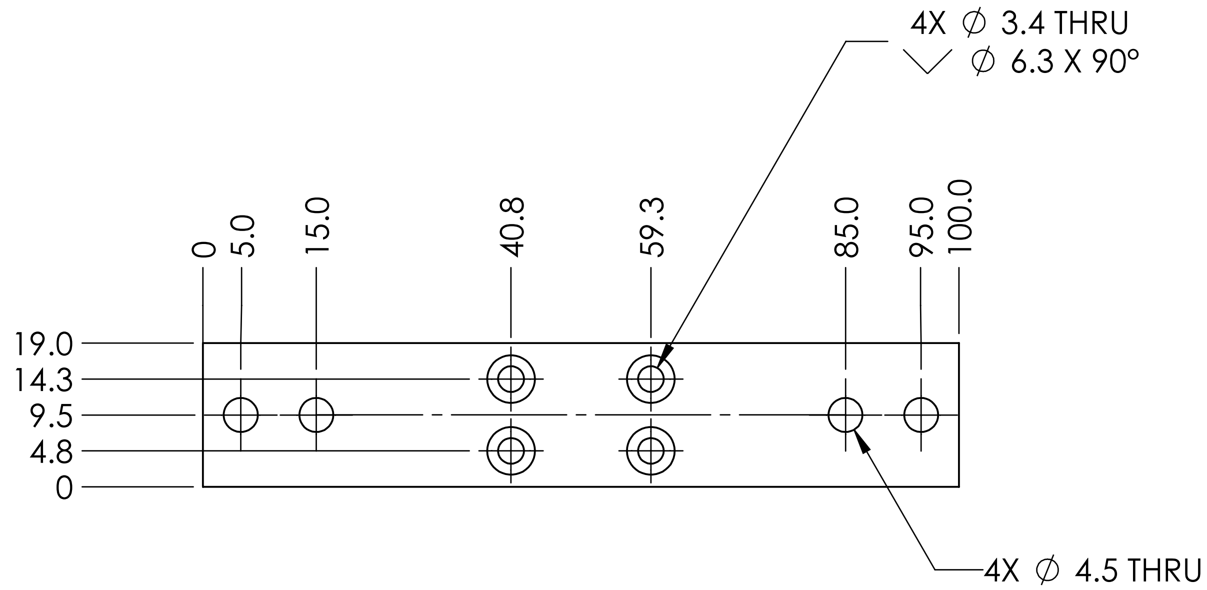

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3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: CRK

DATE (MM/DD/YY) 6/3/2022

MATERIAL: 14 Gauge Stainless Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-030-009

PART NAME: Cyl Clevis Support

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 1

SIZE A3

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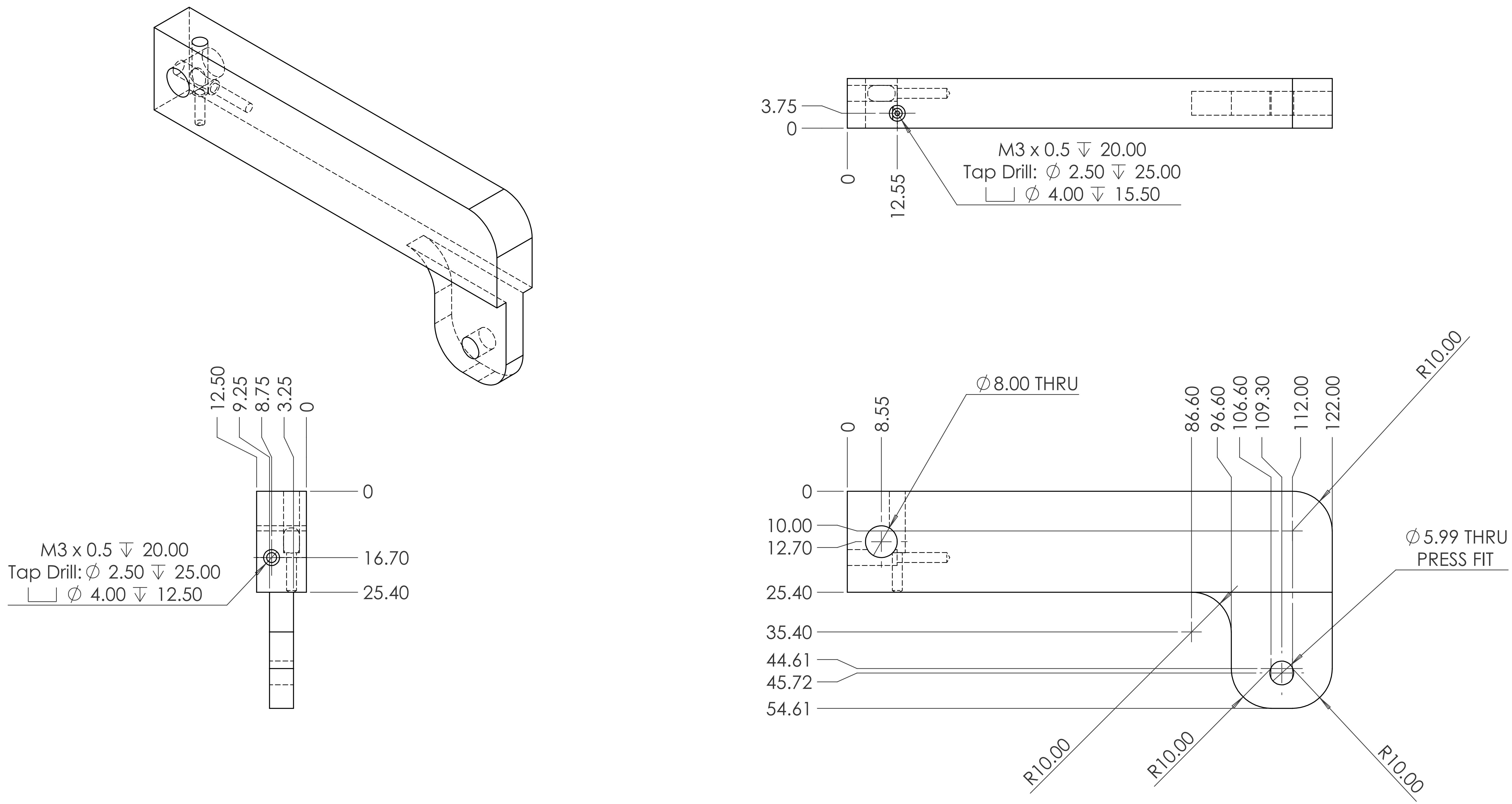

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Fax 616-554-9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M-1994

MASTER

GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: LD

DATE (MM/DD/YY) 5/31/2022

MATERIAL: ALUMINUM

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 2

PART NUMBER: A40-1400-11-030-010

PART NAME: lever arm

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 1

SIZE A3

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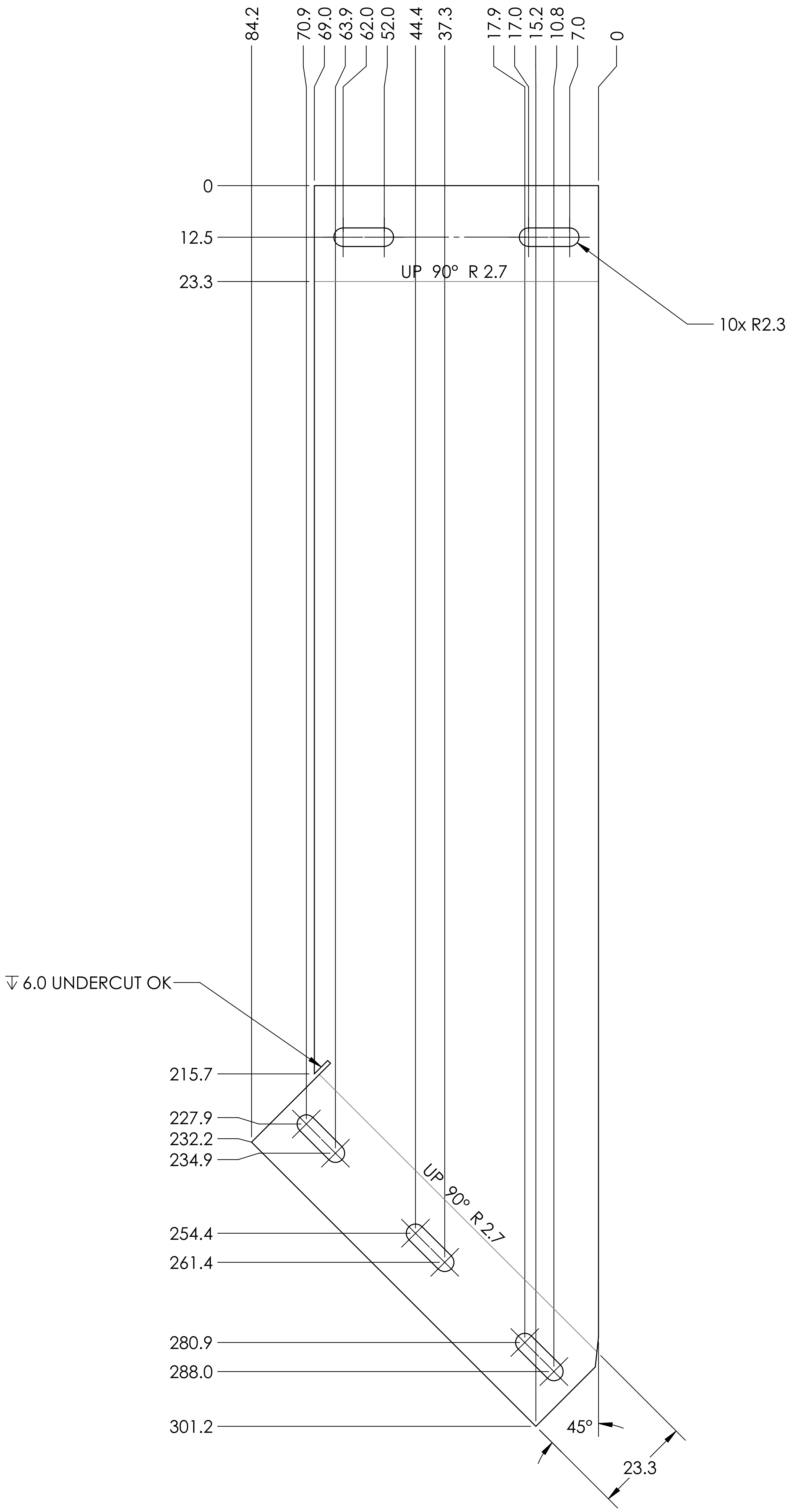

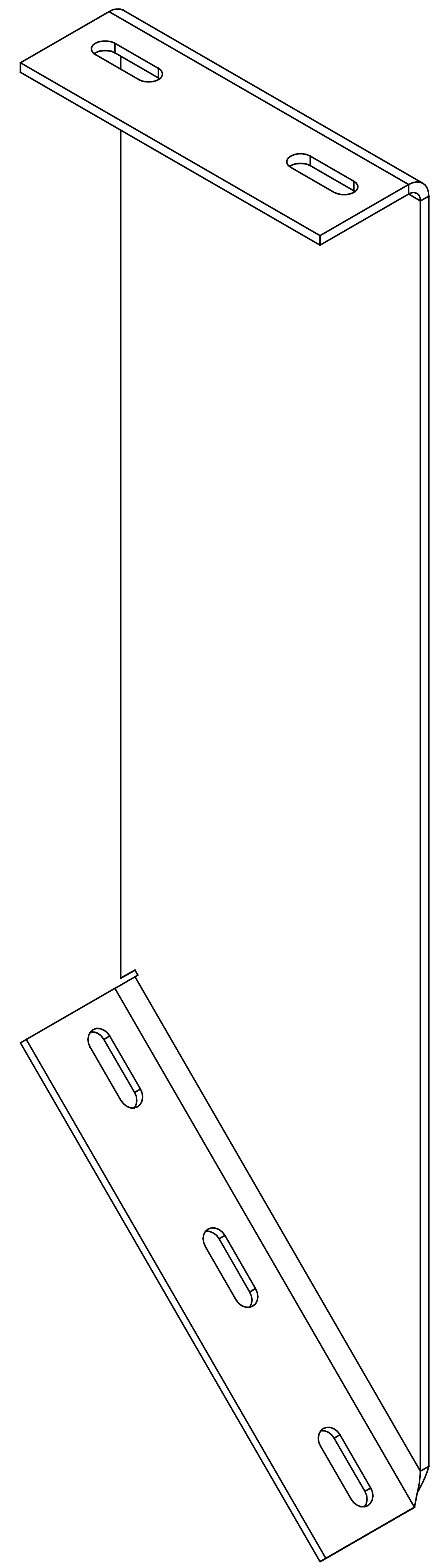

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 2		PART NUMBER A40-1400-11-030-011	PART NAME Vertical Support	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 2

SIZE A2

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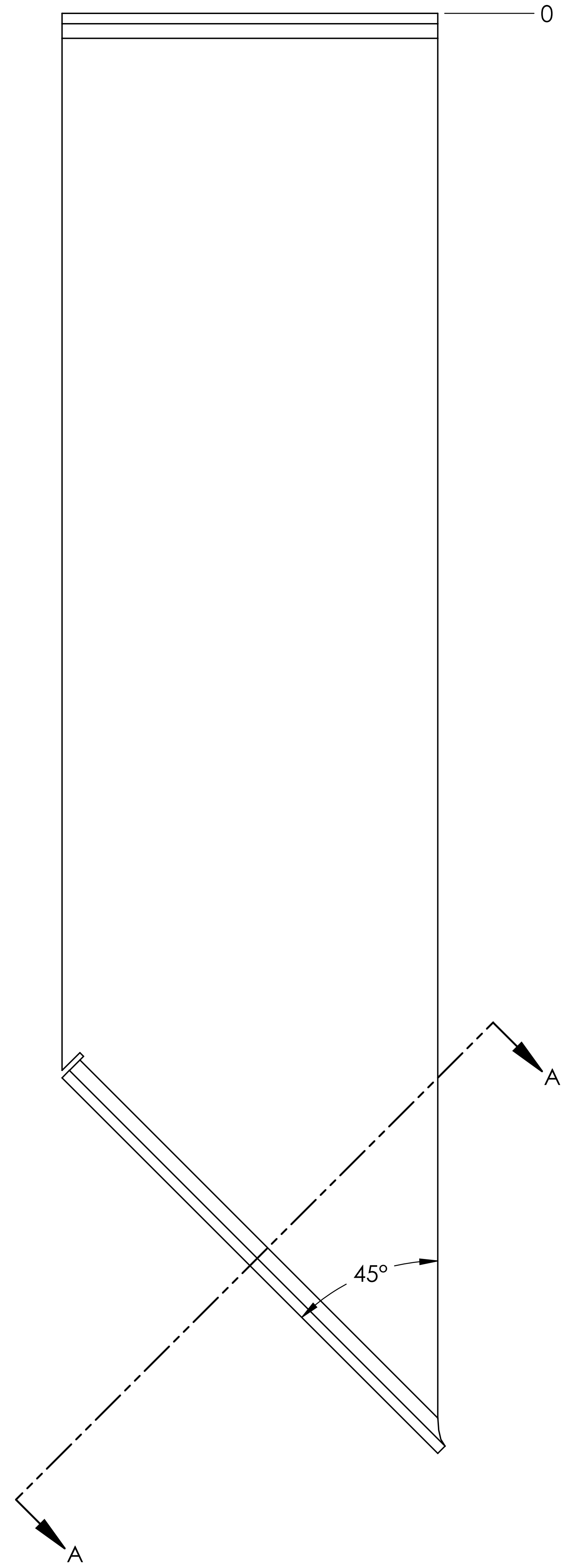

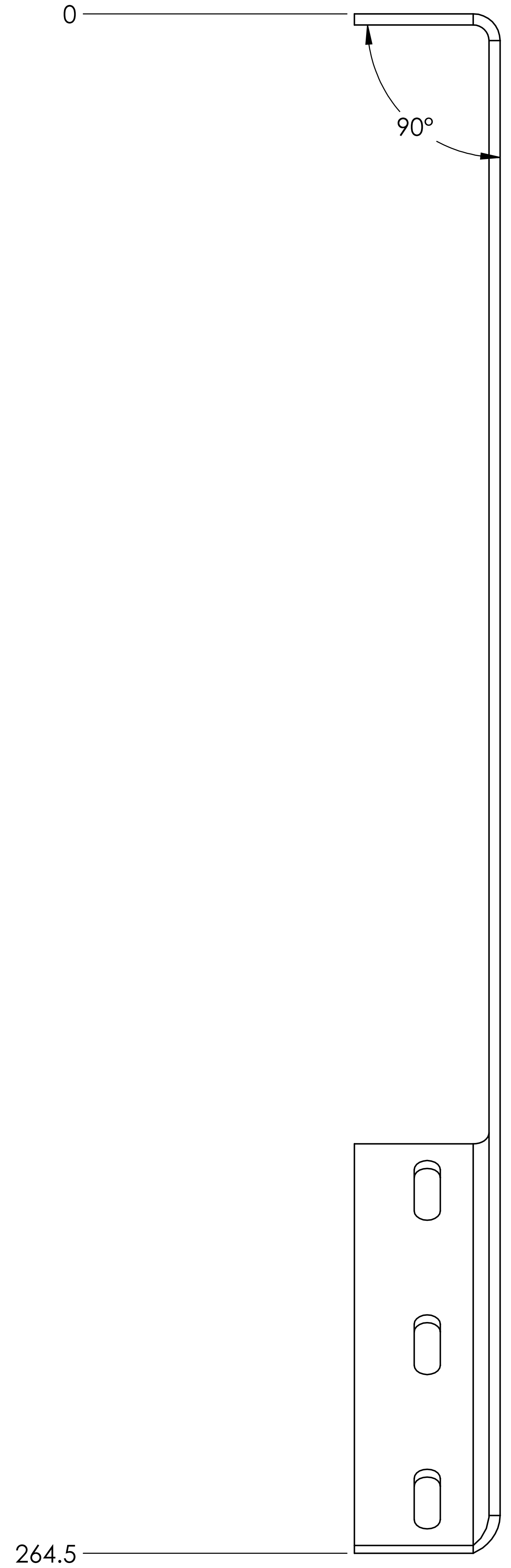

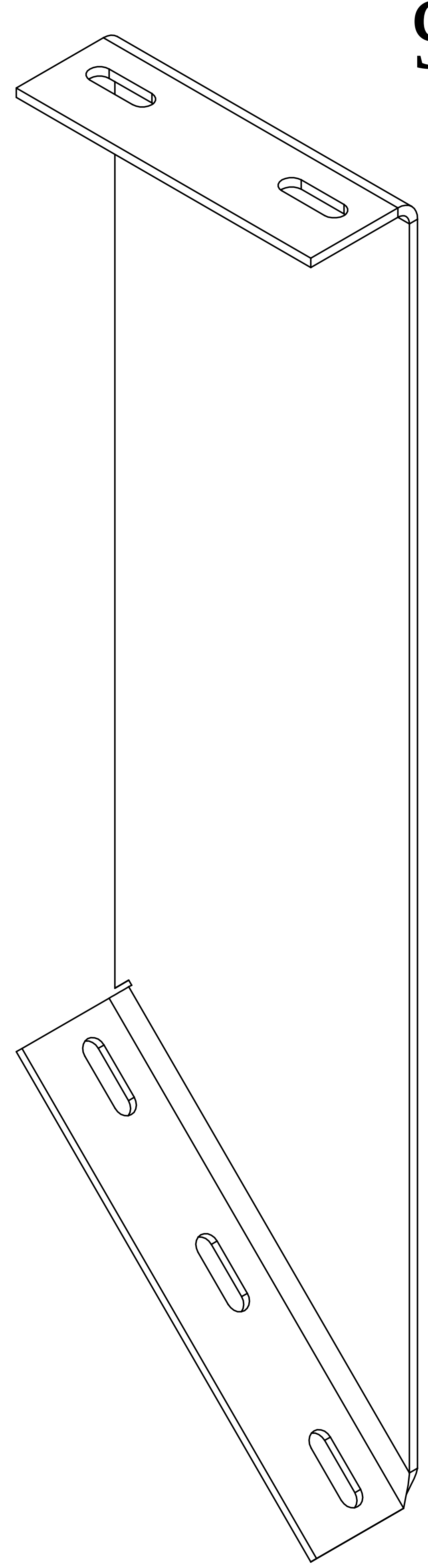

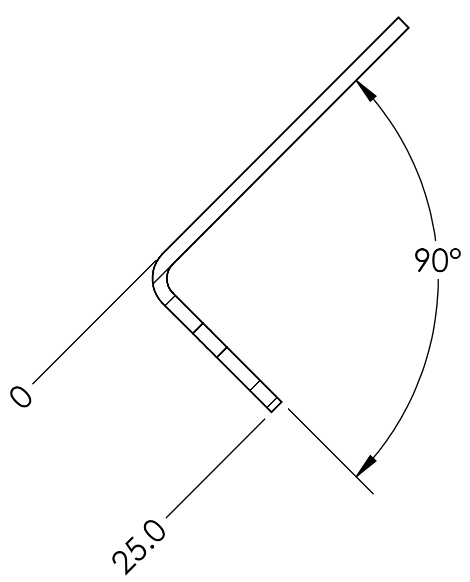

SECTION A-A

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 2		PART NUMBER A40-1400-11-030-011	PART NAME Vertical Support	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 2 OF 2

SIZE A2

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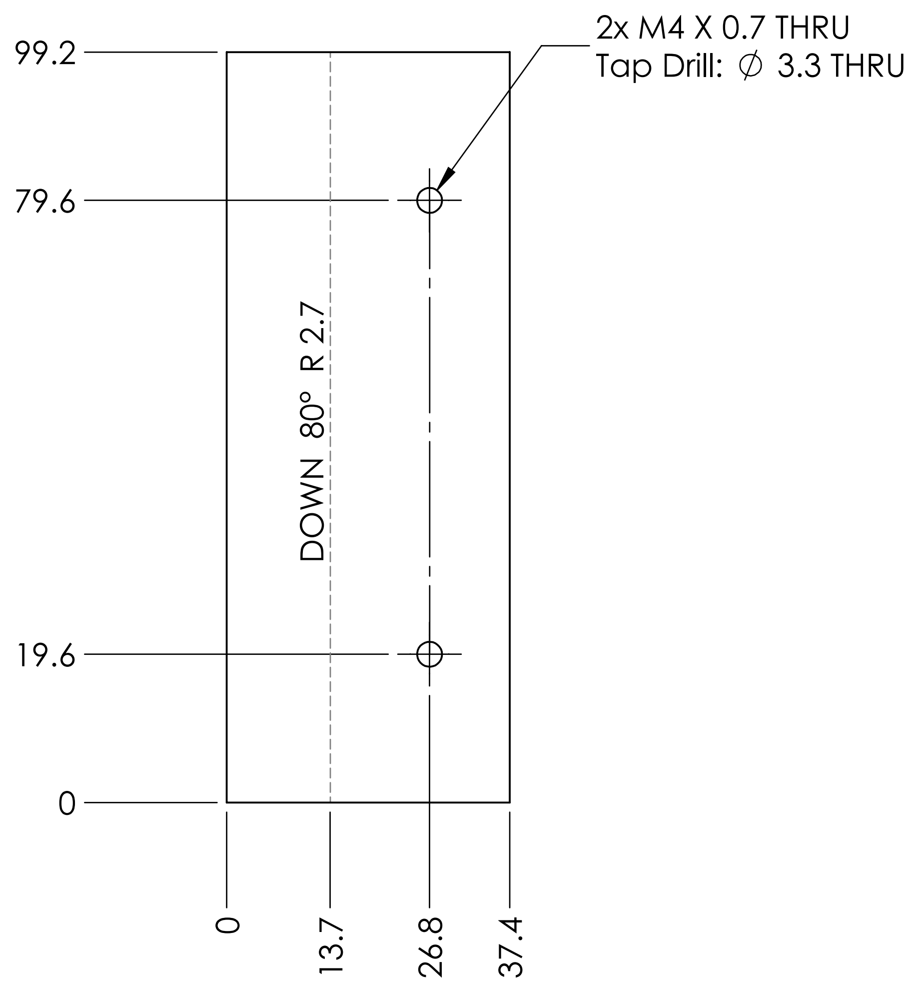

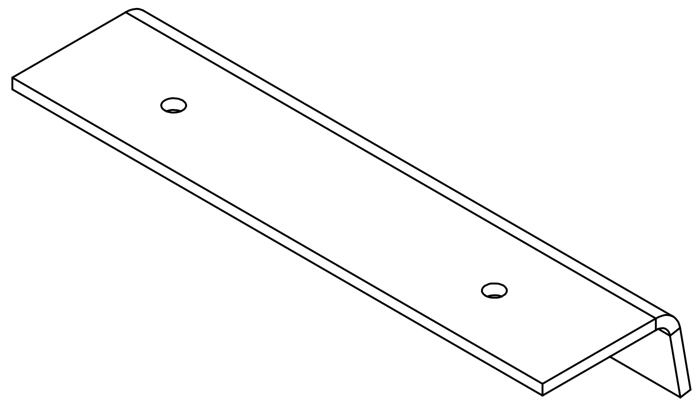

Swoboda, Inc. swoboda
4108 52nd Street, SE Ph. 616–554–6161
Kentwood, MI 49512–9636 Fax 616–554–9093

3RD Angle Projection

METRIC

IN ACCORDANCE WITH ASME Y14.5M–1994

MASTER

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

CAD SYSTEM: SW

DRAWN: CRK

DATE (MM/DD/YY) 6/2/2022

MATERIAL: 14 Gauge Stainless Steel

HEAT TREAT: NO

ALL DIMENSIONS IN MM

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING: NO

REV: 0

QTY: 4

PART NUMBER: A40–1400–11–030–012

PART NAME: Chute Extension

MOD: N

VENDOR PART#: N/A

DO NOT SCALE

SCALE: 1:1

SHEET: 1 OF 2

SIZE A3

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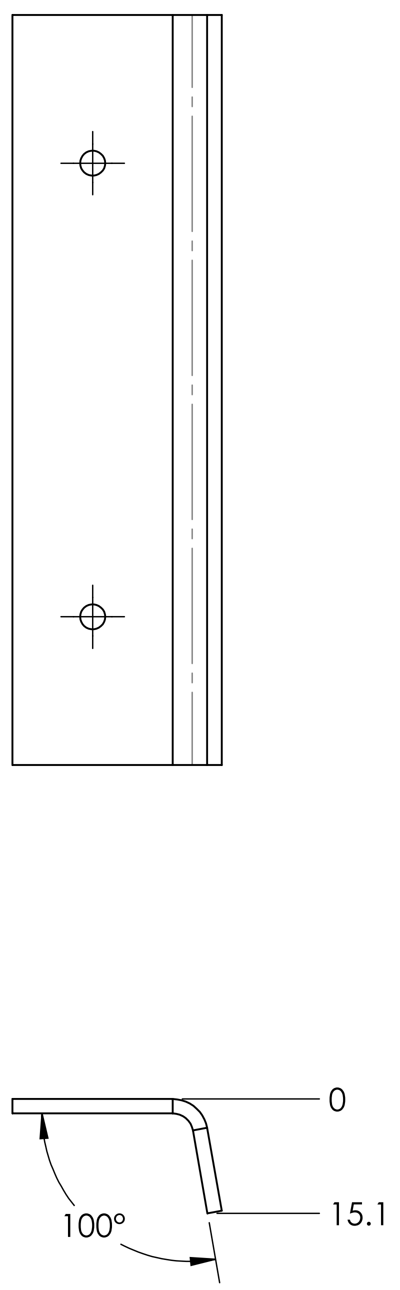

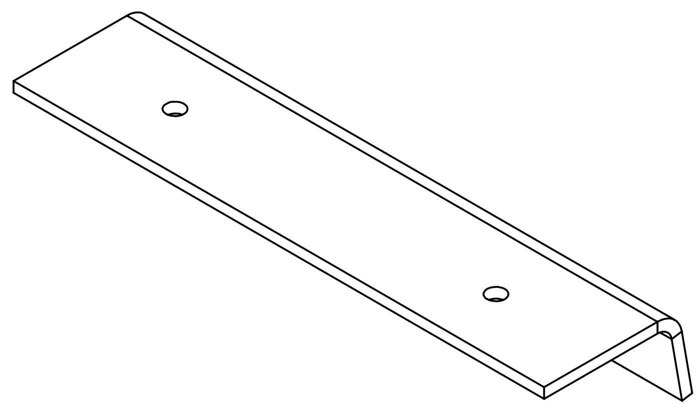

swoboda Swoboda, Inc. 4108 52nd Street, SE Kentwood, MI 49512-9636 Ph. 616-554-6161 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER CAD SYSTEM: SW
DRAWN: CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL: 14 Gauge Stainless Steel	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 4		PART NUMBER: A40-1400-11-030-012	PART NAME: Chute Extension	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 2 OF 2

SIZE A3

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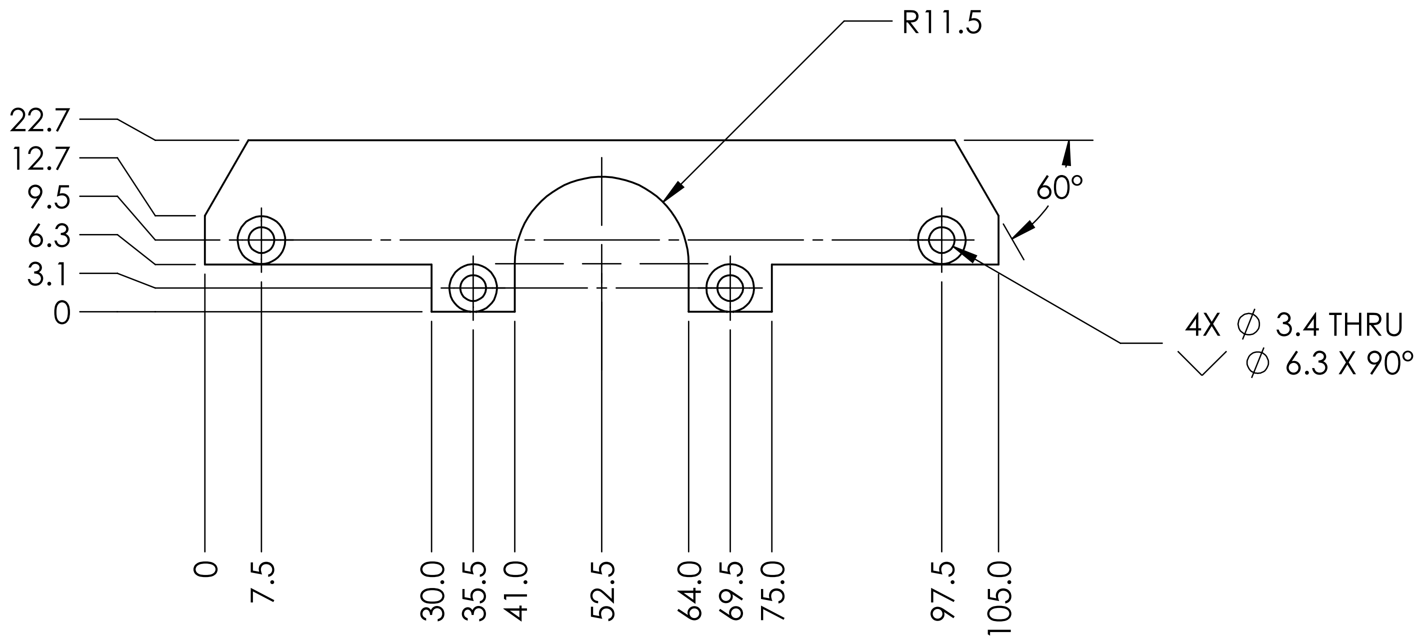

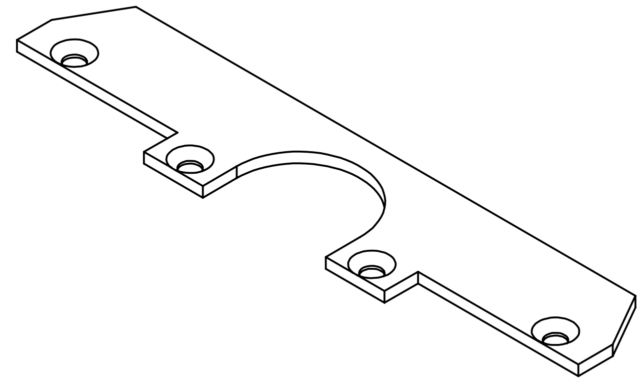

swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER CAD SYSTEM: SW
DRAWN: CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL: 14 Gauge Stainless Steel	HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING: NO		REV: 0
QTY: 4		PART NUMBER: A40-1400-11-030-013	PART NAME: Door Shroud	
MOD: N	VENDOR PART#: N/A	DO NOT SCALE	SCALE: 1:1	SHEET: 1 OF 1

SIZE A3

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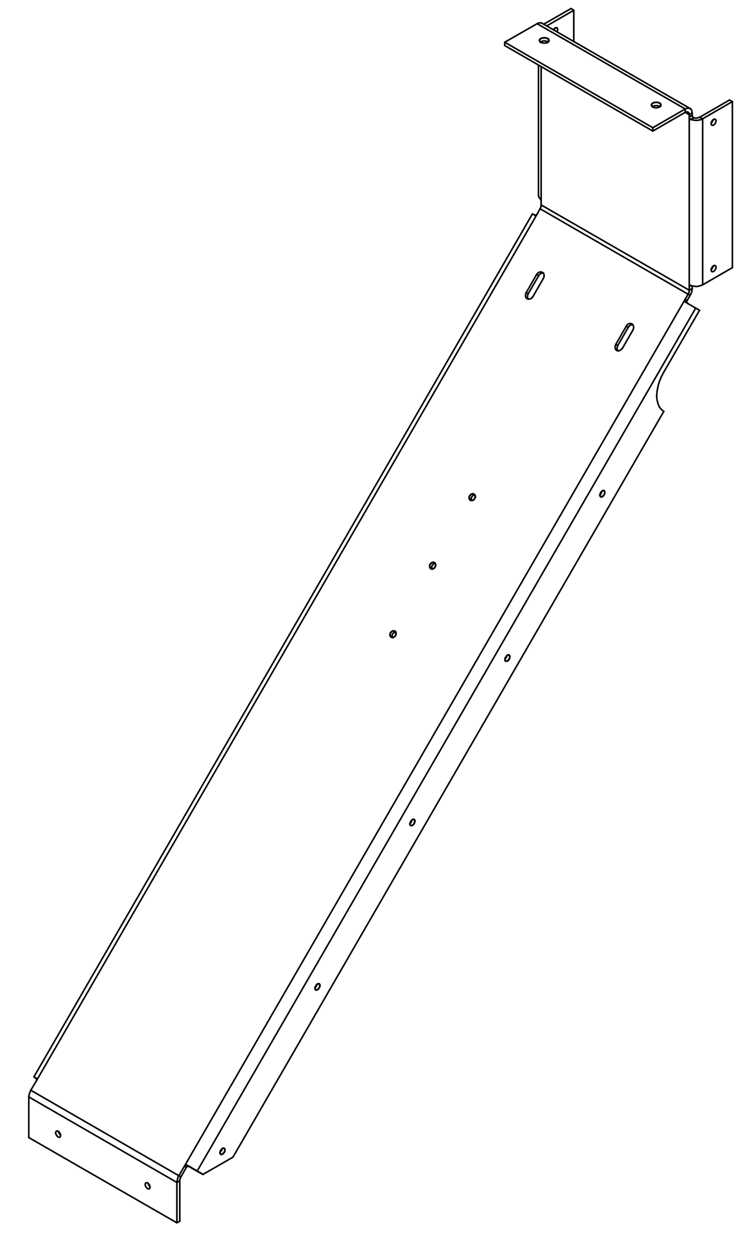
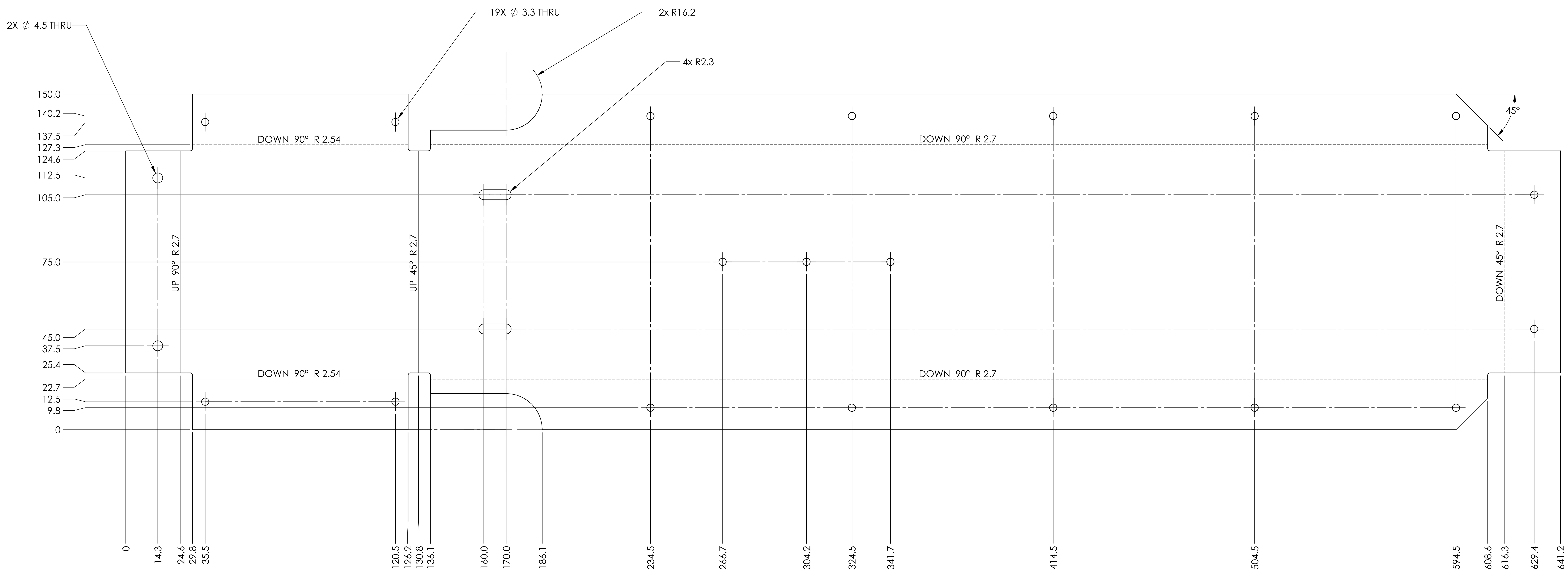
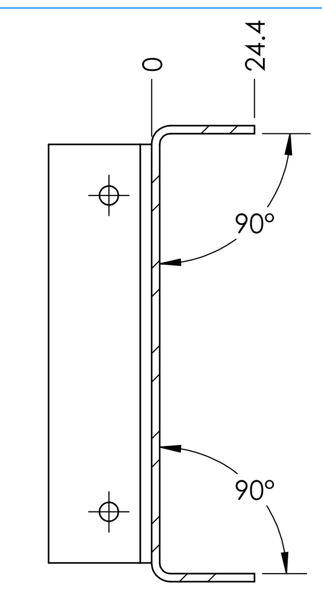


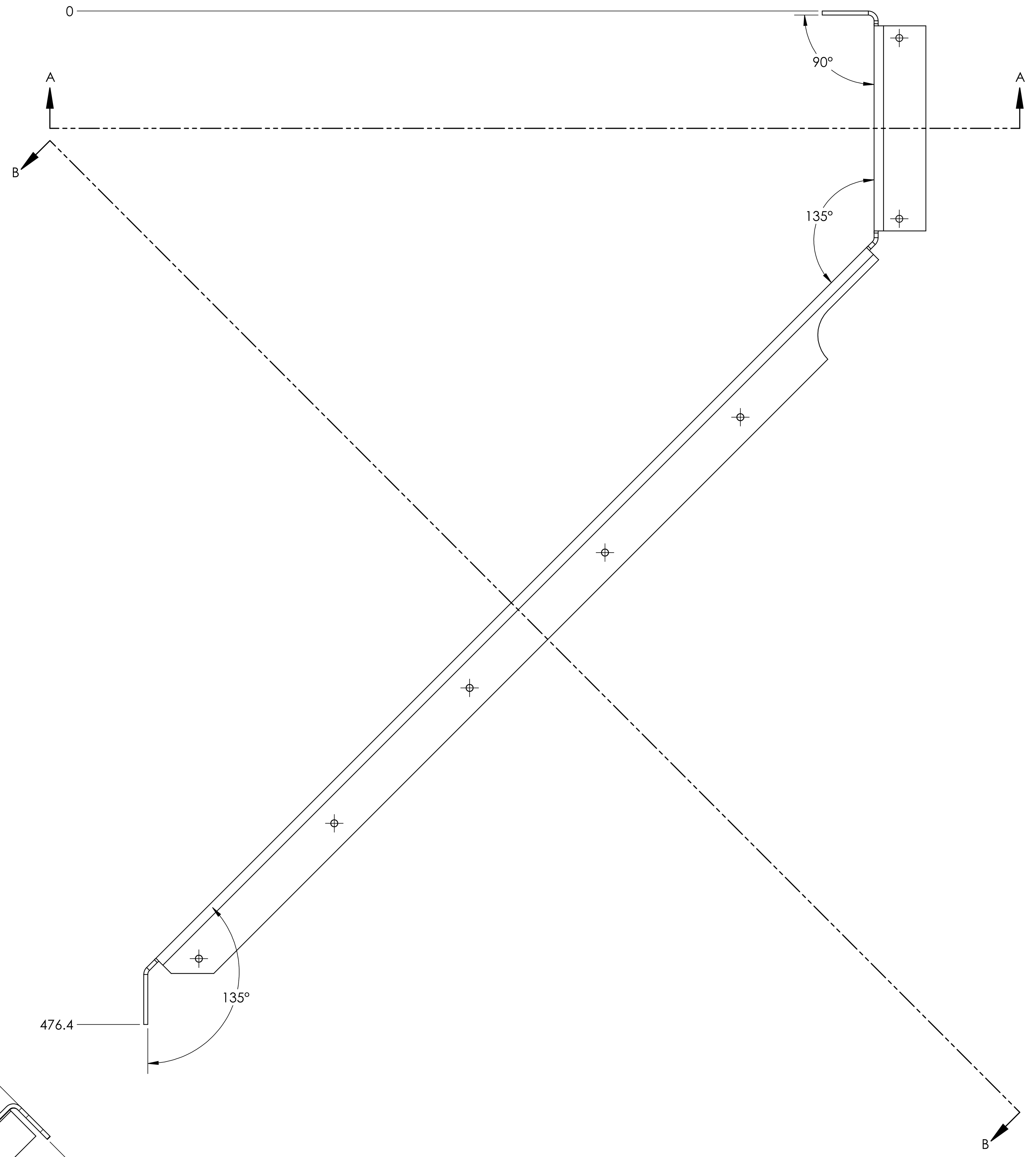


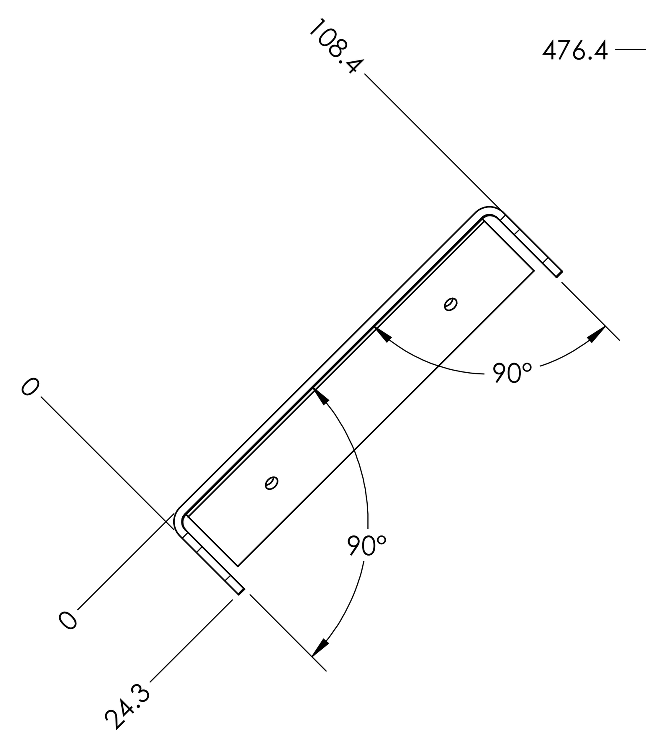
swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC All Dimensions in MM	IN ACCORDANCE WITH ASME Y14.5M-1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 1		PART NUMBER A40-1400-11-030-014	PART NAME outside panel	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 2

SIZE A1



SECTION A-A





SECTION B-B

swoboda
Swoboda, Inc.
4108 52nd Street, SE
Kentwood, MI 49512-9636
Ph. 616-554-6161
Fax 616-554-9093

3RD ANGLE PROJECTION

METRIC
All Dimensions in MM

IN ACCORDANCE WITH ASME Y14.5M-1994

CAD DATA IS MASTER

CAD SYSTEM NX

GENERAL DIMENSIONAL TOLERANCING:
X.X=±0.1 X.XX=±0.05 ANGLE=±1°

DRAWN CRK

DATE (MM/DD/YY) 6/2/2022

MATERIAL 14 Gauge Stainless Steel

HEAT TREAT NO

ALL EDGES BROKEN 0.5 MM MAX
UNLESS OTHERWISE SPECIFIED

SURFACE COATING NO

REV 0

QTY: 1

PART NUMBER A40-1400-11-030-014

PART NAME outside panel

MOD N

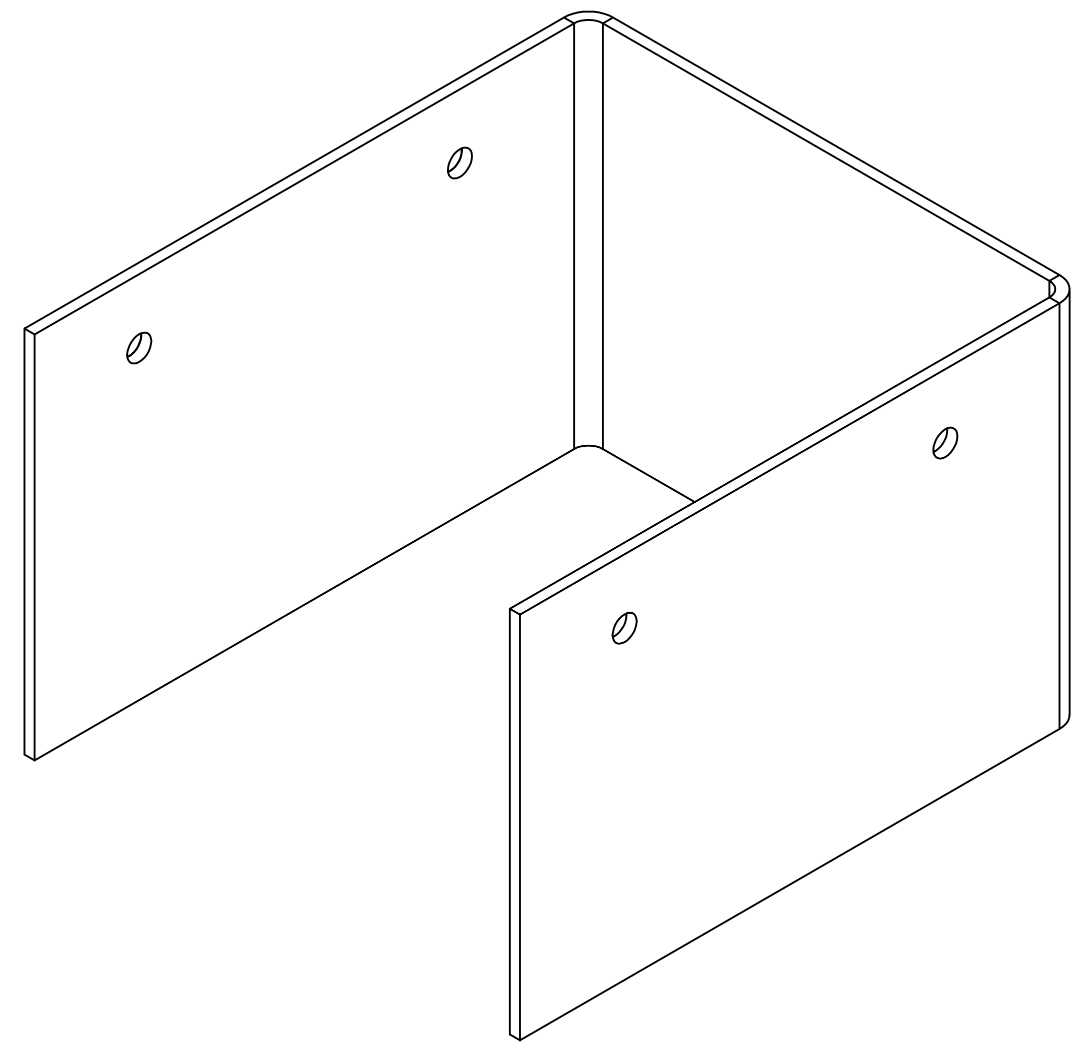
VENDOR PART# N/A

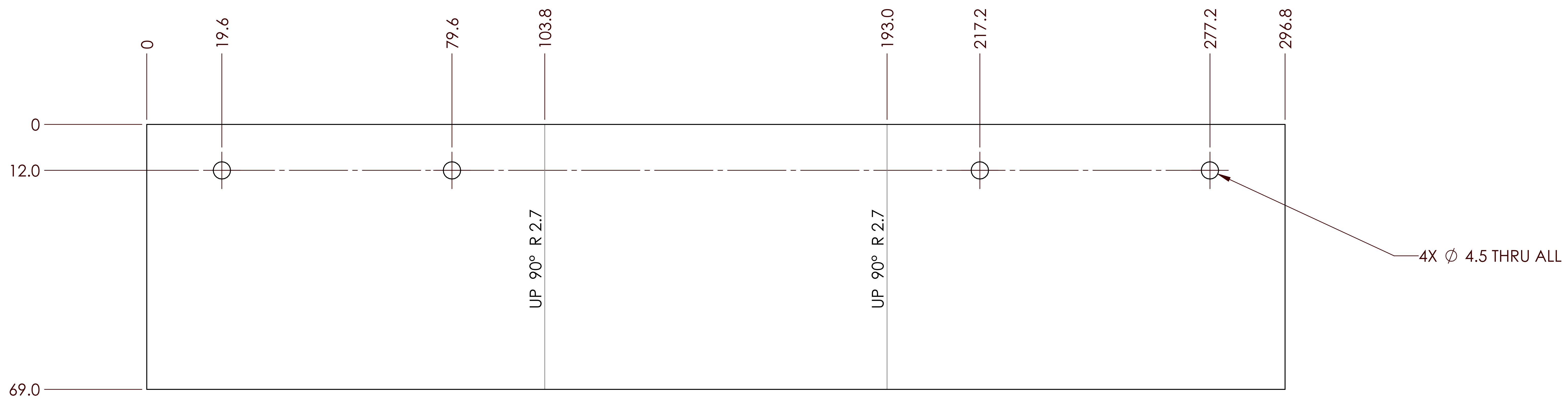
DO NOT SCALE

SCALE 1:1.5

SHEET 2 OF 2

SIZE A1





swoboda Swoboda, Inc. 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	CAD DATA IS MASTER CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel		HEAT TREAT NO
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 3		PART NUMBER A40-1400-11-030-015	PART NAME Chute Bottom	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 1 OF 2

SIZE A2

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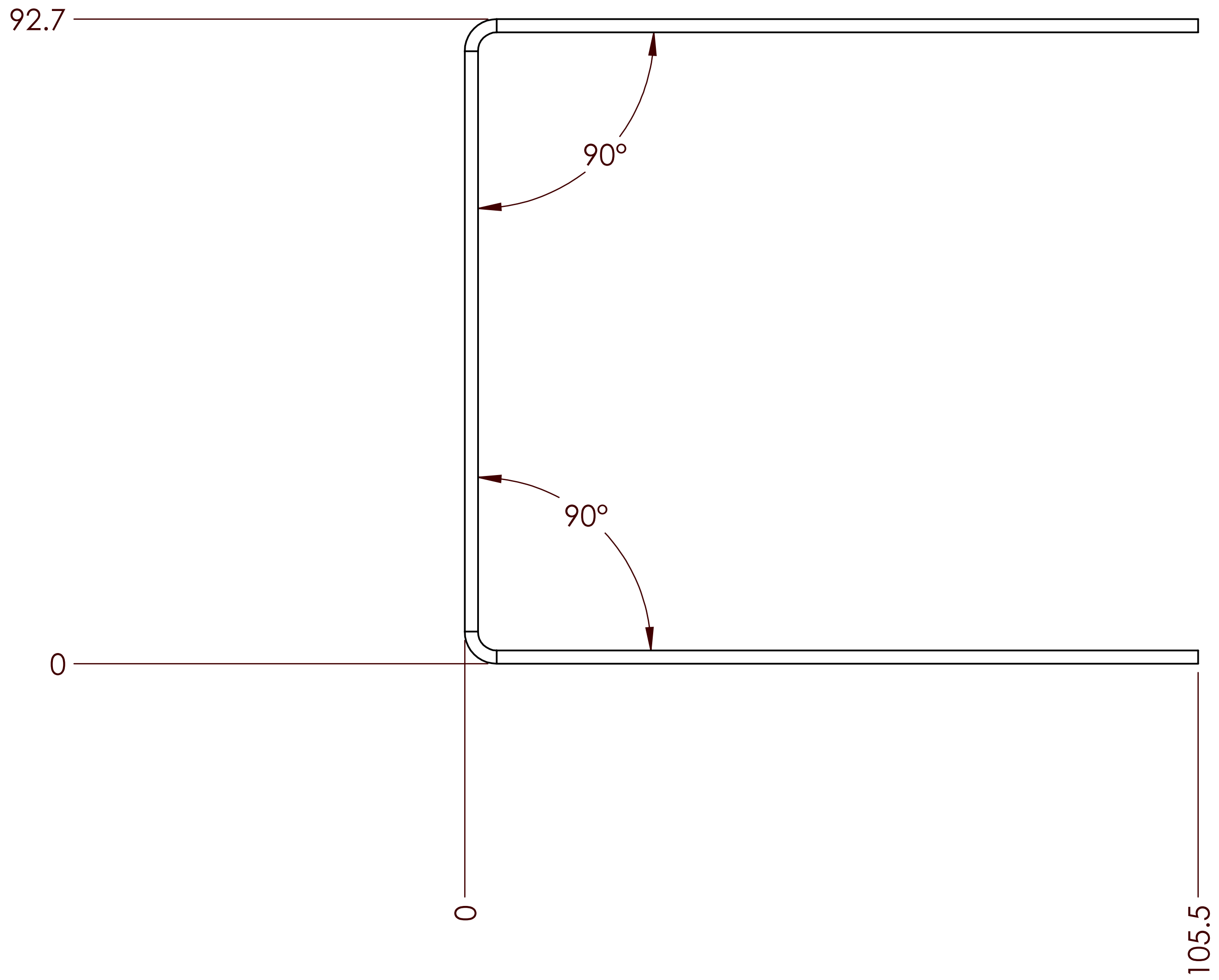

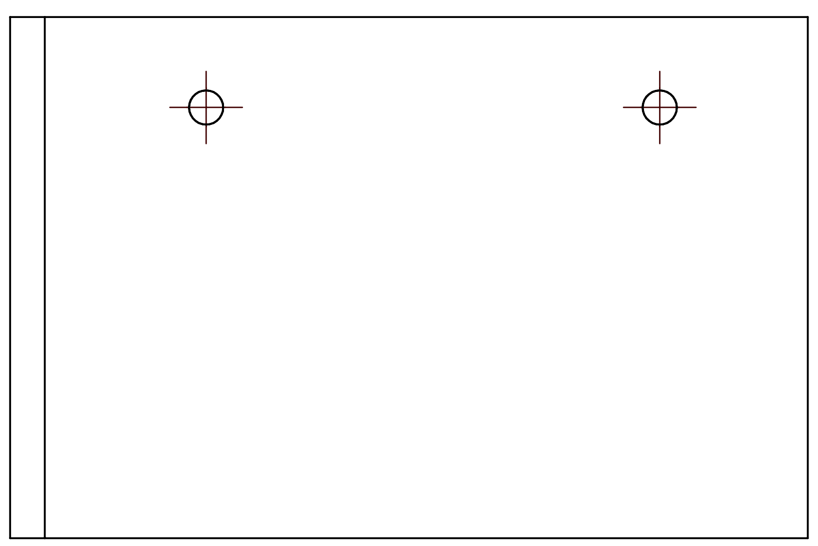

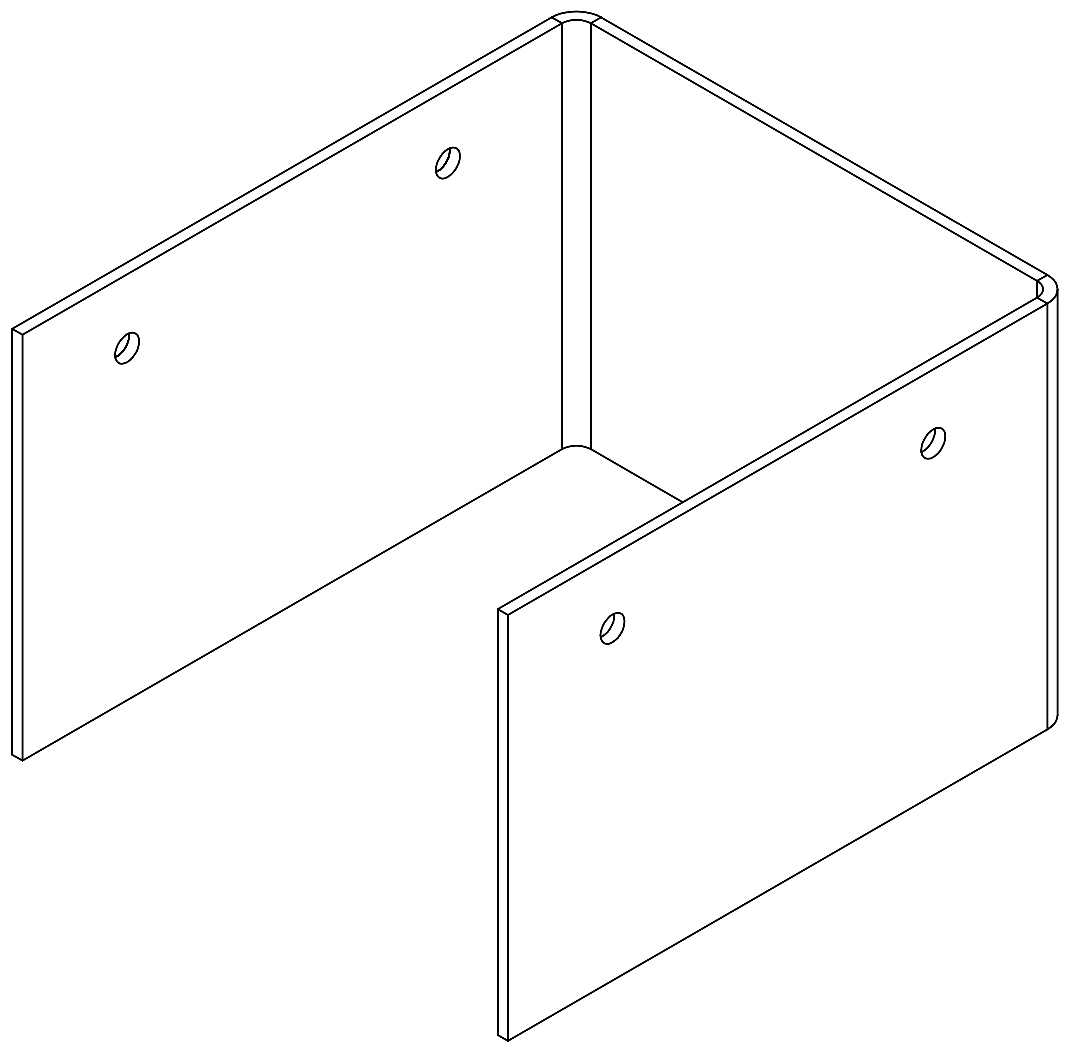

Swoboda, Inc. 4108 52nd Street, SE Ph. 616–554–6161 Kentwood, MI 49512–9636 Fax 616–554–9093	3RD ANGLE PROJECTION	METRIC ALL DIMENSION IN MM	IN ACCORDANCE WITH ASME Y14.5M–1994	CAD DATA IS MASTER
		GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°		CAD SYSTEM NX
DRAWN CRK	DATE (MM/DD/YY) 6/2/2022	MATERIAL 14 Gauge Stainless Steel	HEAT TREAT NO	
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED		SURFACE COATING NO		REV 0
QTY: 3		PART NUMBER A40–1400–11–030–015	PART NAME Chute Bottom	
MOD N	VENDOR PART# N/A	DO NOT SCALE	SCALE 1:1	SHEET 2 OF 2

SIZE A2

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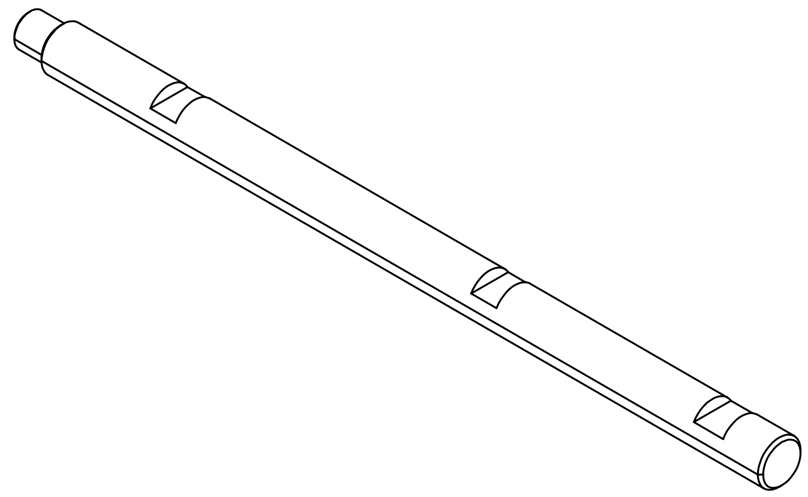

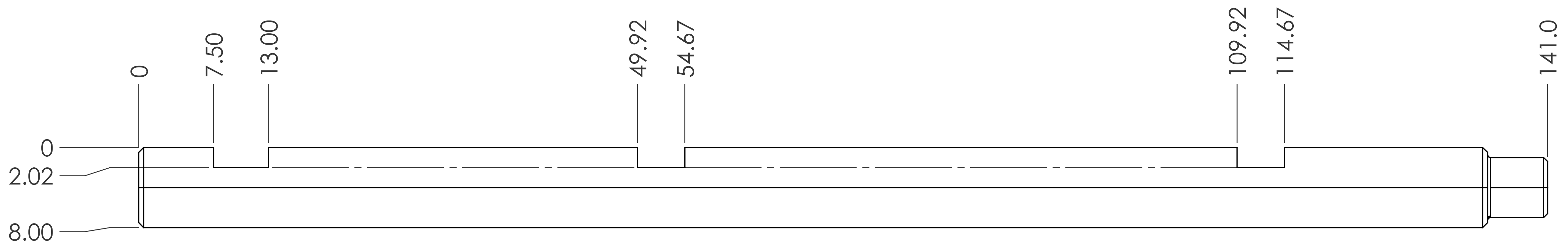

Swoboda, Inc. swoboda 4108 52nd Street, SE Ph. 616-554-6161 Kentwood, MI 49512-9636 Fax 616-554-9093	3RD Angle Projection	METRIC	IN ACCORDANCE WITH ASME Y14.5M-1994 GENERAL DIMENSIONAL TOLERANCING: X.X=±0.1 X.XX=±0.05 ANGLE=±1°	MASTER CAD SYSTEM: SW
DRAWN: LD DATE (MM/DD/YY) 7/1/2022	MATERIAL: STEEL		HEAT TREAT: NO	ALL DIMENSIONS IN MM
ALL EDGES BROKEN 0.5 MM MAX UNLESS OTHERWISE SPECIFIED	SURFACE COATING: NO			REV: 0
QTY: 2	PART NUMBER: A40-1400-11-030-016		PART NAME: Trap Door Shaft	
MOD: Y VENDOR PART#: PSFGG8-135-F6-P6-M3	DO NOT SCALE		SCALE: 2:1	SHEET: 1 OF 1 SIZE A3

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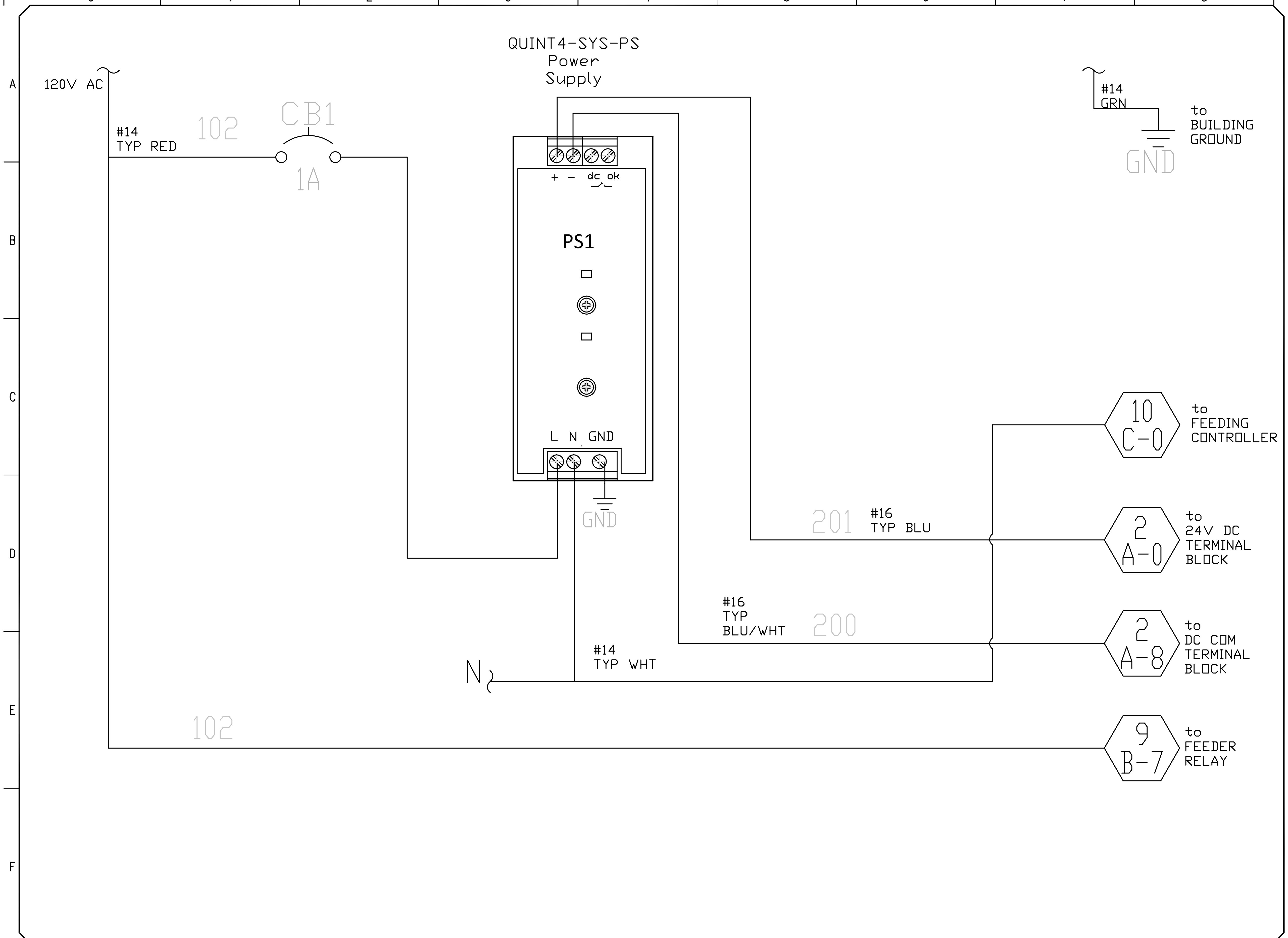
Winton Washer Machine Eletrical Details

INDEX



1

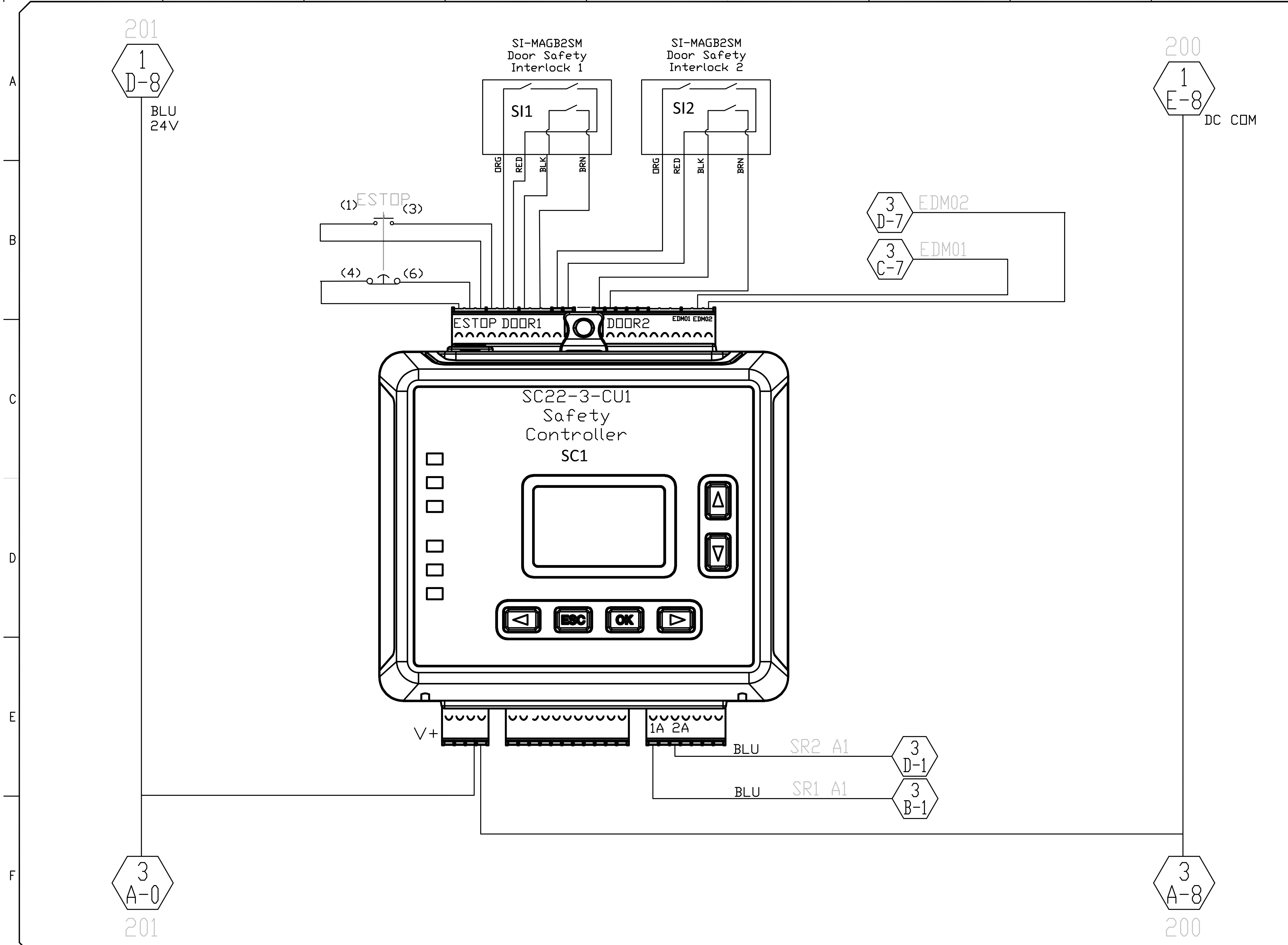
NO.	DATE	REVISION	BY

DWG TITLE
POWER SUPPLY

ENGINEER TEAM_20	CHECKED BY DANIEL_W
JOB NO SWOBODA	DRAWN BY JORDAN_H
SCALE N.T.S.	DATE 8/1/2022

DWG NO 1

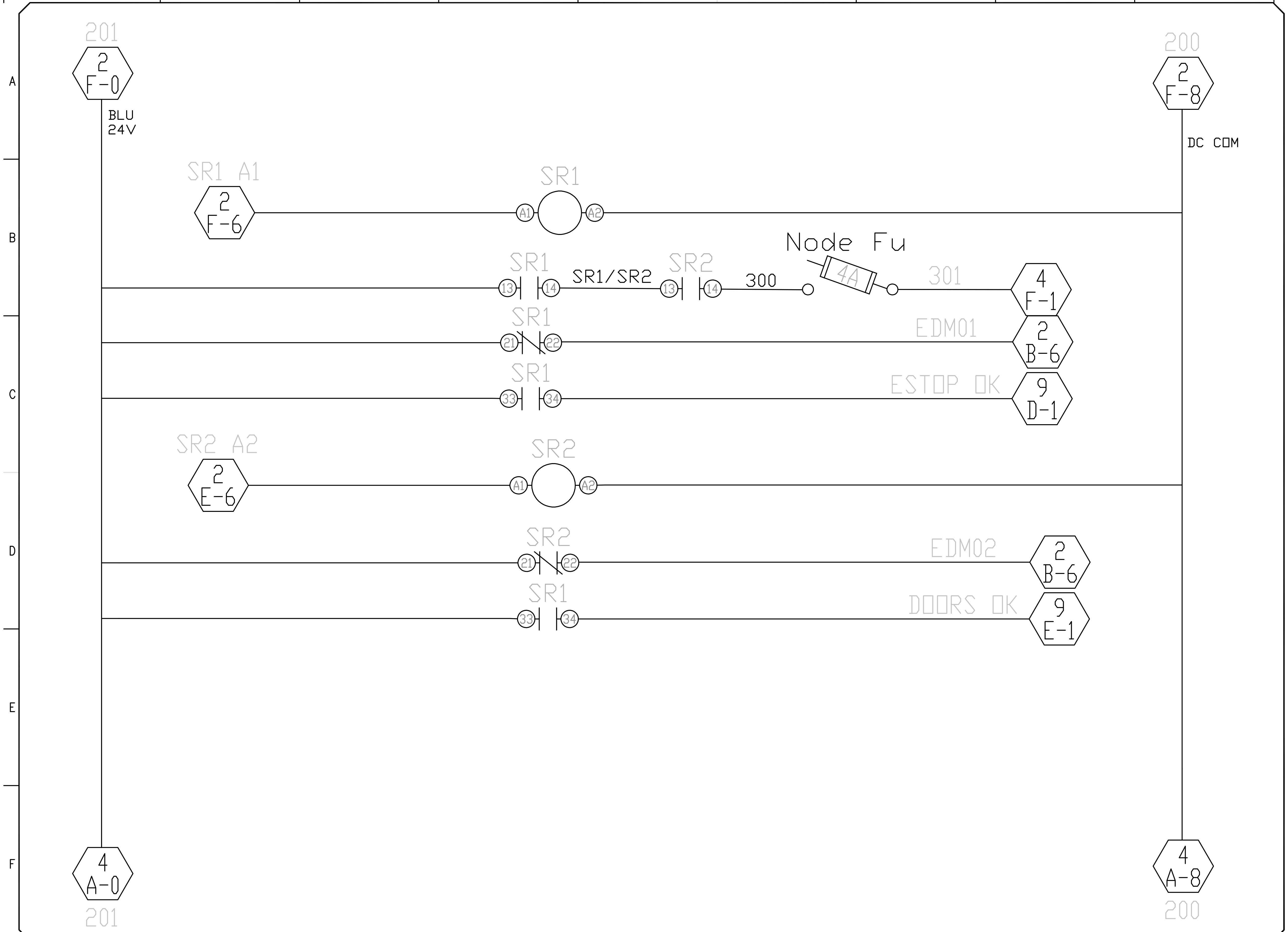
SHEET NO 1 OF 17



NO.	DATE	REVISION	BY

DWG TITLE: *SAFETY CONTROLLER*

ENGINEER: TEAM_20	CHECKED BY: DANIEL_W
JOB NO: SWOBODA	DRAWN BY: JORDAN_H
SCALE: N.T.S.	DATE: 8/1/2022
DWG NO: 2	
SHEET NO: 2 OF 17	

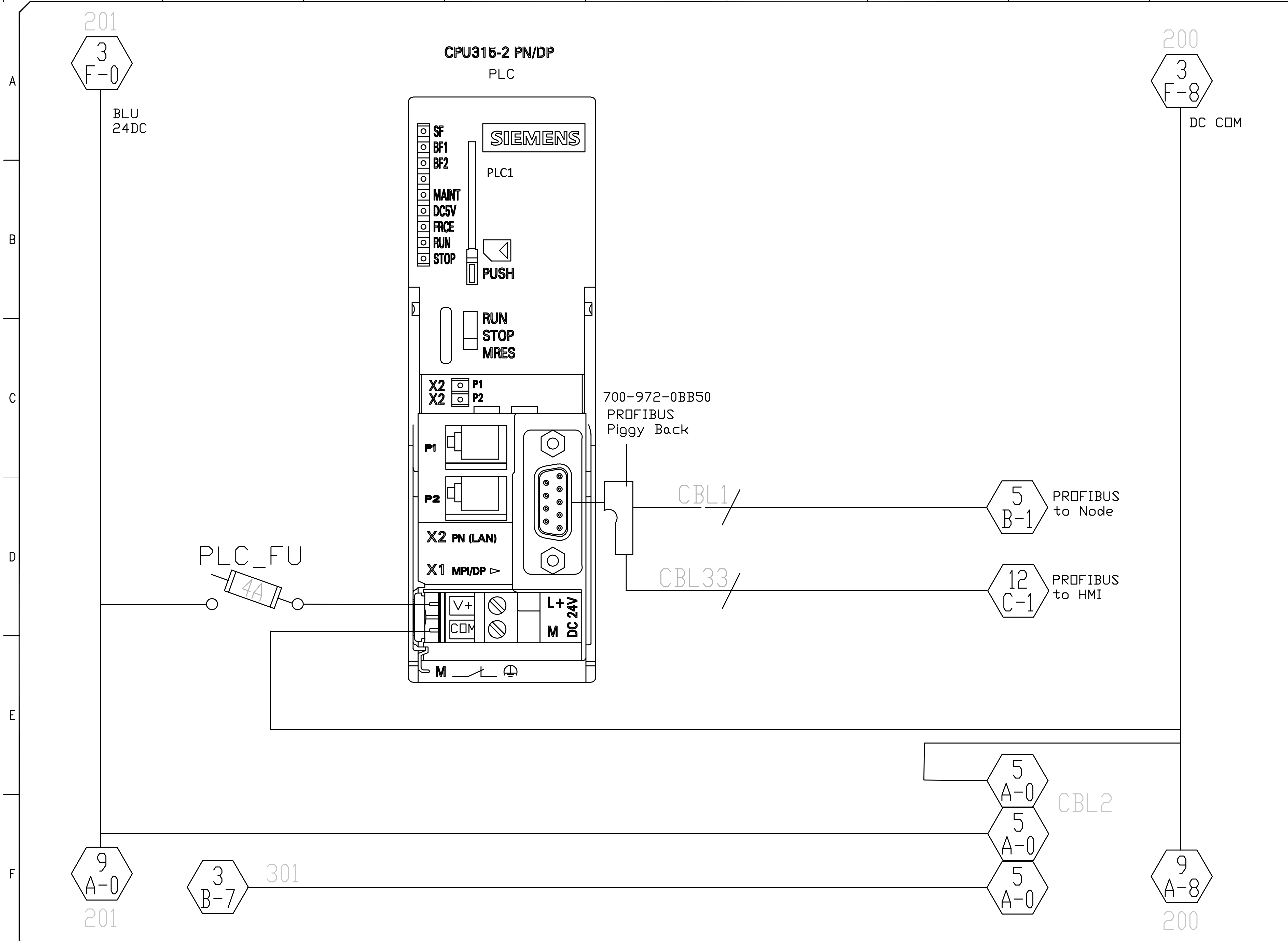


Autodesk

NO.	DATE	REVISION	BY

DWG TITLE	SAFETY_RELAY
ENGINEER TEAM_20	CHECKED BY DANIEL_W
JOB NO SWOBODA	DRAWN BY JORDAN_H
SCALE N.T.S.	DATE 8/1/2022
DWG NO 3	
SHEET NO 3 OF 17	

CAD DWG FILE CAD#



4

Autodesk

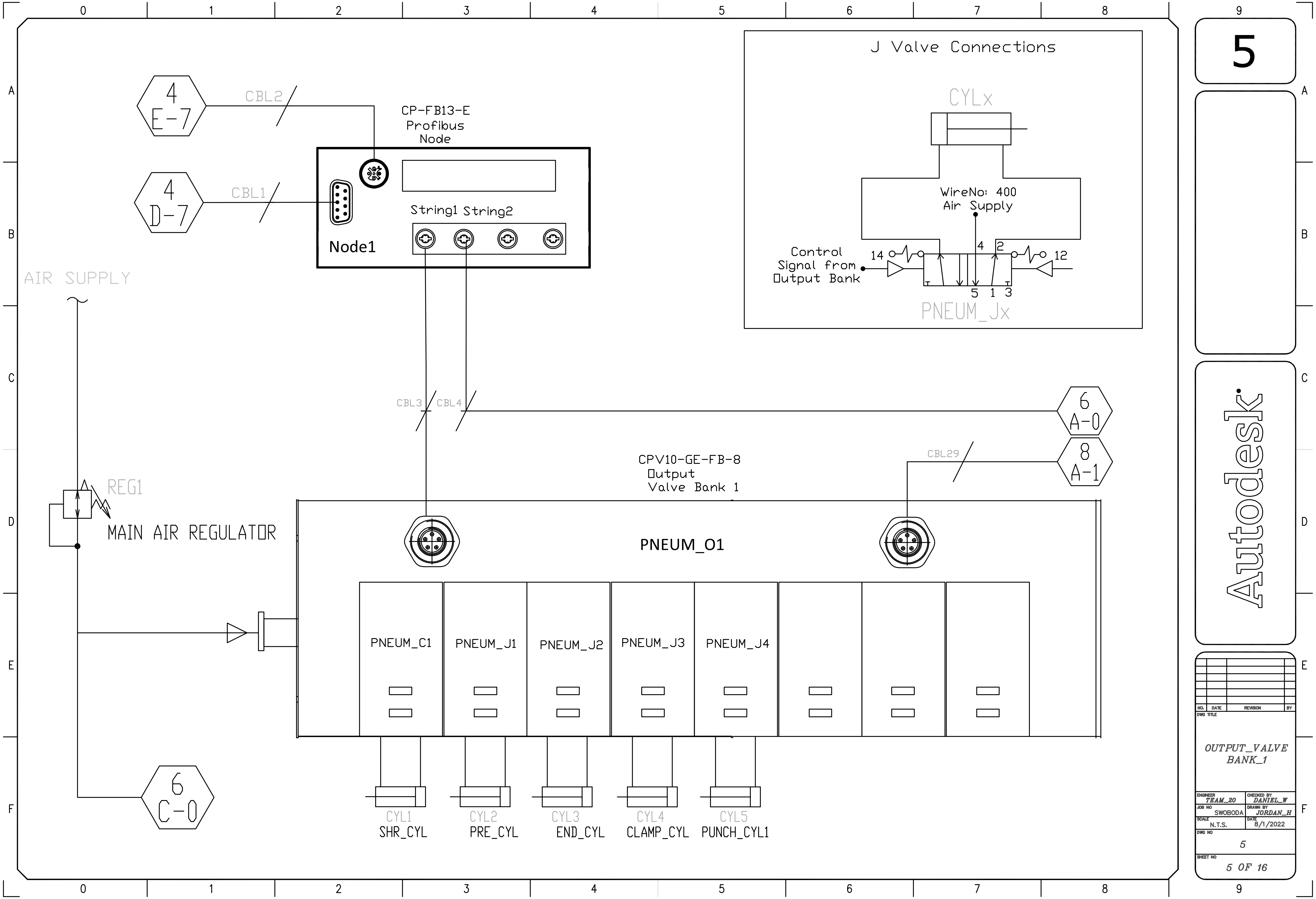
NO.	DATE	REVISION	BY

DWG TITLE
SIEMENS S7300

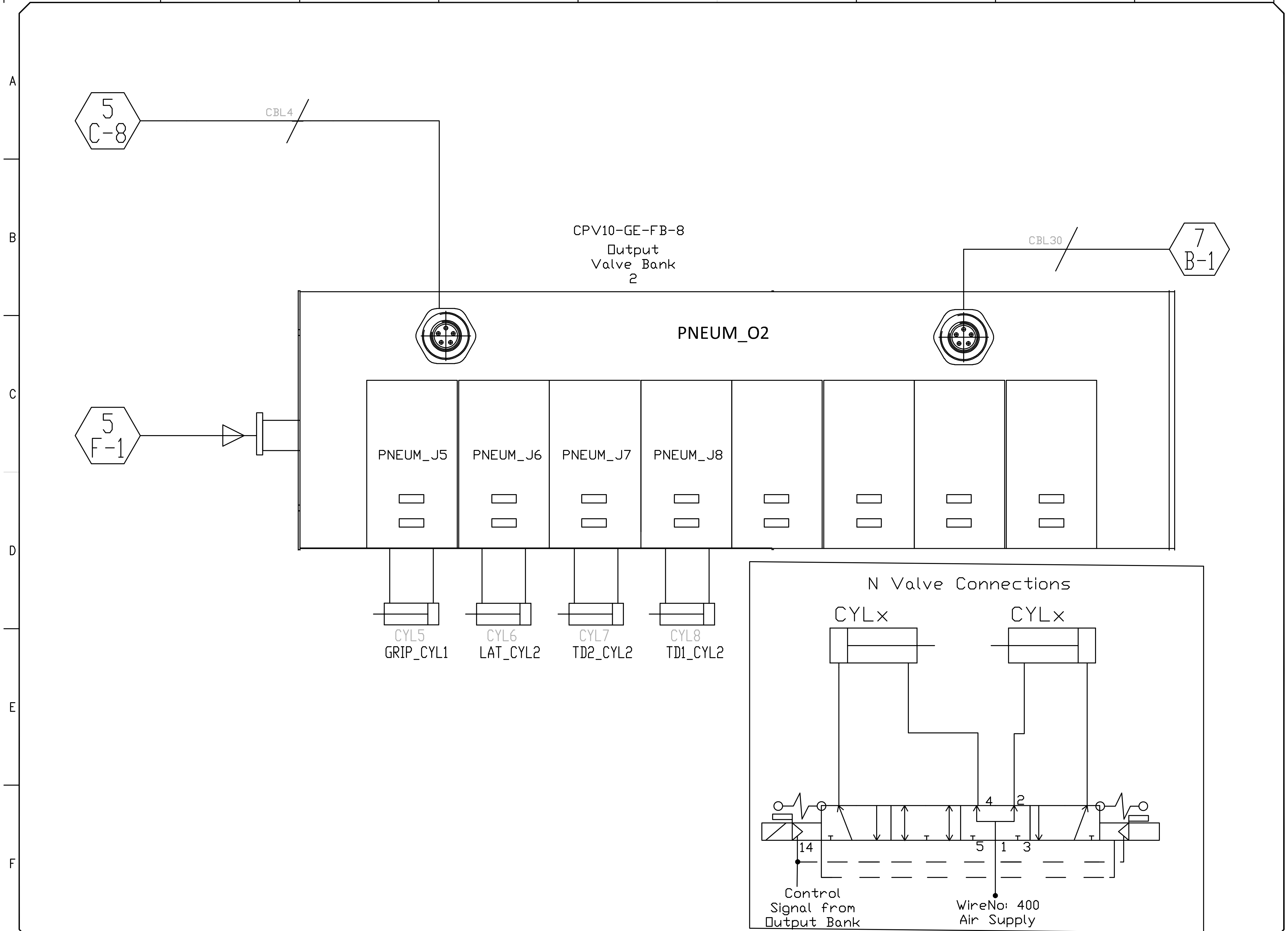
ENGINEER TEAM_20	CHECKED BY DANIEL_W
JOB NO SWOBODA	DRAWN BY JORDAN_H
SCALE N.T.S.	DATE 8/1/2022

DWG NO 4

SHEET NO 4 OF 17



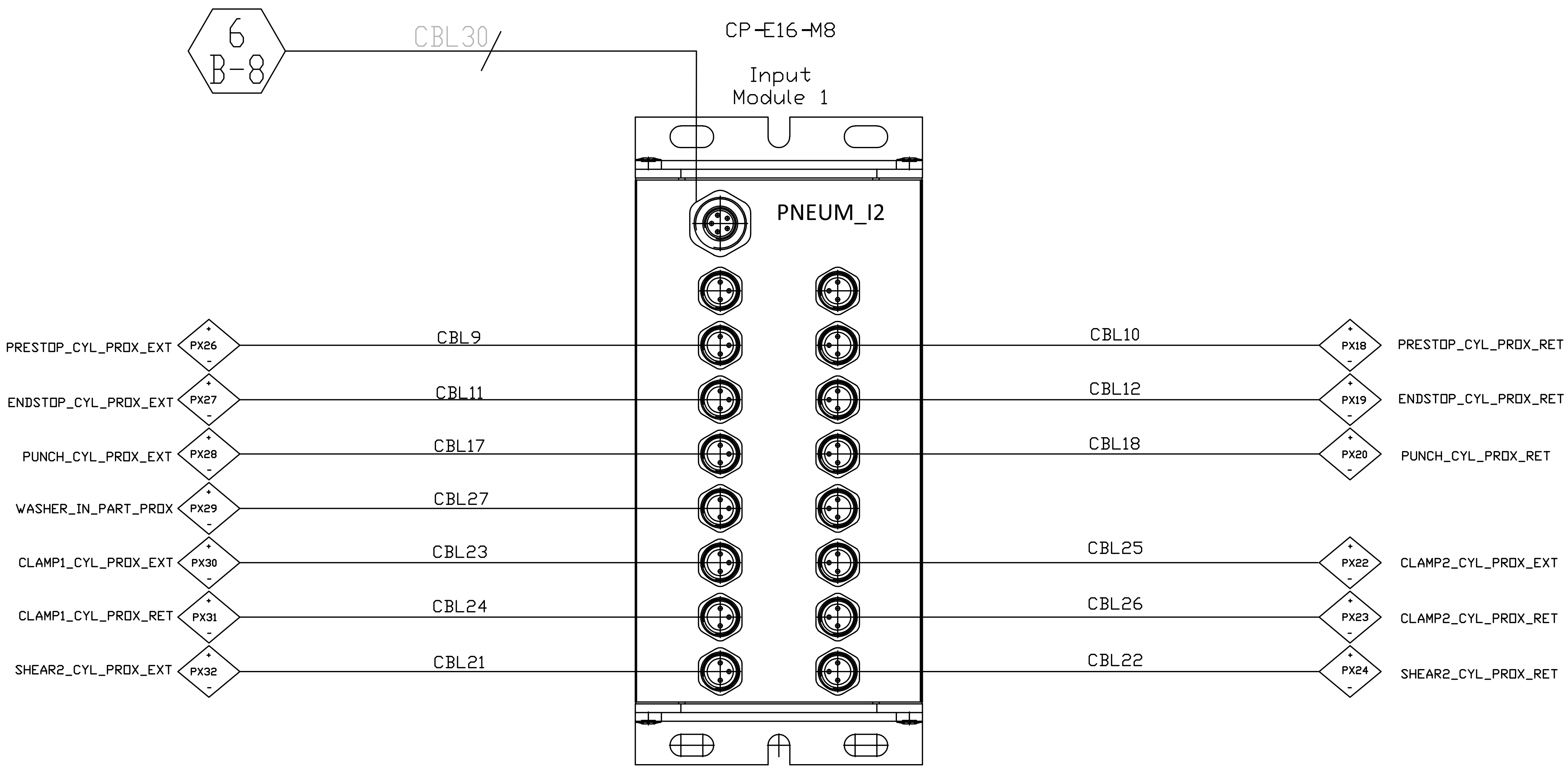
5
J Valve Connections
CYLx
WireNo: 400
Air Supply
Control
Signal from
Output Bank
14
4
2
12
5 1 3
PNEUM_Jx
CBL2
CBL1
4
E-7
4
D-7
CP-FB13-E
Profibus
Node
String1 String2
Node1
AIR SUPPLY
CBL3
CBL4
6
A-0
CBL29
8
A-1
CPV10-GE-FB-8
Output
Valve Bank 1
PNEUM_O1
REG1
MAIN AIR REGULATOR
PNEUM_C1
PNEUM_J1
PNEUM_J2
PNEUM_J3
PNEUM_J4
6
C-0
CYL1
SHR_CYL
CYL2
PRE_CYL
CYL3
END_CYL
CYL4
CLAMP_CYL
CYL5
PUNCH_CYL1
Autodesk
NO.
DATE
REVISION
BY
DWG TITLE
OUTPUT_VALVE
BANK_1
ENGINEER
TEAM_20
CHECKED BY
DANIEL_W
JOB NO
SWOBODA
DRAWN BY
JORDAN_H
SCALE
N.T.S.
DATE
8/1/2022
DWG NO
5
SHEET NO
5 OF 16



NO.	DATE	REVISION	BY

DWG TITLE: OUTPUT_VALVE BANK_2

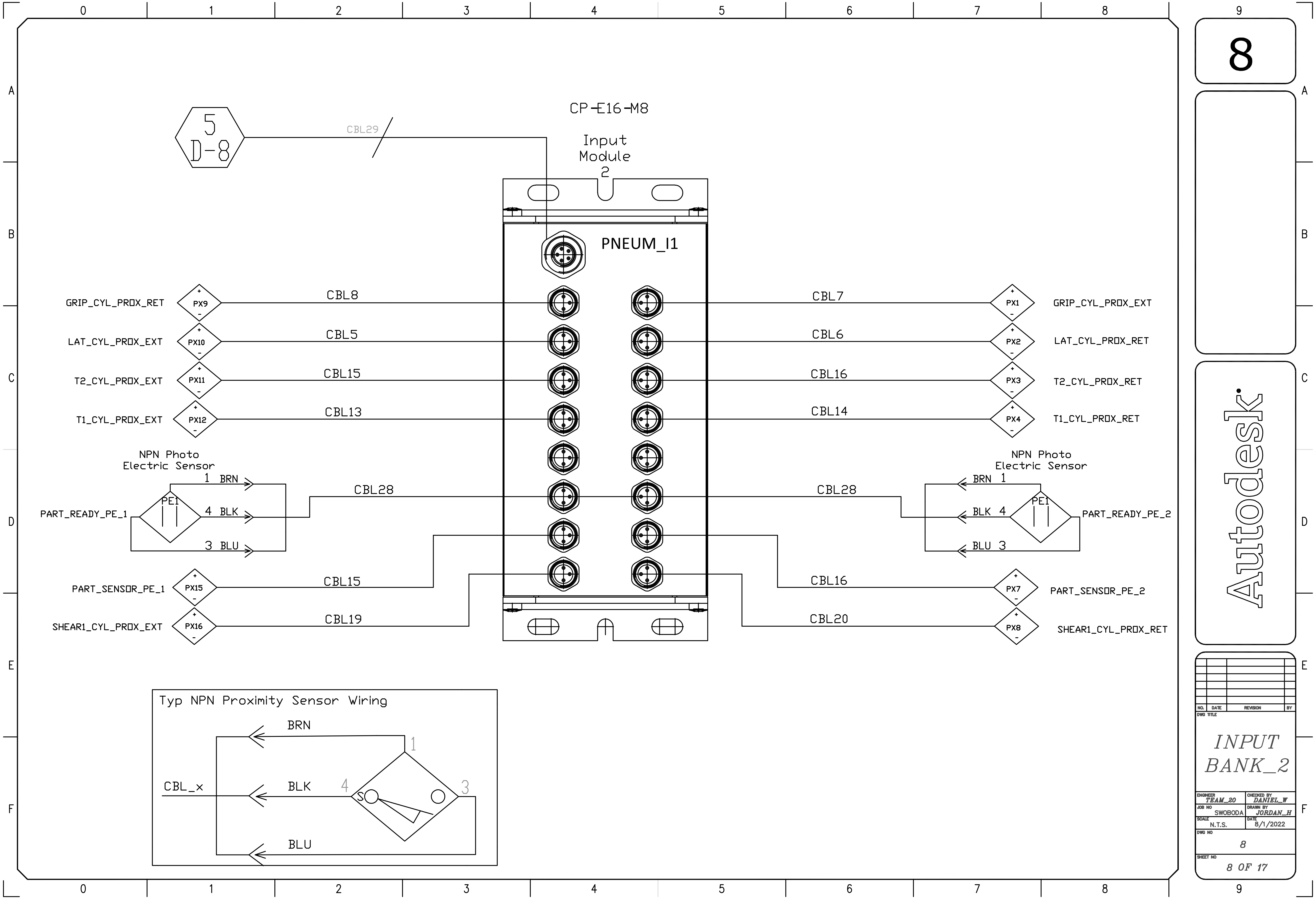
ENGINEER: TEAM_20
CHECKED BY: DANIEL_W
JOB NO: SWOBODA
DRAWN BY: JORDAN_H
SCALE: N.T.S.
DATE: 8/1/2022
DWG NO: 6
SHEET NO: 6 OF 17



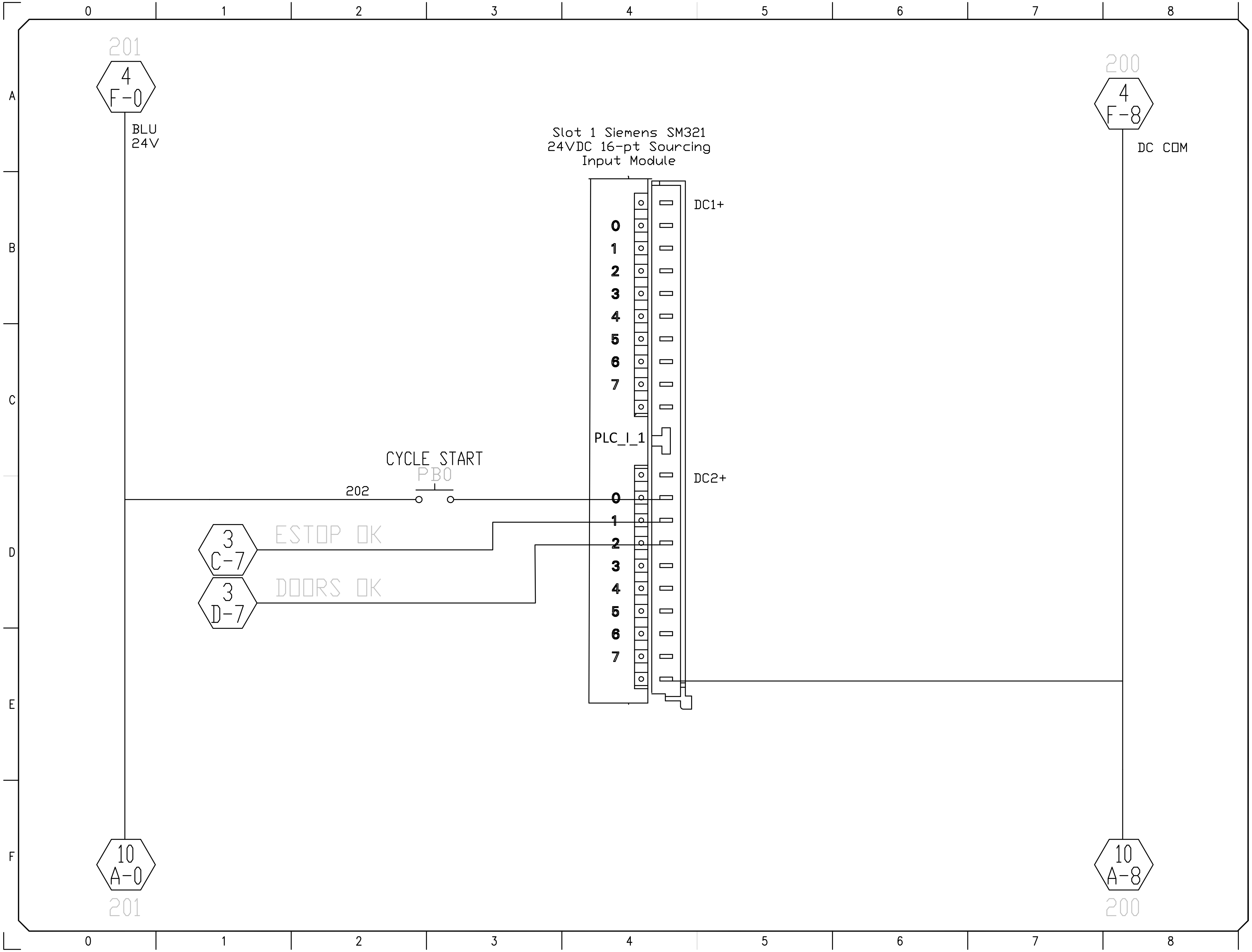
NO.	DATE	REVISION	BY

DWG TITLE: *INPUT BANK_1*

ENGINEER: TEAM_20	CHECKED BY: DANIEL_W
JOB NO: SWOBODA	DRAWN BY: JORDAN_H
SCALE: N.T.S.	DATE: 8/1/2022
DWG NO: 7	
SHEET NO: 7 OF 17	



8
CP-E16-M8
Input
Module
2
5
D-8
CBL29
PNEUM_I1
GRIP_CYL_PROX_RET
PX9
CBL8
CBL7
PX1
GRIP_CYL_PROX_EXT
LAT_CYL_PROX_EXT
PX10
CBL5
CBL6
PX2
LAT_CYL_PROX_RET
T2_CYL_PROX_EXT
PX11
CBL15
CBL16
PX3
T2_CYL_PROX_RET
T1_CYL_PROX_EXT
PX12
CBL13
CBL14
PX4
T1_CYL_PROX_RET
NPN Photo
Electric Sensor
1 BRN
4 BLK
3 BLU
PE1
PART_READY_PE_1
CBL28
CBL28
NPN Photo
Electric Sensor
BRN 1
BLK 4
BLU 3
PE1
PART_READY_PE_2
PART_SENSOR_PE_1
PX15
CBL15
CBL16
PX7
PART_SENSOR_PE_2
SHEAR1_CYL_PROX_EXT
PX16
CBL19
CBL20
PX8
SHEAR1_CYL_PROX_RET
Typ NPN Proximity Sensor Wiring
BRN
1
CBL_x
BLK
4
S
3
BLU
Autodesk
NO.
DATE
REVISION
BY
DWG TITLE
INPUT
BANK_2
ENGINEER
TEAM_20
CHECKED BY
DANIEL_W
JOB NO
SWOBODA
DRAWN BY
JORDAN_H
SCALE
N.T.S.
DATE
8/1/2022
DWG NO
8
SHEET NO
8 OF 17



9

Autodesk

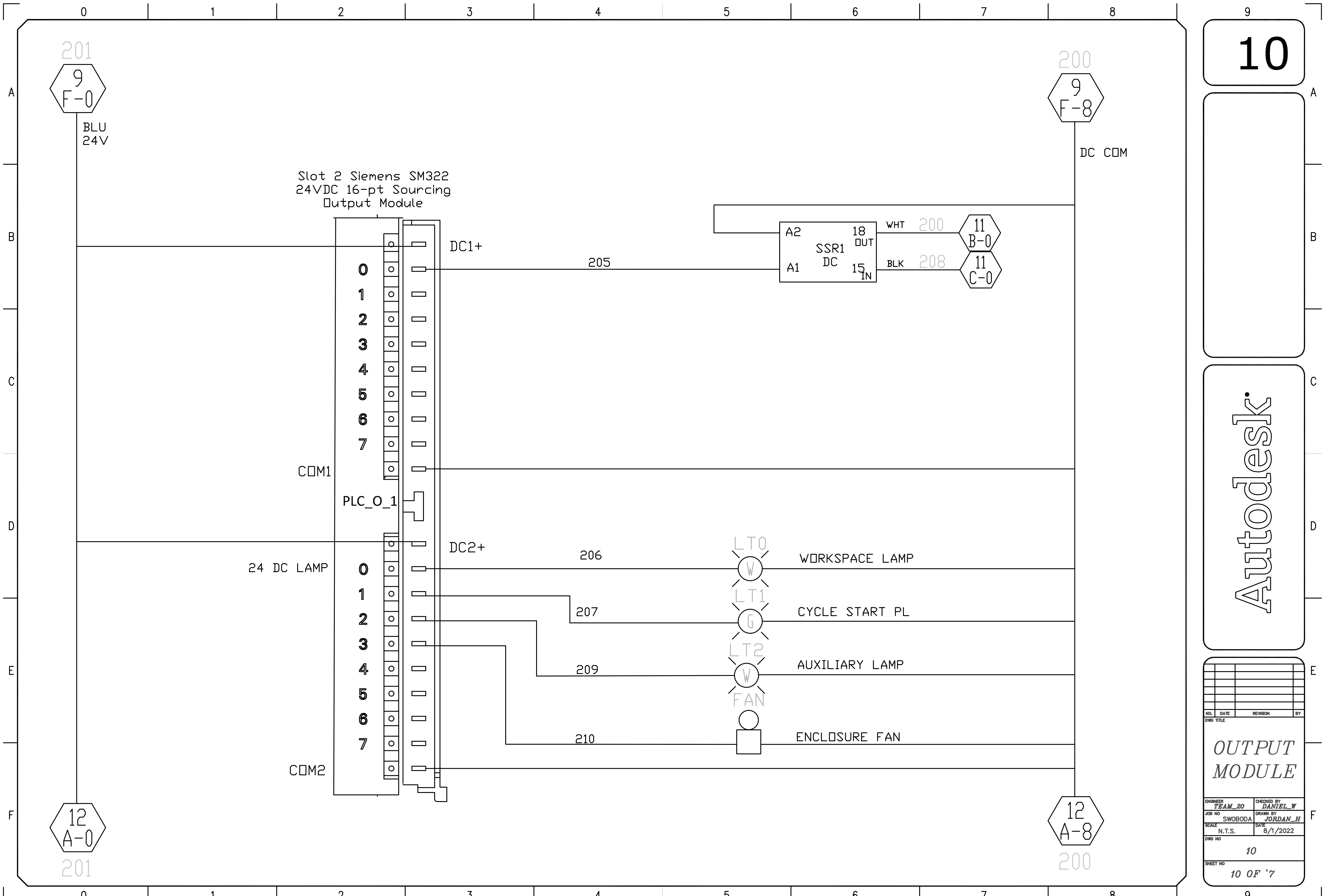
NO.	DATE	REVISION	BY

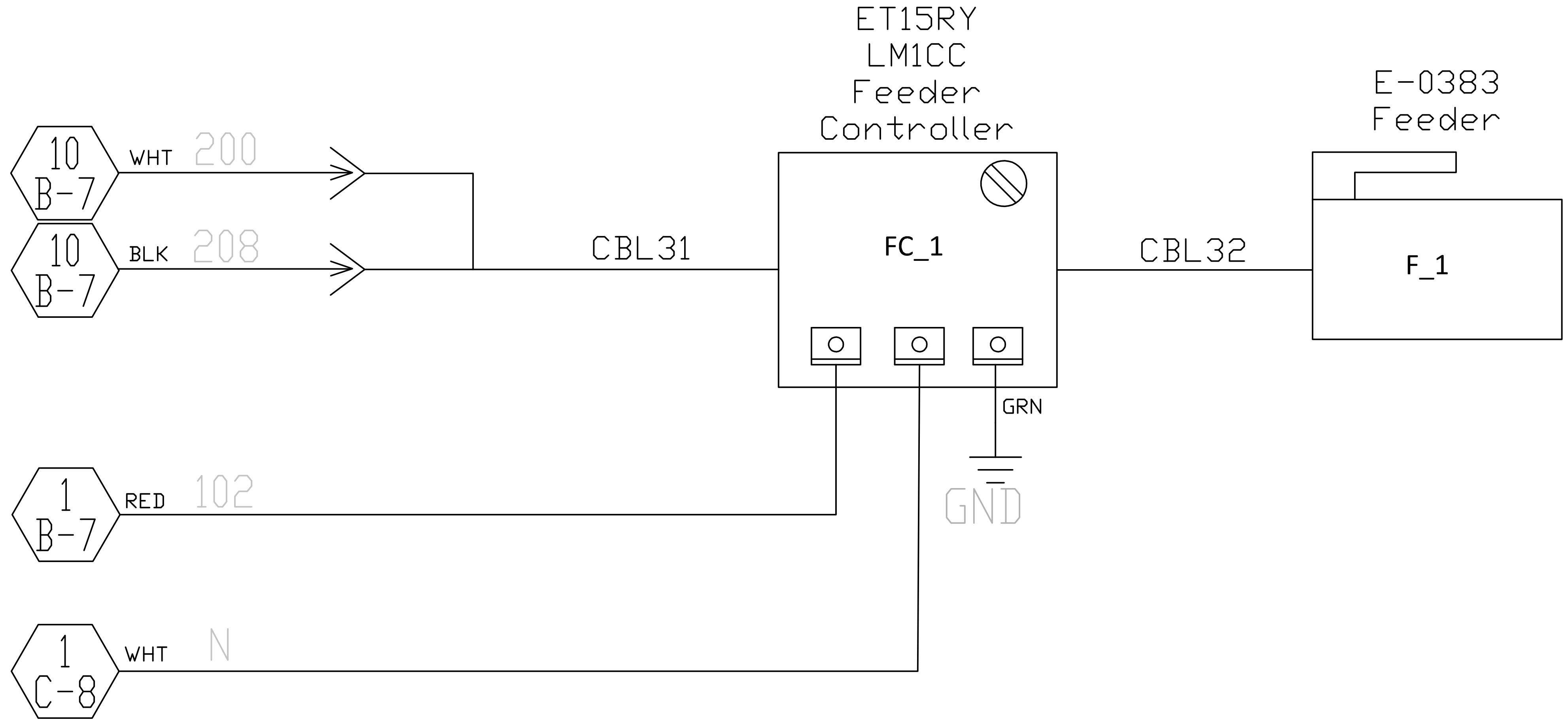
DWG TITLE
INPUT MODULE

ENGINEER TEAM_20	CHECKED BY DANIEL_W
JOB NO SWOBODA	DRAWN BY JORDAN_H
SCALE N.T.S.	DATE 8/1/2022

DWG NO 9

SHEET NO 9 OF 17


10
201
9
F-0
BLU
24V
200
9
F-8
DC COM
Slot 2 Siemens SM322
24VDC 16-pt Sourcing
Output Module
DC1+
0
1
2
3
4
5
6
7
COM1
PLC_O_1
205
A2
A1
SSR1
DC
18
OUT
15
IN
WHT
200
11
B-0
BLK
208
11
C-0
DC2+
24 DC LAMP
0
1
2
3
4
5
6
7
COM2
206
LT0
W
WORKSPACE LAMP
207
LT1
G
CYCLE START PL
209
LT2
W
AUXILIARY LAMP
FAN
210
ENCLOSURE FAN
12
A-0
201
12
A-8
200
Autodesk
NO.
DATE
REVISION
BY
DWG TITLE
OUTPUT
MODULE
ENGINEER
TEAM_20
CHECKED BY
DANIEL_W
JOB NO
SWOBODA
DRAWN BY
JORDAN_H
SCALE
N.T.S.
DATE
8/1/2022
DWG NO
10
SHEET NO
10 OF '7



NO.	DATE	REVISION	BY

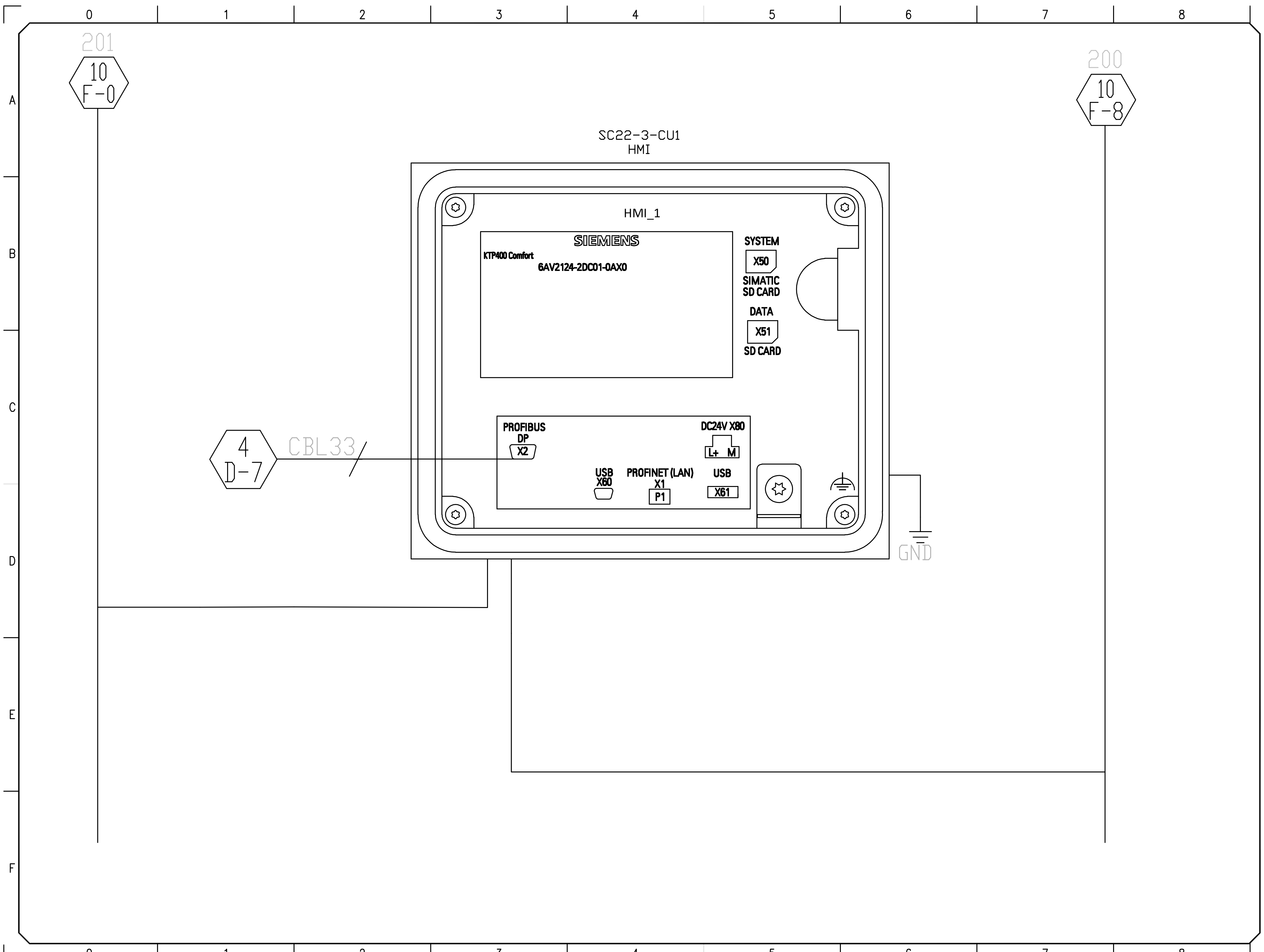
DWG TITLE

FEEDER CONTROLLER

ENGINEER *TEAM_20*	CHECKED BY *DANIEL_W*
JOB NO SWOBODA	DRAWN BY *JORDAN_H*
SCALE N.T.S.	DATE 8/1/2022

DWG NO *11*

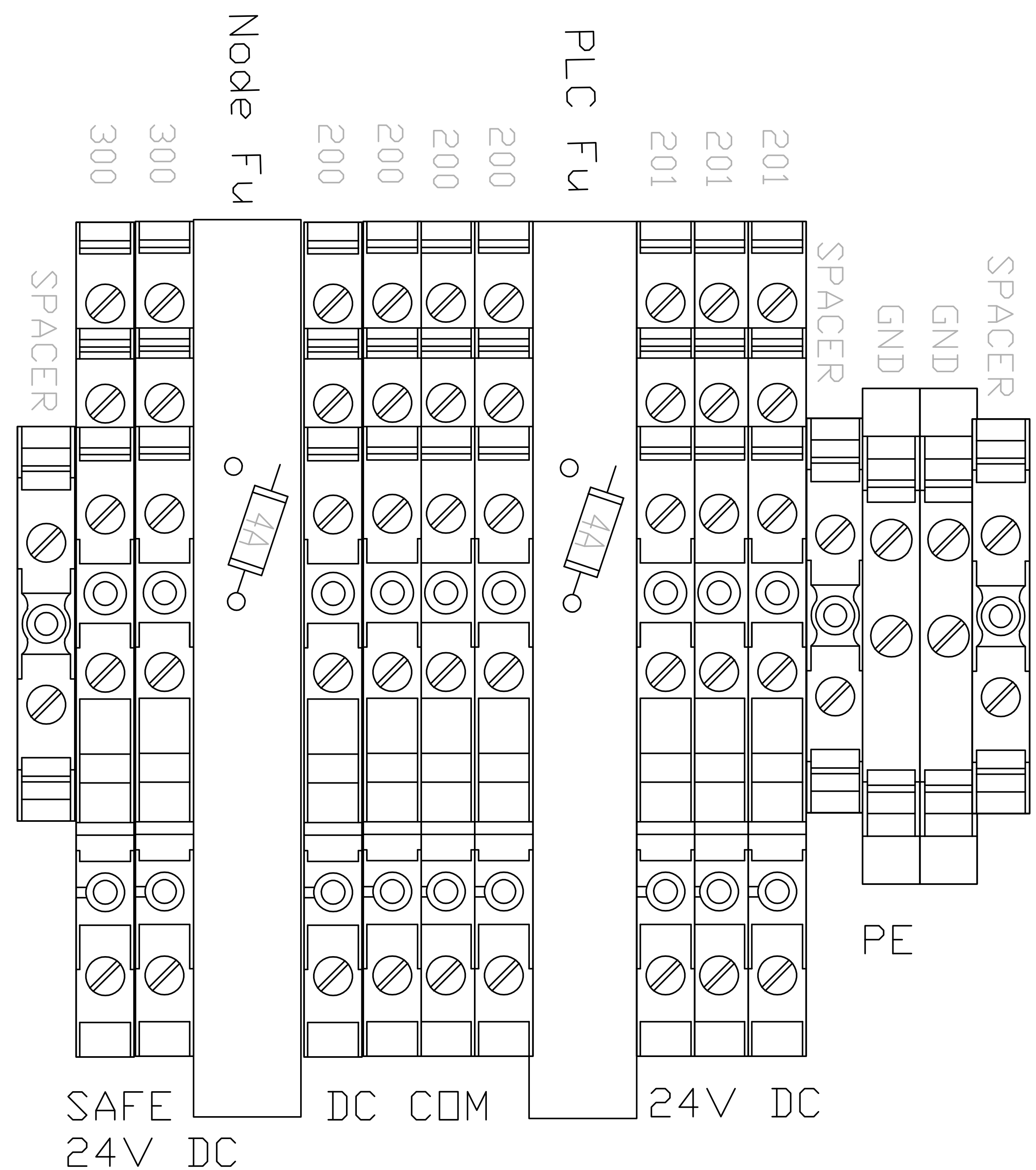
SHEET NO *11 OF 17*



NO.	DATE	REVISION	BY

DWG TITLE
HMI

ENGINEER TEAM_20
CHECKED BY DANIEL_W
JOB NO SWOBODA
DRAWN BY JORDAN_H
SCALE N.T.S.
DATE 8/1/2022
DWG NO 12
SHEET NO 12 OF 17



NO.	DATE	REVISION	BY

DWG TITLE

TERMINAL BLOCKS

ENGINEER *TEAM_20*	CHECKED BY *DANIEL_W*
JOB NO SWOBODA	DRAWN BY *JORDAN_H*
SCALE N.T.S.	DATE 8/1/2022
DWG NO *14*	
SHEET NO *14 OF 17*	

PLC Panel Bill Of Materials			
Component	Model	Quantity	Manufacturer
PS1	QUINT4-SYS-PS	1	Phoenix Contact
CB1	C32H-DC C1A	1	Merlin Gerin
SC1	SC22-3-CU1	1	Banner
PLC_FU	1CP22	1	BUssman
PLC	Siemens Simatic S7-300, PNP	1	Siemens
HMI_FU	1CP16	1	Bussman
HMI	KTP400 Comfort	1	Siemens
PLC_I_1	SM321, Source (PNP) PLC Input Module	1	Siemens
PLC_O_1	SM322, Source (PNP) 16DO PLC Output Modul	1	Siemens
SSR1 AC	AD-SSR810-DC-28Z	1	Omron
Fan	GDT12025B24V2P2.54AP	1	GSTIME

Autodesk

NO.	DATE	REVISION	BY

DWG TITLE
PLC BOM

ENGINEER TEAM_20	CHECKED BY DANIEL_W
JOB NO SWOBODA	DRAWN BY JORDAN_H
SCALE N.T.S.	DATE 8/1/2022

DWG NO 15

SHEET NO 15 OF 17

Field Device Bill Of Materials

Component	Model	Quantity	Manufacturer
PX[1-22]	QUINT4-SYS-PS	23	SMC Pneumatics
PX23	DW-AD-501-04	1	Contrinex
PE	VSM-2M5NAEL-2M	1	Banner
ESTOP	XN1E-LV413Q4MR	1	IDEC
CYCLE_START	HB-H60-063	1	Precision Mixer
SI	SI-MAGB2SM	2	Banner
FC1	ET15RY LM1CC	1	Feeding Concepts Inc
F1	E-0383	1	Feeding Concepts Inc
Node1	CP-FB13-E	1	Festo
PNEUM_O	cpv10-GE-FB-8	2	Festo
PNEUM_I	CP-E16-M8	2	Festo
PNUEM_J	J Valve	8	Festo
PNEUM_N	N Valve	1	Festo
CYL1	Lat	1	
CYL2	Grip	1	
CYL3	Prestop	1	
CYL4	Endstop	1	
CYL5	Rot 1	1	
CYL6	Rot 2	1	
CYL7	Punch	1	
CYL8	Clamp 1	1	
CYL9	Clamp 2	1	
CYL10	Shear 1	1	
CYL11	Shear 2	1	
LT0	WLS28-2XW285XQ	1	Banner

NO.	DATE	REVISION	BY

DWG TITLE
FIELD DEVICE BOM

ENGINEER TEAM_20	CHECKED BY DANIEL_W
JOB NO SWOBODA	DRAWN BY JORDAN_H
SCALE N.T.S.	DATE 8/1/2022

DWG NO 17

Cable List

C1	Profibus Signal to Node	PROFIBUS FC Standard Cable GP
C2	Power to Node	NEBU-M12-W8 5 Pin
C3	Power to Input Module 1	NEBU-M12-W8 5 Pin
C4	Power to Input Module 2	NEBU-M12-W8 5 Pin
C5	PX1	M12, 3-PIN, NEBU-LE
C6	PX2	M12, 3-PIN, NEBU-LE
C7	PX3	M12, 3-PIN, NEBU-LE
C8	PX4	M12, 3-PIN, NEBU-LE
C9	PX5	M12, 3-PIN, NEBU-LE
C10	PX6	M12, 3-PIN, NEBU-LE
C11	PX7	M12, 3-PIN, NEBU-LE
C12	PX8	M12, 3-PIN, NEBU-LE
C13	PX9	M12, 3-PIN, NEBU-LE
C14	PX10	M12, 3-PIN, NEBU-LE
C15	PX11	M12, 3-PIN, NEBU-LE
C16	PX12	M12, 3-PIN, NEBU-LE
C17	PX13	M12, 3-PIN, NEBU-LE
C18	PX14	M12, 3-PIN, NEBU-LE
C19	PX15	M12, 3-PIN, NEBU-LE
C20	PX16	M12, 3-PIN, NEBU-LE
C21	PX17	M12, 3-PIN, NEBU-LE
C22	PX18	M12, 3-PIN, NEBU-LE
C23	PX19	M12, 3-PIN, NEBU-LE
C24	PX20	M12, 3-PIN, NEBU-LE
C25	PX21	M12, 3-PIN, NEBU-LE
C26	PX22	M12, 3-PIN, NEBU-LE
C27	PX23	M12, 3-PIN, NEBU-LE
C28	PE1	M12, 3-PIN, NEBU-LE
C29	Power to Output Module 1	NEBU-M12-W8 5 Pin
C30	Power to Output Module 2	NEBU-M12-W8 5 Pin
C31	Feeder Controller	Standard 120 AC Receptacle Cable
C32	Feeder	Standard 120 AC Receptacle Cable
C33	Profibus	PROFIBUS FC Standard Cable GP

Autodesk

NO.	DATE	REVISION	BY

DWG TITLE
CABLE LIST

ENGINEER TEAM_20	CHECKED BY DANIEL_W
JOB NO SWOBODA	DRAWN BY JORDAN_H
SCALE N.T.S.	DATE 8/1/2022

DWG NO 17

Appendix B - Vendor Quotes

Quote

RFQ#:	
Date Quoted: 4/14/22	**Our Quote No:** 1107669
Sales Contact: Jeff Meppelink	

PEERLESS STEEL

Peerless Steel - Grandville Branch
3280 Century Center S.W.
Grandville, MI 49418

Phone 800-442-7192
Fax 616-530-6740

Quote Date: 4/14/22	**Terms:** 1/2% 10 Net 30
To:	Swoboda-Berger, Inc. 4108 52nd Street S.E. Kentwood, MI 49512-9636
Ship To:	Swoboda-Berger, Inc. 4108 52nd Street S.E. Kentwood, MI 49512-9636 (Local)

SERVICE ISO 9001 CERTIFIED QUALITY VALUE

Line	Your Part No Your Job No Your Detail No	Description	Wt. (lbs)	Qty	Unit Price	Amount
1	a-40-1400-11 018-003	A-2 DCF 5/8x1-1/4 Flat (1-1/2 in) Cutting		2 pcs	$9.0000 / pc	$18.00
2	a-40-1400-11 019-001	A-2 DCF 1-1/4x1-1/2 Flat (32 in) Cutting		1 pc	$88.9244 / pc	$88.92
3	a-40-1400-11 019-002/003	A-2 GFS 1/8x1x36 Flat (Full Bars)		2 pcs	$26.7821 / pc	$53.56
4	a-40-1400-11 019-007/019- 006/005	A-2 GFS 1/8x1-1/4x36 Flat (18 in) Cutting		1 pc	$18.3465 / pc	$18.35
5	a-40-1400-11 11-008	A-2 DCF 1x2 Flat (3 in) Cutting		2 pcs	$11.5359 / pc	$23.07
6	a-40-1400-11 016-001/002	A-2 DCF 4x5 Flat (2 in) Cutting		2 pcs	$55.7448 / pc	$111.49
7	a-40-1400-11 012-004	1018 CD 1-3/4x3 Flat (4-1/2 in) Cutting		2 pcs	$28.9747 / pc	$57.95
8	a-40-1400-11 012-005	1018 CD 1x3 Flat (3 in) Cutting		2 pcs	$15.0931 / pc	$30.19
9	a-40-1400-11 011-001	1018 CD 1-3/4x6 Flat (14 in) Cutting		1 pc	$135.4257 / pc	$135.43
10	a-40-1400-11 011-005	1018 CD 1x5 Flat (5-1/4 in) Cutting		1 pc	$32.4488 / pc	$32.45

Gran

Plexus Systems www.plex.com 4/18/22 11:05 AM jmeppelink Page 1

Quote

RFQ#:	
Date Quoted: 4/14/22	**Our Quote No:** 1107669
Sales Contact: Jeff Meppelink	

PEERLESS STEEL

Peerless Steel - Grandville Branch
3280 Century Center S.W.
Grandville, MI 49418

Phone 800-442-7192
Fax 616-530-6740

SERVICE QUALITY ISO 9001 CERTIFIED VALUE

Quote Date: 4/14/22	**Terms:** 1/2% 10 Net 30
To:	Swoboda-Berger, Inc. 4108 52nd Street S.E. Kentwood, MI 49512-9636
Ship To:	Swoboda-Berger, Inc. 4108 52nd Street S.E. Kentwood, MI 49512-9636 (Local)

Line	Your Part No Your Job No Your Detail No	Description	Wt. (lbs)	Qty	Unit Price	Amount
11	a-40-1400-11 011-018	1018 CD 2-1/2x4-1/2 Flat (10 in) Cutting		2 pcs	$107.1589 / pc	$214.32
12	a-40-1400-11 013-001	1018 CD 2-1/2x6 Flat (13 in) Cutting		2 pcs	$176.5320 / pc	$353.06
13	a-40-1400-11 015-003	1018 CD 1/4x2 Flat (2 in) Cutting		2 pcs	$9.3277 / pc	$18.66
14	a-40-1400-11 019-004/005	1018 CD 1-3/4x3-1/2 Flat (3-1/4 in) Cutting		1 pc	$29.7216 / pc	$29.72
15	a-40-1400-11 011-021	1018 CD 1/2x6 Flat (14 in) Cutting		2 pcs	$39.1729 / pc	$78.35
16	a-40-1400-11 011-022	1018 CD 1-1/4x3 Flat (4 in) Cutting		2 pcs	$19.7274 / pc	$39.45
17		D-2 DCF 1-1/2x2-1/2 Flat (12 in) Cutting		1 pc	$79.0510 / pc	$79.05
		Total Weight	**0**			

Plexus Systems www.plex.com 4/18/22 11:05 AM jmeppelink Page 2

Quote

RFQ#:	
Date Quoted: 4/14/22	**Our Quote No:** 1107669
Sales Contact: Jeff Meppelink	

PEERLESS STEEL

Peerless Steel - Grandville Branch
3280 Century Center S.W.
Grandville, MI 49418

Phone 800-442-7192
Fax 616-530-6740

SERVICE QUALITY ISO 9001 CERTIFIED VALUE

Quote Date: 4/14/22	**Terms:** 1/2% 10 Net 30
To:	**Swoboda-Berger, Inc.** **4108 52nd Street S.E.** **Kentwood, MI 49512-9636**
Ship To:	**Swoboda-Berger, Inc.** **4108 52nd Street S.E.** **Kentwood, MI 49512-9636 (Local)**

Line	Your Part No Your Job No Your Detail No	Description	Wt. (lbs)	Qty	Unit Price	Amount
Fuel/Energy/Packaging						$18.82
Delivery Upon Request 1. Prices quoted are based on receiving the total order and valid for 48 hours. 2. Weight may vary at time of shipping. 3. All quotes are in U.S. dollars, all contracts are accepted in the United States. 4. Price and surcharge in effect at time of shipment will apply. 5. Special order items are not subject to cancellation.			**Total Price**			**$1,400.84**

LABOR STANDARDS - Production of the articles and/or the services covered by this invoice are in full compliance with the Fair Labor Standards Act of 1958, as amended.
All claims for shortage must be made within 5 days after receipt.

NOTICE - These provisions comprise additional terms of this contract limiting the seller's warranty obligation and excluding liability for consequential damages. Any inconsistent terms contained in any prior or subsequent communication between seller and buyer shall be void and are superseded by these provisions.
LIMITATION OF WARRANTY LIABILITY - Seller hereby warrants that the material described herein conforms to specifications. Seller's liability is expressly limited to replacement of defective material or refund of purchase price to the original purchaser, at seller's option, when material is properly worked or used within a reasonable time. In no event shall seller be liable for any labor claims or special, indirect, consequential, or other damages, whether arising under any warranty, express or implied, or otherwise, and the remedies of buyer expressed herein are exclusive. Anything contained in prior or subsequent communications between buyer and seller which purports to alter this provision shall be void and is superseded by this provision. This warranty is made in lieu of all other express and implied warranties, including any implied warranty of merchantability or fitness for a particular purpose, and of any other obligations or liability on the part of seller.

Seller neither assumes nor authorizes any person to assume for it any liability not expressed herein.

Quotation with Errors

MISUMI USA, INC.
1475 E Woodfield Rd, Ste. 1300 SCHAUMBURG, IL 60173
inquire@misumiusa.com www.misumiusa.com
Phone: 800-681-7475 Fax: 800-681-7402

Quotation Number: **WQ29BA949200**
Quotation Date(Revised Date) April 25 2022 (-)
Your MISUMI Contact: FS11
Page: 1/ 1

Customer PO Reference									
Customer	Code	X24456	Name	101014429469				Registration No	
	Department			Attention	LANCE DEEMTER	Phone	6165406144	FAX	
	Address	6303 PIERCE ST ALLENDALE, MI 49401 USA							
Ship To	Code	X24456	Name	101014429469					
	Department			Attention	LANCE DEEMTER	Phone	6165406144	FAX	
	Address	6303 PIERCE ST ALLENDALE, MI 49401 USA							
Ship Mode		FED D9 COL	Payment	Credit Card				Trade Term	

No.	Customer Item Reference / Product Code / Product Name / Item Remarks / Error Message	Leadtime (working days)	Est.Ship Date / * Revised Date	Exp.	Weight	Pack Item / Quantity	Unit Price (USD)	Amount(USD)	Brand Name / Valid until
1	CD85N16-125-A SMC AIR CYLINDER Complete your quote request to ask MISUMI to check the next available ship date.					1	36.25		SMC
2	PHS22 ROD END	3 day(s)	April 28 2022		4 g	2	40.95	81.90	THK May 23 2022

Remarks:

Item Total:	81.90
Est. S&Hdlg.:	0.00
Tax:	4.91
Total:	86.81

Error items are not included in the price above.

Information:
NOTICE: Subject to the terms and conditions above and at
https://us.misumi-ec.com/contents/terms/use.html
Invoice may also include duty, tax and/or handling charges.
North America Trade Terms FOB Origin
Leadtimes are based on After Receipt of Order.

Order Request : If you wish to place an order for this quotation, please fill in below.

Ship Method (Please select)
- ☐ **Partial shipments are NOT allowed. (Shipment will be arranged on the latest date of all items.)**
- ☐ **Partial shipments are allowed. (Items will be shipped on the dates indicated above.)**
- ☐ **Specify shipment dates. (Please specify a shipment date of your choice per item.)**

Your Purchase Order No:
Signature: ______________________ **Date:** ______________

MiMOTION

Quote

Date: 04/23/22

MI.COM WEB ORDER SUPPORT
1605 ALTON ROAD
IRONDALE, AL 35210
PHONE : 8556422557
FAX : 2059515319

Note: Due to recent volatility of raw materials, price and delivery are subject to change based on availability at time of order.

Requests for statutory and regulatory documentation (REACH, RoHS, California Prop 65, Conflict Minerals, Certificates of Conformance, Safety Data Sheets, and other applicable compliance documents) for the product(s) in this order must be communicated by the customer to the Motion Industries, Inc. sales representative at the time the order is placed. Motion Industries, Inc. cannot accept requests for these documents after completion of the sale.

To:
Lance Deemter SHIPPING TO:

null, null 49504
PO:

Quote Number: EB99 - 0001035650
Customer RFQ:
FOB: FOB ORG,FRT PP&ADD
Quote Sent By:
Payment Terms:
Delivery: STOCK UNLESS NOTED

Description	Manufacturer	Quantity	Unit	Unit Price	Amount
LINE ITEM: 001					
22205CE4C3 STD.SMALL SPHER.ROL.BRGS		4	EA	$150.110	$600.44
SPHERICAL ROLLER BEARING - 25 MM ID, 52 MM OD, 18 MM WIDTH, STRAIGHT BORE, OPEN, STEEL CAGE					
ITEM NO: 00148019	NSK				
	Expected Date:				
LINE ITEM: 002					
22208CDE4C3 STD.SMALL SPHER.ROL.BRGS		2	EA	$217.600	$435.20
SPHERICAL ROLLER BEARING - 40 MM ID, 80 MM OD, 23 MM WIDTH, STRAIGHT BORE, OPEN, STEEL CAGE					
ITEM NO: 05868371	NSK				
	Expected Date:				
LINE ITEM: 003					
RB1412 SHOCK ABSORBER		2	EA	$40.530	$81.06
SHOCK ABSORBER					
ITEM NO: 01149439	SMC CORP				
	Expected Date:				
HARMONIZED TARIFF CD: 8412909025					

BUYER UNDERSTANDS AND AGREES THAT GOODS PRESENTED TO BUYER PURSUANT TO THIS INVOICE ARE BEING TENDERED CONTINGENT UPON BUYER'S AGREEMENT TO ALL OF MOTION'S TERMS AND CONDITIONS RELATED TO SALES. MOTION'S TERMS AND CONDITIONS ARE AVAILABLE AT THE MOTION BRANCH OR AT WWW.MOTIONINDUSTRIES.COM. BUYER'S ACCEPTANCE OF THE DELIVERY OF THE GOODS SHALL CONFIRM BUYER'S AGREEMENT TO ALL OF MOTION'S TERMS AND CONDITIONS.

Description	Manufacturer	Quantity	Unit	Unit Price	Amount
				SUB TOTAL:	$1,116.70
				SALES TAX:	$44.67
				TOTAL: USD	$1,161.37

Want to view inventory and place orders on-line? MotionIndustries.com can meet your needs. Register On-line at www.MotionIndustries.com.

BUYER UNDERSTANDS AND AGREES THAT GOODS PRESENTED TO BUYER PURSUANT TO THIS INVOICE ARE BEING TENDERED CONTINGENT UPON BUYER'S AGREEMENT TO ALL OF MOTION'S TERMS AND CONDITIONS RELATED TO SALES. MOTION'S TERMS AND CONDITIONS ARE AVAILABLE AT THE MOTION BRANCH OR AT WWW.MOTIONINDUSTRIES.COM. BUYER'S ACCEPTANCE OF THE DELIVERY OF THE GOODS SHALL CONFIRM BUYER'S AGREEMENT TO ALL OF MOTION'S TERMS AND CONDITIONS.

Quotation with Errors

MISUMI USA, INC.
1475 E Woodfield Rd, Ste. 1300 SCHAUMBURG, IL 60173
inquire@misumiusa.com www.misumiusa.com
Phone: 800-681-7475 Fax: 800-681-7402

Quotation Number: **WQ296D627C00**
Quotation Date(Revised Date) April 15 2022 (April 22 2022)
Your MISUMI Contact: FS11
Page: 1/ 3

Customer PO Reference		A40-1400-11								
Customer	Code	X24456	Name	101014429469				Registration No		
	Department				Attention	LANCE DEEMTER	Phone	6165406144	FAX	
	Address	6303 PIERCE ST								
		ALLENDALE, MI 49401 USA								
Ship To	Code	X24456	Name	101014429469						
	Department				Attention	LANCE DEEMTER	Phone	6165406144	FAX	
	Address	6303 PIERCE ST								
		ALLENDALE, MI 49401 USA								
Ship Mode		FED D9 COL	Payment	Credit Card				Trade Term		

No.	Customer Item Reference / Product Code / Product Name / Item Remarks / Error Message	Leadtime (working days)	Est.Ship Date (* Revised Date)	Exp.	Weight	Pack Item / Quantity	Unit Price (USD)	Amount(USD)	Brand Name	Valid until
1	CLBPB40-49-12 Bearing Spacer	5 day(s) *	April 28 2022		493 g	1 EA	29.60	29.60	MISUMI	May 14 2022
2	CLBPB40-49-10 Bearing Spacer	5 day(s) *	April 28 2022		493 g	1 EA	29.60	29.60	MISUMI	May 14 2022
3	FPSFJBA-D14-L60-M5 LINEAR SHAFT	10 day(s)	May 7 2022		292 g	4 EA	17.30	69.20	MISUMI	April 29 2022
4	CLBPB25-31-12 Bearing Spacer	5 day(s) *	April 28 2022		588 g	2 EA	24.28	48.56	MISUMI	May 14 2022
5	CLBUB25-31-20 Bearing Spacer	5 day(s) *	April 28 2022		588 g	2 EA	24.28	48.56	MISUMI	May 14 2022

Quotation with Errors

MISUMI USA, INC.
1475 E Woodfield Rd, Ste. 1300 SCHAUMBURG, IL 60173
inquire@misumiusa.com www.misumiusa.com
Phone: 800-681-7475 Fax: 800-681-7402

Quotation Number: **WQ296D627C00**
Quotation Date(Revised Date) April 15 2022 (April 22 2022)
Your MISUMI Contact: FS11
Page: 2/ 3

Customer PO Reference		A40-1400-11							
Customer	Code	X24456	Name	101014429469				Registration No	
	Department		Attention	LANCE DEEMTER	Phone	6165406144	FAX		
	Address	6303 PIERCE ST ALLENDALE, MI 49401 USA							
Ship To	Code	X24456	Name	101014429469					
	Department		Attention	LANCE DEEMTER	Phone	6165406144	FAX		
	Address	6303 PIERCE ST ALLENDALE, MI 49401 USA							
Ship Mode		FED D9 COL	Payment	Credit Card				Trade Term	

No.	Customer Item Reference / Product Code / Product Name / Item Remarks / Error Message	Leadtime (working days)	Est.Ship Date / * Revised Date	Exp.	Weight	Pack Item / Quantity	Unit Price (USD)	Amount(USD)	Brand Name / Valid until
6	PSFGZ15-45-M8-N10-SC22 LINEAR SHAFT	8 day(s) *	May 2 2022		45 g	1 EA	27.72	27.72	MISUMI May 14 2022
7	FPSFJTB-D12-L20-N3-J5 LINEAR SHAFT	15 day(s)	May 12 2022		18 g	1 EA	40.70	40.70	MISUMI April 22 2022
8	RB1411 SHOCK ABSORBER	1 day(s) *	April 23 2022		200 g	2	40.02	80.04	SMC May 14 2022
9	CDQ2B12-15DCZ SMC AIR CYLINDER	14 day(s) *	May 12 2022		55 g	1	28.72	28.72	SMC May 14 2022
10	CDQ2A80-200DCMZ SMC AIR CYLINDER	14 day(s) *	May 12 2022		7,274	2	168.84	337.68	SMC May 14 2022

Quotation with Errors

MiSUMi
MISUMI USA, INC.
1475 E Woodfield Rd, Ste. 1300 SCHAUMBURG, IL 60173
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Quotation Number: **WQ296D627C00**
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Page: 3/ 3

Customer PO Reference		A40-1400-11							
Customer	Code	X24456	Name	101014429469				Registration No	
	Department			Attention	LANCE DEEMTER	Phone	6165406144	FAX	
	Address	6303 PIERCE ST ALLENDALE, MI 49401 USA							
Ship To	Code	X24456	Name	101014429469					
	Department			Attention	LANCE DEEMTER	Phone	6165406144	FAX	
	Address	6303 PIERCE ST ALLENDALE, MI 49401 USA							
Ship Mode		FED D9 COL	Payment	Credit Card				Trade Term	

No.	Customer Item Reference / Product Code / Product Name / Item Remarks / Error Message	Leadtime (working days)	Est.Ship Date (* Revised Date)		Exp.	Weight	Pack Item Quantity	Unit Price (USD)	Amount(USD)	Brand Name / Valid until
11	PHS22 ROD END	3 day(s) *	April 26 2022			4 g	2	40.95	81.90	THK May 14 2022
12	SFR22-60 ROTARY SHAFT	4 day(s) *	April 27 2022			320 g	2 EA	25.01	50.02	MISUMI May 14 2022
13	NSFRBE-D30-L31.5-M12-T68-Q25-N12 ROTARY SHAFT	9 day(s)	May 4 2022			2	2	29.45	58.90	MISUMI April 22 2022
14	NSFRBE-D48-L31.5-M12-T68-Q40-N12 ROTARY SHAFT Please click the checkbox and complete your quote request to ask MISUMI Customer Service for assistance.						1			MISUMI

Remarks:

Item Total:	931.20
Est. S&Hdlg.:	0.00
Tax:	55.85
Total:	987.05

Error items are not included in the price above.

Information:
NOTICE: Subject to the terms and conditions above and at
https://us.misumi-ec.com/contents/terms/use.html
Invoice may also include duty, tax and/or handling charges.
North America Trade Terms FOB Origin
Leadtimes are based on After Receipt of Order.

Order Request : If you wish to place an order for this quotation, please fill in below.

Ship Method (Please select)
- ☐ **Partial shipments are NOT allowed. (Shipment will be arranged on the latest date of all items.)**
- ☐ **Partial shipments are allowed. (Items will be shipped on the dates indicated above.)**
- ☐ **Specify shipment dates. (Please specify a shipment date of your choice per item.)**

Your Purchase Order No:
Signature: ____________________ **Date:** ____________________

Quotation

MISUMI USA, INC.
1475 E Woodfield Rd, Ste. 1300 SCHAUMBURG, IL 60173
inquire@misumiusa.com www.misumiusa.com
Phone: 800-681-7475 Fax: 800-681-7402

Quotation Number: **WQ29B929C700**
Quotation Date(Revised Date) April 23 2022 (-)
Your MISUMI Contact: FS11
Page: 1/ 1

Customer PO Reference		A40-1400-11-30							
Customer	Code	X24456	Name	101014429469				Registration No	
	Department				Attention	LANCE DEEMTER	Phone	6165406144	FAX
	Address	6303 PIERCE ST ALLENDALE, MI 49401 USA							
Ship To	Code	X24456	Name	101014429469					
	Department				Attention	LANCE DEEMTER	Phone	6165406144	FAX
	Address	6303 PIERCE ST ALLENDALE, MI 49401 USA							
Ship Mode		FED D9 COL	Payment	Credit Card				Trade Term	

No.	Customer Item Reference / Product Code / Product Name / Leadtime (working days) / Item Remarks / Error Message	Est.Ship Date / * Revised Date		Exp.	Weight	Pack Item / Quantity	Unit Price (USD)	Amount(USD)	Brand Name / Valid until
1	SFLC698ZZ L.D.R.G. Ball Bearings 1 day(s)	April 25 2022			16 g	2 EA	14.04	28.08	MISUMI May 23 2022
2	SFLC626ZZ BALL BEARING 3 day(s)	April 27 2022			20 g	2 EA	13.67	27.34	MISUMI May 23 2022
3	PSFGG8-135-F6-P6-M3 Linear Shaft 8 day(s)	May 2 2022			110 g	2 EA	26.82	53.64	MISUMI May 23 2022

Remarks:

Item Total:	109.06
Est. S&Hdlg.:	0.00
Tax:	6.54
Total:	115.60

Information:
NOTICE: Subject to the terms and conditions above and at
https://us.misumi-ec.com/contents/terms/use.html
Invoice may also include duty, tax and/or handling charges.
North America Trade Terms FOB Origin
Leadtimes are based on After Receipt of Order.

Order Request : If you wish to place an order for this quotation, please fill in below.

Ship Method (Please select)
- ☐ **Partial shipments are NOT allowed. (Shipment will be arranged on the latest date of all items.)**
- ☐ **Partial shipments are allowed. (Items will be shipped on the dates indicated above.)**
- ☐ **Specify shipment dates. (Please specify a shipment date of your choice per item.)**

Your Purchase Order No:
Signature: ______________________ **Date:** ______________

SMC PNEUMATICS.COM

Powered by Orange Coast Pneumatics
A National Elite Distributor for SMC

Phone: 800.660.0733
sales@ocaire.com

Formal Quote ID # 9B5F6008ChdG1MG

Click here to continue this order.

	Cart Summary		
	CD85N16-125-A SMC CD85N16-125-A cyl, iso, dbl act, sw capable, C85 ROUND BODY CYLINDER*** **Available to Ship Today:** 0	$43.52 x 1	**$43.52**
	CQ-D080 SMC CQ-D080 clevis, rear, double, CQ2 COMPACT CYLINDER **Available to Ship Tomorrow*:** 61 qty	$18.60 x 2	**$37.20**

Subtotal: $80.72

$6.05 Handling Fee is added to all orders under $75.

Price quote is good for 30 days. Availability is subject to change at anytime.
*If stock is 0, please allow 6 to 8 weeks for delivery.

Notes:

SMCpneumatics.com

3810 Prospect Ave., Unit A Yorba Linda, CA 92886
Phone: 800.660.0733

Appendix C - Design Verification

Reference Validation Methods

Appendix D - Hand Calculations

D.1 - Bearing Design Calculations

$$if\ \overrightarrow{R_0} = 55{,}000\ N \rightarrow \overrightarrow{R_0} = F_r$$

Reactor Force at the shear pivot

$$if\ \frac{1\ part}{10\ s} \cdot \frac{3600\ s}{1\ hr} \cdot \frac{24\ hr}{1\ day} \cdot \frac{300\ days}{1\ year} \cdot \frac{5\ years}{1\ life} = 12{,}960{,}000\ \frac{parts}{life}$$

For reference additional reference

$$= 360\ \frac{parts}{hr}$$

$$= 8640\ \frac{parts}{day}$$

$$= 2{,}592{,}000\ \frac{parts}{year}$$

$$\frac{12{,}960{,}000\ \frac{parts}{life}}{360\ \frac{parts}{hr}} = 36{,}000\ \frac{hr}{life}$$

Assumption: Worse Case Scenario

$$C_{10} = a_f \cdot F_r \left(\frac{life * N * 60}{L_{10}}\right)^{\frac{3}{10}}$$

$$C_{10} = 1.5 \cdot 55\ KN \left(\frac{36\ Khr * 5\ \frac{rev}{min} * 60}{10^6}\right)^{\frac{3}{10}} = 168{,}459\ N$$

$$if\ \frac{1\ part}{10\ s} \cdot \frac{3600\ secs}{1\ hr} \cdot \frac{18\ hr}{1\ day} \cdot \frac{250\ days}{1\ year} \cdot \frac{5\ years}{1\ life} = 8{,}100{,}000\ \frac{parts}{life}$$

$$\frac{8{,}100{,}000\ \frac{parts}{life}}{360\ \frac{parts}{hr}} = 22{,}500\ \frac{hr}{life}$$

Assumption: Conservative usage (Reduction of hrs./day)

$$C_{10} = a_f \cdot F_r \left(\frac{life * N * 60}{L_{10}}\right)^{\frac{3}{10}}$$

$$C_{10} = 1.5 \cdot 55\ KN \left(\frac{22.5\ Khr * 5\ \frac{rev}{min} * 60}{10^6}\right)^{\frac{3}{10}} = 146{,}300\ N$$

Assumption: Chosen Life of 5 years

$$C_{10} = a_f \cdot F_r \left(\frac{life * N * 60}{L_{10}}\right)^{\frac{3}{10}}$$

$$C_{10} = 1.0 \cdot 55\ KN \left(\frac{22.5\ Khr * 5\ \frac{rev}{min} * 60}{10^6}\right)^{\frac{3}{10}} = 112{,}303\ N$$

Tertiary Link (2nd Pivot Point)

$F_r = 11{,}608\ N$

$N = 21\ \frac{rev}{min}$

$L_{10} = 10^6$

$a_f = 1.0$

$$If\ V = \omega * r_{min}$$

$$\omega = \frac{V}{r_{min}}$$

$$\omega = \frac{0.1309\ \frac{m}{s}}{0.06\ m} = 2.18\frac{rot}{s}$$

D.2 - Projected Cost Analysis

Note: The following calculations are based on a simplified model which does not consider power usage, maintance of the Winton Washer Recycler nor operator time.

Assumption: Worse Case Scenario

$$if\ \frac{1\ part}{10\ s}\cdot\frac{3600\ secs}{1\ hr}\cdot\frac{18\ hr}{1\ day}\cdot\frac{250\ days}{1\ year}\cdot\frac{5\ years}{1\ life} = 8{,}100{,}000\ \frac{parts}{life}$$

Without Winton Washer Recycler:

$$if\ 1\ part = 0.13955\ lb$$

$$and\ Exchange\ Rate = \frac{\$\ 0.30}{lb}$$

$$8{,}100{,}000\ \frac{parts}{life}\cdot 0.13955\ \frac{lb}{part}\cdot\frac{\$\ 0.30}{lb} = \frac{\$339{,}107}{5\ years}$$

For reference additional reference

$$= \frac{\$67{,}821}{year}$$

$$= \frac{\$5{,}651.78}{month}$$

With Winton Washer Recycler:

$$if\ 1\ part = 0.13955\ lb$$

$$and\ Exchange\ Rate = \frac{\$\ 0.30}{lb}$$

$$8{,}100{,}000\ \frac{parts}{life}\cdot 0.104\ \frac{lb}{part}\cdot\frac{\$\ 1.50}{lb} = \frac{\$1{,}263{,}600}{5\ years}$$

Assumption: Worse Case Scenario

$$if\ \frac{1\ part}{10\ s} \cdot \frac{3600\ secs}{1\ hr} \cdot \frac{18\ hr}{1\ day} \cdot \frac{250\ days}{1\ year} \cdot \frac{5\ years}{1\ life} = 8{,}100{,}000\ \frac{parts}{life}$$

Without Winton Washer Recycler:

$$if\ 1\ part = 0.13955\ lb$$

$$and\ Exchange\ Rate = \frac{\$\ 0.30}{lb}$$

$$8{,}100{,}000\ \frac{parts}{life} \cdot 0.13955\ \frac{lb}{part} \cdot \frac{\$\ 0.30}{lb} = \frac{\$339,107}{5\ years}$$

For reference additional reference

$$= \frac{\$67,821}{year}$$

$$= \frac{\$5,651.78}{month}$$

With Winton Washer Recycler:

$$if\ 1\ part = 0.13955\ lb$$

$$and\ Exchange\ Rate = \frac{\$\ 0.30}{lb}$$

$$8{,}100{,}000\ \frac{parts}{life} \cdot 0.104\ \frac{lb}{part} \cdot \frac{\$\ 1.50}{lb} = \frac{\$1,263,600}{5\ years}$$

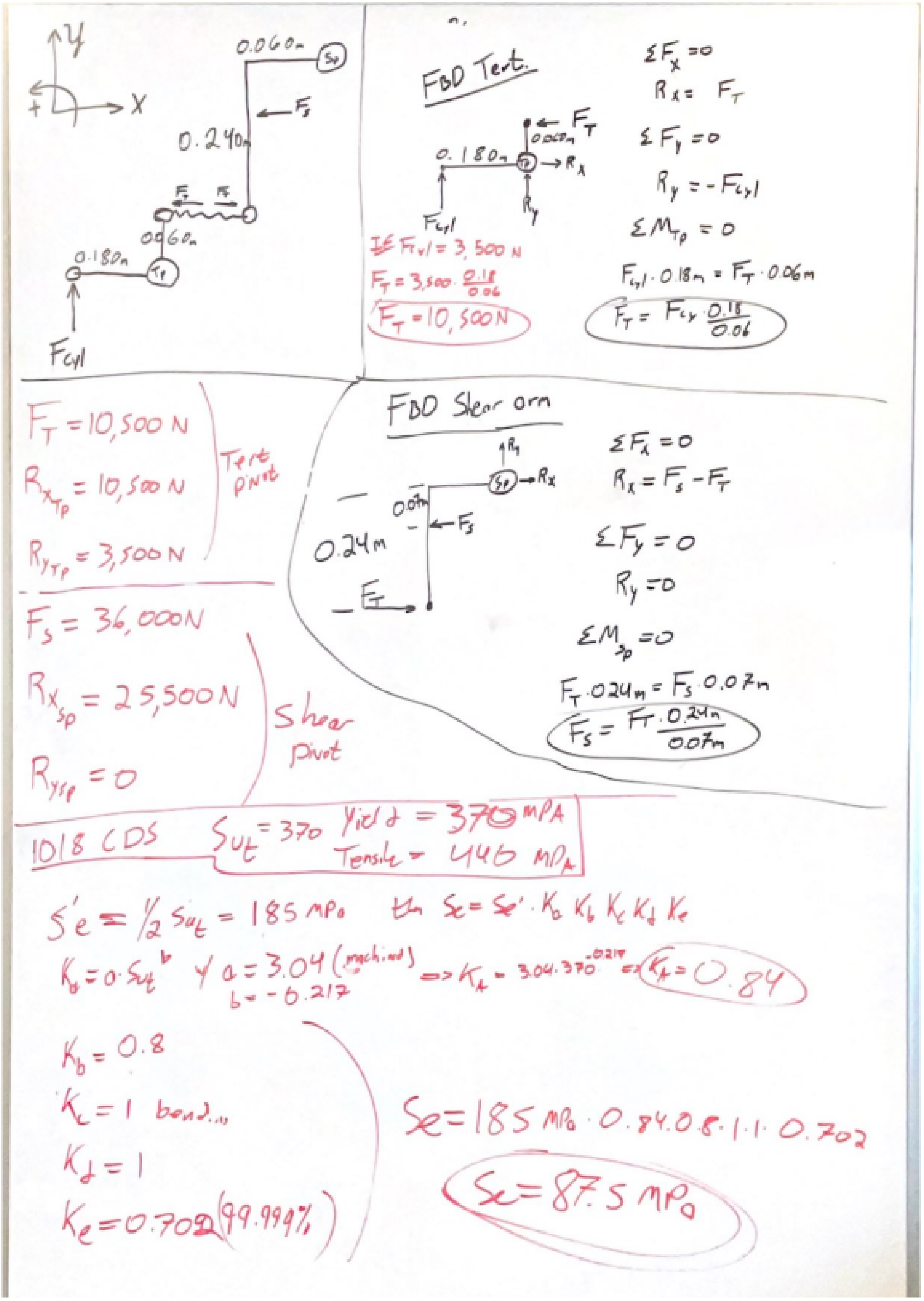
For reference additional reference

$$= \frac{\$252,720}{year}$$

$$= \frac{\$21,060}{month}$$

Adding the Winton Washer Recycler to the Recycling Process increases the company’s Revenue by **272.626%** at the machines most conservative usage

$$\frac{\left|\frac{\$21,060}{month} - \frac{\$5,651.78}{month}\right|}{\frac{\$21,060}{month}} \cdot 100 = 272.626\%$$



FEA Verification

Appendix E - Scoping Document (Complete with Signature)

GVSU Capstone Project 2021

Sponsor: Swoboda

Project: Winton Recycler

Project Specifications and Scope of Work Approval

Florian Melder - Swoboda Sponsor Contact

Signature ______________ Date 2/19/2022

Dr. Wendy Reffeor - GVSU Team Advisor

Signature ______________ Date 2/17/2022

Aziz Sarhan - Team Captain

Signature ______________ Date 2/19/22

Lance Deemter - Sponsor Point of Contact

Signature ______________ Date 2/19/22

Crystal Kinney - GVSU Advisor Contact

Signature ______________ Date 2/19/22

Daniel Weller - Secretary

Signature ______________ Date 2/19/22

Jordan Hayes

Signature ______________ Date 2/19/22

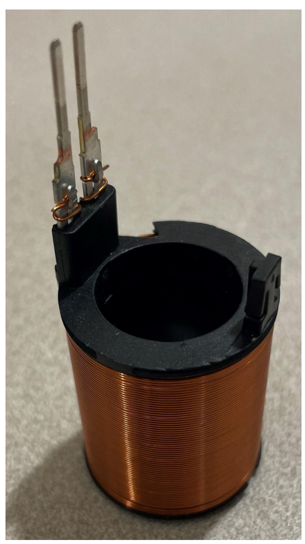
1

This scoping document represents the entirety of the commitment between the GVSU senior project team and the Swoboda regarding this project.

Statement of Problem

- **Current State:**
  - The Winton solenoid, is a device used by a customer of Swoboda in the creation of automotive transmission actuators (Figure E.1). Swoboda manufactures roughly 1.8 million Winton solenoids annually. The Winton solenoid is an overmolded component, containing a copper wound coil (Figure E.2a), steel washer, and brass plated copper terminals (Figure E.4). For recycling purposes, the Winton solenoid can be separated into three pieces: an overmolded coil (Figure E.2b), a steel washer (Figure E.3), and a plastic head (Figure E.4). Scrapped parts from the Winton solenoid production line are recycled as a complete assembly (Figure E.1), drastically diminishing the value per pound of scrap received by Swoboda from the recycling company, as separating the steel from the plastic and copper isn't an easy task.
  - The recyclability of the overmolded coils, steel washer, and the plastic head will decrease third-party processing costs and increase Swoboda's profitability. The current scrap rate for the Winton solenoid is almost 8%, a device to increase the value of the scrapped parts will increase the profitability of this line.

Figure E.1: Winton Solenoid



(E.2a) Copper Wound Coil

(E.2b) Overmolded Copper Coil

Figure E.2: Components of Winton Solenoid

Figure E.3: Steel Washer

Figure E.4: Plastic Head

- **Desired State**
  - Swoboda desires to increase the profitability of the Winton production line through the recycling of the scrapped parts in a disassembled state of 3 pieces: overmolded coil (Figure E.2b), steel washer (Figure E.3), and a plastic head (Figure E.4). The required state of each of the three pieces is listed below. Note that although 3 main parts are required, it is expected that plastic byproduct will also result from the separation process.
  - The following are descriptions of the required states of each separated component as specified by Swoboda.
    - Overmolded Coil (Figure E.2b)
      - The overmolded coil will contain a coil of copper encased in a plastic overmolded body and any plastic byproduct created during separation.
      - No amount of steel is allowed within the overmolded coil.
      - The copper coils within the overmold cast **will not be** extracted. For recycling purposes, this is acceptable. The Overmolded Coil will be recycled under recycling code 314.
    - Steel Washer (Figure E.3)
      - The steel washer shall contain steel and any amount of plastic byproduct created during separation. May also contain copper and/or brass. Washer will be recycled under recycling code 315.
    - Plastic Head (Figure E.4)
      - The plastic heads will contain plastic, a rubber O-ring, brass plated copper terminals, and any plastic byproduct created during separation. Plastic Head will be recycled under recycling code 315.

- The likely hood of the separated components becoming mutilated during the separation process cannot be overlooked. However, due to the separated components being recycled, component mutilation will not affect machine efficiency.

Functional Requirements

- Improve the value of recycled scrap materials using an automated machine to disassemble a completed scrap part into various components. This will increase revenue generated from recycling, thus increasing the profits received by Swoboda.
- The machine should be a fully functioning automated cell that can separate the Winton solenoid into three components (head, washer, overmolded coil) and place the components into separate bins. The Black Box Diagram in Figure E.5 shows inputs and outputs predicted to occur within the Winton Recycler.

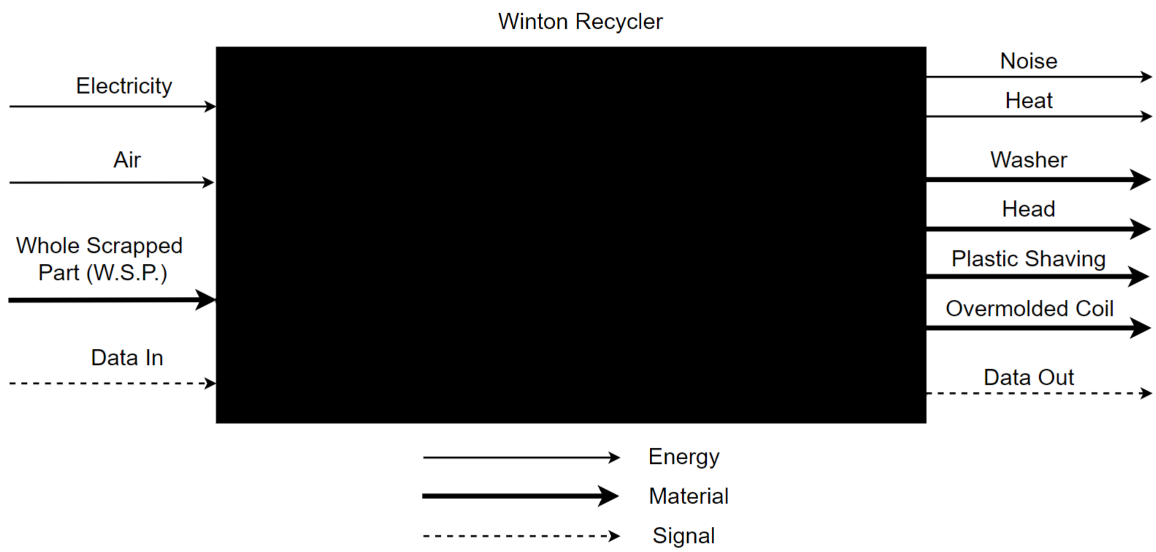


Figure E.5: Black Box Diagram for Winton Recycler

- As seen in [Figure E.6](#), the Function Structure Diagram (FSD) of the Winton Recycler shows the critical subfunctions present within the machine, as well as how the inputs and outputs are distributed throughout the subfunctions.
    - Orienting part: All functions dealing with the movement of the Whole Scrap Part (W.S.P.) from the outside world to the first point of contact with the disassembly mechanism. (i.e. feeding mechanism).
    - Part Movement: First point of contact between W.S.P. and disassembly mechanism. This includes taking W.S.P. from the feeding mechanism and moving to the disassembly mechanism.
    - Head Removal and Washer Removal: Both are part of the disassembly mechanism. But both are conducted separately from each other.
    - Sorting: Sorting includes all functions used to properly sort and store the disassembled components.

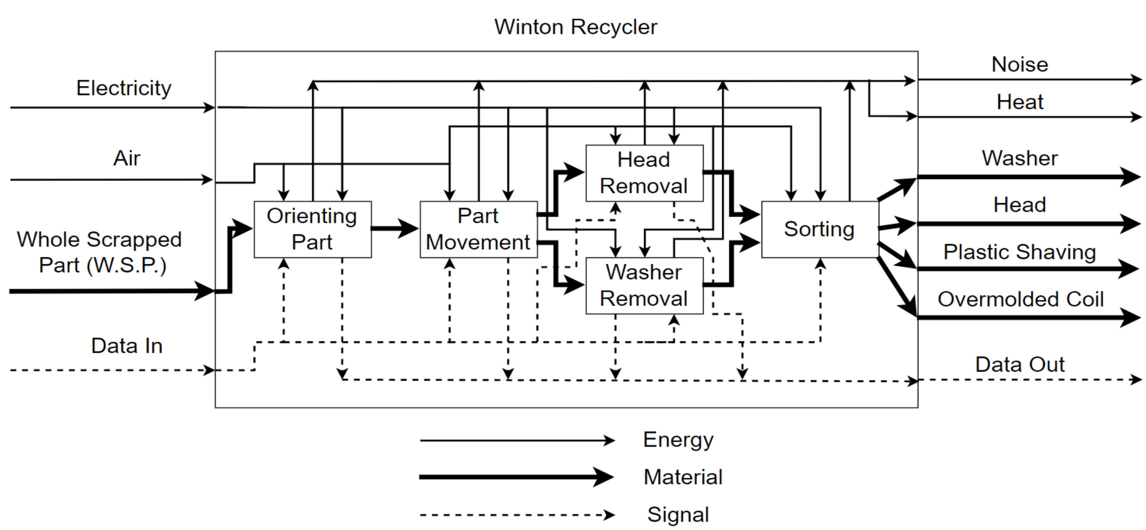


Figure E.6: Function Structure Diagram for Winton Recycler

Design Constraints

- The machine is required to operate with 110-volt single-phase power.
- The machine is required to operate within the range of air pressure from 6 to 8 bar.
- The use of any hydraulic power is not allowed, per Swoboda's requirements.
- The machine is required to be portable. Portability is defined by the ability of the operator/technician to move the machine along a level concrete surface with the use of 4 locking and swiveling casters attached to the machine's base. The caster maximum allowable load will then define the metric of portability. The maximum weight should be less than 400 kg. The size of the machine during movement should be the same as the size of the machine during normal operating conditions.
- Machine work instructions are an optional constraint. The instructions should be in written form, following the attached template. The instructions are optional due to time constraint considerations.
- Metric units are required to be used
- The required maximum size of the machine is to be defined by the volumetric footprint of: [0.9 m (width) x 1.0 m (length) x 2.2 m (height)]
- The machine is required to have a maximum opening size defined by a sphere of 38 mm in diameter which will be placed into all openings. No opening shall allow the sphere to pass through. The reason for defining maximum opening size is to guard against all human interaction with moving components of the machine.
- The required maximum cycle time is 10 seconds. Assuming the loading of W.S.P. in que form, the cycle time is defined as time required to load, disassemble, and separate 1 W.S.P. No operator interaction is required to define cycle time.
- The required maximum interaction time with the operator/technician is 15 minutes per 60 minute the machine is in use. This is to be defined as all interactions required to properly

operate the machine during normal operation.

- Solenoid disassembly must result in the 3 main components (head, washer, overmolded coil) along with plastic debris.
- Human Machine Interface (HMI) is required to be accomplished through a Siemens touch screen unit and is required to display the status of: interrupted safety devices, error messages pertaining to machine operation, and a cycle counter.
- The machine control shall use a Siemens PLC.
- The machine is required to include a visual indication of the operating status of the safety equipment in the form of a green illuminated push button.
- A minimum of 1 emergency stop button must be in place. An E-stop button must be reachable from all points of the machine, including when any doors are open. Once activated, the E-stop button must eliminate all transfer of energy to the machine.
- Communication to I/0 and HMI must be conducted via ProfiBUS.
- I/0 must be achieved using Festo CPI valve banks and input blocks.

Specifications

Table E.1.1: Required Specifications

Specification	Required or Optional	Value	Units	Test Method
Maximum Input Power	Required	110 V	volts	DMM
Maximum Input Air	Required	$6 < x < 8$	bar	Pressure Gauge

Pressure				
Use of hydraulic power is not allowed	Required	Yes/No	-	Visual Inspection

Table E.1.2: Required Specifications (cont.)

Specification	Required or Optional	Value	Units	Test Method
Tutorial - written, following attached template	Required	-	-	Visual Inspection
Use metric units	Required	-	-	Engineer Drawing
Maximum Size of Machine	Required	Width: 0.9 m Height: 2.2 m Length: 1.0 m	meters	Tape measure
Maximum Opening Size	Required	-	-	Sphere test
Maximum Cycle Time	Required	10 s	seconds	1 hr. Trial Test (10 min sub trial)
Machine Safety Equipment Status Indicator	Required	-	-	Yes/No
Minimum 1 Emergency stop equipped and reachable	Required	-	-	Yes/No

Communication to I/0 and HMI via ProfiBUS	Required	-	-	Yes/No
Maximum interaction time with operator/technician per hour of use	Required	15 minutes per 60 minutes (in use)	minute s	1 hr. Trial Test
Proper separation of Solenoid into 3 components (head, washer, overmolded coil)	Required	> 99/100 (99%)	parts	1 hr. Trial Test (100 part sub trial)
HMI	Required	-	-	Visual Inspection
I/0 achieved with Festo CPI valve banks and input blocks	Required	-	-	Visual Inspection
PLC Control	Required	-	-	Visual Inspection
Portability	Required	< 400 kg	kilogra ms	Mass Scale

Deliverables

- A fully functioning automated cell that can separate the Winton solenoid into three components (head, washer, overmolded coil) and place the components into separate bins.

Test Methods

- All tests regarding length measurement will be conducted with a basic tape measure.
- The mass of the machine will be measured with the warehouse scale available at Swoboda
- Testing of maximum opening size will be performed using a sphere of 38 mm diameter. The sphere will be tested for fitment into all openings (excluding the top of the machine) with a pass/fail method. Passing criteria corresponds to an opening which inhibits the sphere passing through the opening. Failure criteria corresponds to an opening which does not inhibit the sphere passing through the opening.
- Testing of cycle time, operator interaction, and results of separation will all be conducted using a 1 hour trial of continuous running of the machine.
    - Average cycle time will be calculated with the count of total W.S.P. disassembled (n) in a 10-minute sub-trial. The sub-trial will be duplicated 3 separate times during the 1 hour main trial. The average of the 3 average cycle times will then be calculated using Equation 1.

$$Average\ Cycle\ Time = \frac{\sum_{i=1}^{3} \frac{600}{n_i}}{3} \left(\frac{seconds}{Part}\right) \tag{1}$$

    - Operation interaction times will be recorded throughout the 1-hour trial, and the total interaction time will result from the sum of the individual times.
    - The proper level of separation will be tested with a sub-trial of 100 parts disassembled. Once 100 parts have been disassembled, the separation bins will be removed and replaced with empty ones in order to allow for the continued operation of the machine in the 1-hour window. The bins containing the separated parts will

then be individually inspected, counting the total parts contained in each bin, and looking for any material which does not belong in the respective bins. For the bin containing the disassembled head, there should be at least 99/100 heads, and only O-rings or plastic debris. For the bin containing the steel washer, there should be at least 99/100 washers and plastic debris. For the bin containing the overmolded coil, there should be at least 99/100 coils, and only plastic debris, no steel is allowed in the over molded bin.

- The 100 part sub-trial test will be conducted twice to ensure validity of results.

Tutorial Template

swoboda technologies	Swoboda Operating System		WI07.440.00	
	TITLE: Standard of Work for Hutchinson Laser Weld and Leak Test Station		Issue Date: 3/15/19	Rev. Date 3/15/2019
Owner: L. Bandlow		Releaser: L. Bandlow		

1. Important Documentation:

1.1 For all procedures, forms and work instructions referenced within this document

2. Safety Notes:

2.1 The user is obliged at all times to operate the equipment / system only with the safety

2.2 The personnel responsible for the equipment/system shall be obliged to ensure

2.3 The equipment may only be maintained, set-up, repaired, etc. by personnel

3. Traceability:

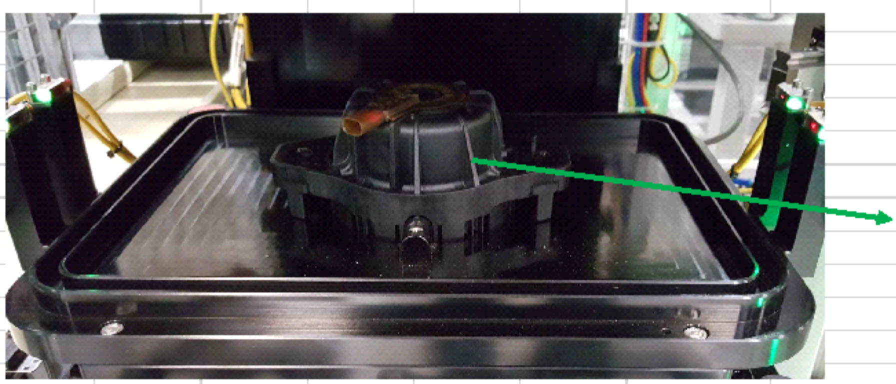
3.1 Make sure purchased materials and components are identified with a Plex WIP

3.1.1 If you find an incorrect label or no label, inform the Business Unit Leader or Quality Engineer. Do NOT start production.

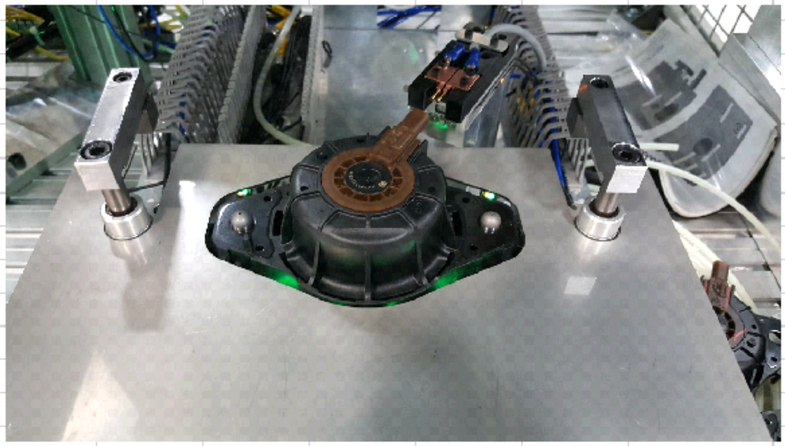
3.2 When the Serial Number changes, the new serial number must be "loaded" in Plex, to enable reporting of production.

4. Manufacturing Product:

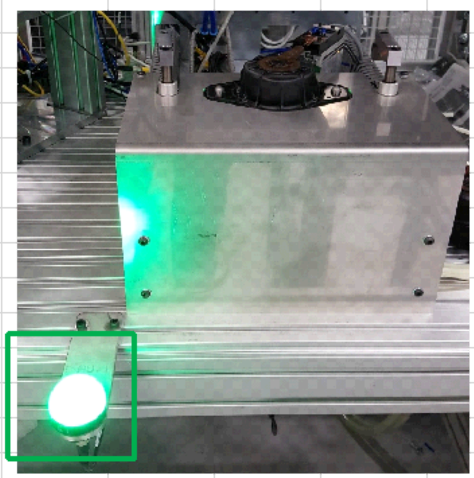
What to do :	Remove the welded H90443 Assembly from the welder.
How to do it:	Check the monitor to verify the part has welded correctly. Ensure that the pin prick has been made if the part is good. If the part fails the welding process, remove and place into the scrap bin and reset the welder. Carefully remove the assembly from the nest to not damage the snap tabs.
Time to complete task:	2 seconds
Why do it:	Verifying a good weld ensures only good parts will advance. Careful removal of the part ensures no damage to the snap tabs will occur.



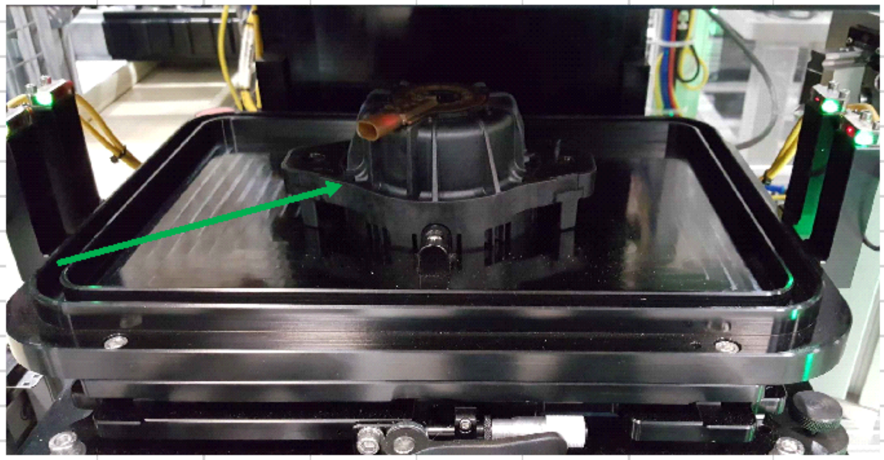
What to do:	Place the welded H90443 Assembly into the air leak test station.
How to do it:	Place the welded H90443 Assembly into the nest of the air leak test station, with the electrical connector facing towards the back of the work station.
Time to complete task:	2 seconds
Why do it:	The nest checks for the presence of each of the snap tabs and allows for a consistent leak test to be performed. The nest and clamping device also secures the part and protects from interference and manual overrides.



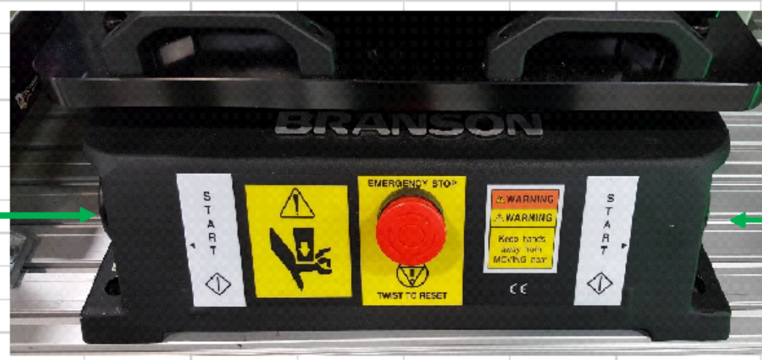
What to do:	Begin the air leak test.
How to do it:	Press the green start button for the air leak tester
Time to complete task:	1 second
Why do it:	To minimize energy use, the station will only test after the operator has confirmed a part is loaded and manually begins the test



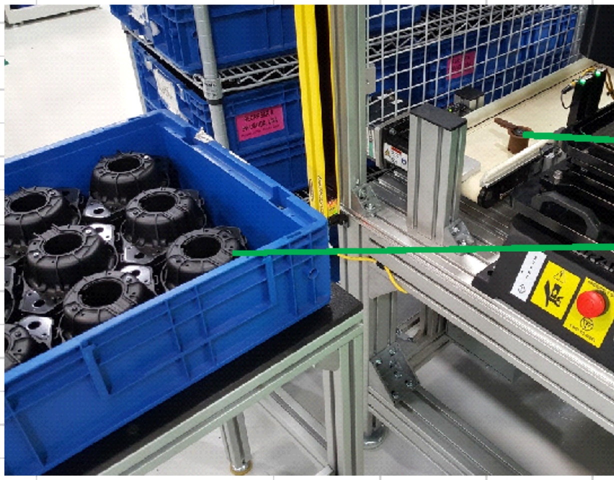
What to do:	Place the unwelded actuator/LBC assembly into the laser welder.
How to do it:	Take the actuator and lower bellows cap assembly and place it into the weld nest of the laser welder with the electrical connector facing out.
Time to complete task:	3 seconds
Why do it:	By placing the parts into a weld nest, a consistent weld can be gotten.

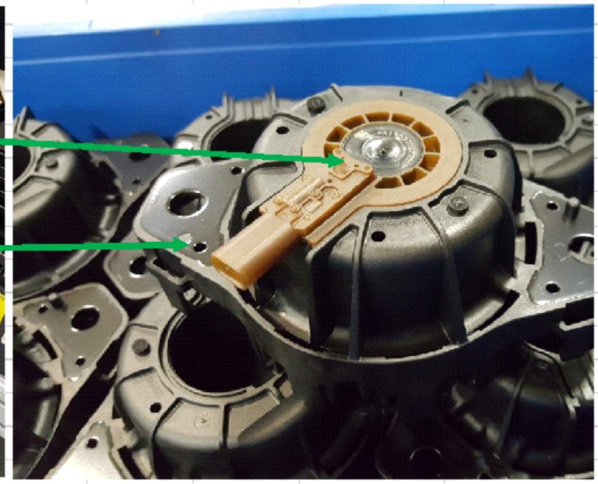


What to do :	Start the laser welder.
How to do it:	Standing clear of the light curtain, hold the start buttons for the laser welder.
Time to complete task:	4 seconds
Why do it:	For safety reasons, the laser welder will only operate when both buttons to activate are pressed and the operator is outside the light curtain.



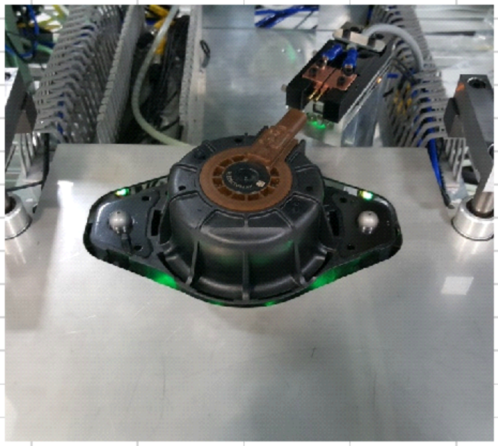
What to do:	Place an assembled actuator into a lower bellows cap
How to do it:	Remove one cooled H64002 Lower Bellows Cap from the box as well as one H90500 Actuator from the conveyor. Place the actuator into the lower bellows cap.
Time to complete task:	4 seconds
Why do it:	By assembling a cool lower bellows cap and a tested actuator, we can be sure the weld will be consistent and with good parts.





What to do :	Prepare the work station for the next cycle.
How to do it:	Make sure that all of the necessary components are available at your station and tidy up anything that may be out of place.
Time to complete task:	2 seconds
Why do it:	Preparing the work station for each cycle ensures efficiency, cleanliness, and quality.

What to do :	Remove the H90443 Assembly from the air leak test station.
How to do it:	Verify both the pass/fail and snap tab verification results on the monitor. If the part passed, place it into a tote for packaging. If the part failed, press the button to aknowledge the failure and unclamp the part, then place it into the reject bin.
Time to complete task:	3 seconds
Why do it:	Unloading the leak tester will allow for the next part to be tested. By immediately scrapping failed parts, there will be less chance for a mixup.



Welding/Testing Time:	21 seconds
Actuator Cover Weld/Test Time:	19 seconds

Appendix F - Concept Selection Document

Scoping / Specifications Document

The Winton solenoid is a device used by a customer of Swoboda in the creation of automotive transmission actuators. Swoboda manufactures roughly 1.8 million Winton solenoids annually. The Winton solenoid is an overmolded component, containing a copper wound coil, steel washer, and brass plated copper terminals. For recycling purposes, the Winton solenoid can be separated into three pieces: an overmolded coil, a steel washer, and a plastic head. Scrapped parts from the Winton solenoid production line are recycled as a complete assembly, drastically diminishing the value per pound of scrap received by Swoboda from the recycling company, as separating the steel from the plastic and copper isn't an easy task.

Morphological Matrix

After consideration of the problem at hand there were sub functions that were created to generate possible solutions for the final design. There were five different sub functions based on the factors at hand, head removal, washer removal, sorting, feeding mechanism, and then transfer part within the machine. For the head removal process there were three different solutions that were prototyped and tested which included: single axle rotational shear, linear shear, and double axle shear. The washer removal process included a punching mechanism as well as a pulling mechanism. The sorting devices that were further looked into included the trap door, independent holes, and gravity fallen. For the feeding mechanism the team looked at how the operator will interact with the operator and concluded that the following would be further tested: vibrating rail and the gravity rail. For the final critical function, transfer of part within the machine, to execute this sub function there were two different mechanisms that were looked at: having a separate placement or when it is placed from the feeding mechanism. A morphological matrix was then generated to help the team better understand the different solutions when acting with one another which are shown in table F.1.

Table F.1: Morphological Matrix of Possible Solutions

	Head Removal	Washer Removal	Sorting	Feeding Mechanism	Transfer Part within Machine
Solution 1	Single Axle Rot. Shear	Punch it	Trap Door	Vibrating Rail	Separate Placement Mech.
Solution 2	Single Axle Rot. Shear	Pull it	Trap Door	Gravity Rail	Placed from Feeding Mech.
Solution 3	Linear Shear	Punch it	Trap Door	Gravity Rail	Placed from Feeding Mech.

Solution 4	Double Axle Rot. Shear	Punch it	Trap Door	Vibrating Rail	Separate Placement Mech.

Concept Designs

After analyzing the morphological matrix, four different possible solutions were then prototyped and used in a pugh matrix to dictate which design would be the most efficient for our application. The baseline function for the pugh matrix was based on a device that was already implemented at Swoboda called the Sonoma Recycler which was then used to distinguish what would be best for the design.

Table F.2.1: Baseline Concept Critical Subfunctions

Head Removal	Washer Removal	Sorting	Feeding Mechanism	Transfer Part within Machine
Guillotine, no blade	Punch it	Independent Holes	Vibrating Rails	Placed from separate feeding mechanisms

Baseline Description:

This baseline description is derived from the Sonoma recycler. This baseline design includes a head removal method using blunt force, which is similar to a guillotine with no blade. The washer removal method is punching it, meaning an actuator sits perpendicular to the washer and it extends out to punch the head out from the seating. The sorting function is that of independent holes, meaning that as each function is completed, the pieces will be sent into independent holes to be sorted. The feeding mechanism is by vibrating rail. The Sonoma pieces are inserted into the vibrating rail and they slowly shimmy down the rail to the clamp. The piece is placed separately from the feeding mechanism, where a multi-stage actuator process pouches the pieces into the clamp for the head removal.

Advantages to Baseline Design

- <u>Head Removal (Guillotine, no blade)</u>: Simple design

- Washer Removal (Punch it): Simple, One Cylinder needed
- Independent Holes: Assigned paths for pieces, no need for automated control.
- Feeding Mechanism (Vibrating Rail): Level delivery, currently in use a Swoboda, reliable, more controlled aspects.
- Transfer Part within Machine (Separate Transfer Mech.): Guaranteed rotational orientation, simple clamp design.

Disadvantages to Baseline Design

- Head Removal (Guillotine, no blade): Requires several strokes, not precise cutting
- Washer Removal (Punch it): Limited access to backside of part, potential damage to washer.
- Independent Holes: Easy for pieces to get mixed up
- Feeding Mechanism (Vibrating Rail): Requires power, extra tuning, added complexity (Incorporated rail), more expensive.
- Transfer Part within Machine (Separate Transfer Mech.): Complex movement required, more likely for the part to slip off, complex coding required.

Table F.2.2: Concept 1 Critical Subfunctions

Head Removal	Washer Removal	Sorting	Feeding Mechanism	Transfer Part within Machine
Single Axle Rotational Shear	Punch it	Trap Door	Vibrating Rail	Separate Placement Mechanism

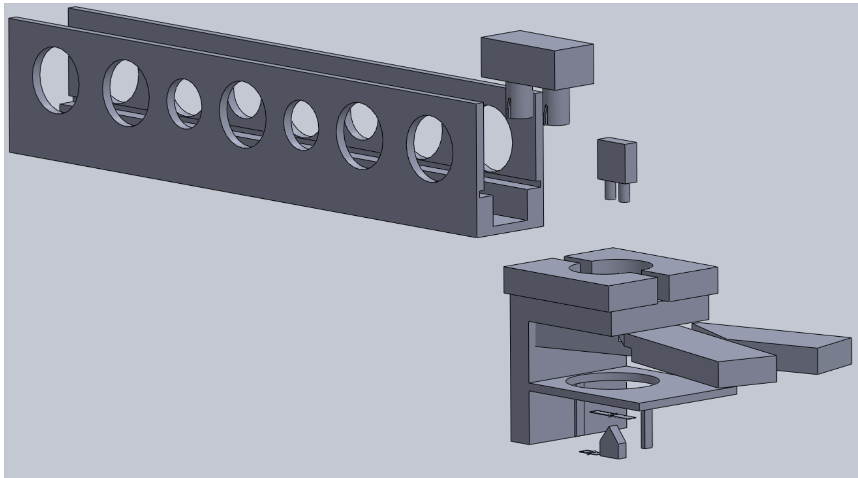


Figure F.1: Concept 1 Design

Concept 1 Description:

This concept design depicted in figure F.1 includes a head removal method using a single axle rotational shear which is similar to traditional pliers. The washer removal method is punching it, meaning an actuator will sit on the top and extend out after the head is removed. Once extended, it will come into contact with the washer and will push the washer out of it's seating. The sorting function is by the means of trap doors. As each function is completed, head removal and washer removal, the pieces will fall by gravity into a trap door sorting system. The feeding mechanism is by vibrating rail. The rail is designed to the Winton solenoid piece to ensure movement restrictions. The rail will vibrate and the pieces will shimmy along the rail. Lastly, the transfer part to the machine function is a placement mechanism. An actuator with pronged pieces will place the Winton solenoid from the vibrating rail to the clamp.

Advantages to Concept 1 Design

- Head Removal (Single Axle Rot. Shear (Traditional Plier)): Effective at shearing head from washer and overmolded coil.
- Washer Removal (Punch it): Simple, One Cylinder needed
- Sorting (Trap Door): Easy, simplistic, not very complex.
- Feeding Mechanism (Vibrating Rail): Level delivery, currently in use a Swoboda, reliable, more controlled aspects.

- Transfer Part within Machine (Separate Transfer Mech.): Guaranteed rotational orientation, simple clamp design.

Disadvantages to Concept 1 Design

- Head Removal (Single Axle Rot. Shear (Traditional Plier)) Requires long moment arms to achieve sufficient force. This increases the size of the machine.
- Washer Removal (Punch it): Limited access to backside of part, potential damage to washer.
- Sorting (Trap Door): Easy for pieces to get mixed up, requires some new/more materials (sheet metals) design constraints
- Feeding Mechanism (Vibrating Rail): Requires power, extra tuning, added complexity (Incorporated rail), more expensive.
- Transfer Part within Machine (Separate Transfer Mech.): Complex movement required, more likely for the part to slip off, complex coding required.

Table F.2.3: Concept 2 Critical Subfunctions

Head Removal	Washer Removal	Sorting	Feeding Mechanism	Transfer Part within Machine
Single Axle Rotational Shear	Pull It	Trap Door	Gravity Rail	Placed from feeding mechanism

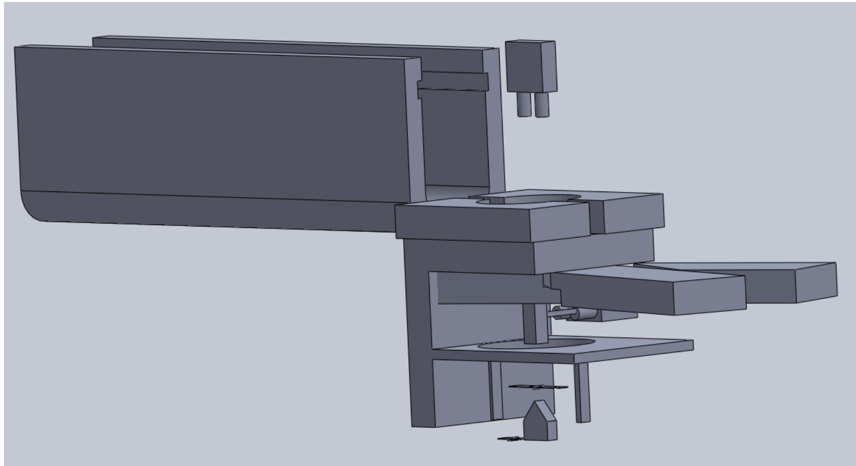


Figure F.2: Concept 2 Design

Concept 2 Description:

This concept design depicted in figure F.2 includes a head removal method using a single axle rotational shear, which is similar to traditional pliers. The washer removal method is to pull it, meaning either a magnetic or pneumatic gripper used to remove washer. The sorting function is by the means of trap doors. As each function is completed, head removal and washer removal, the pieces will fall by gravity into a trap door sorting system. The feeding mechanism is by gravity rail. A gravity rail will allow potential energy to roll the parts down a predesigned rail. Lastly, the transfer part to the machine function is placed directly from the feeding mechanism via rolling off the gravity rail into the clamp.

Advantages to Concept 2 Design

- Head Removal (Single Axle Rotational Shear (Traditional plier)): Effective at shearing head from washer and overmolded coil.
- Washer Removal (Pull it): Ease of Accessibility
- Sorting (Trap Door): Easy, simplistic, not very complex.
- Feeding Mechanism (Gravity Rail): Simple, cost effective, minimal maintenance.
- Transfer Part within Machine (Placed from Feeding Mech.): Simple, correct orientation is more likely, no change in orientation from feeding mechanism to head removal placement.

Disadvantages to Concept 2 Design

- Head Removal (Single Axle Rotational Shear (Traditional pliers)): Maintenance to the blade, blade material
- Washer Removal (Pull it): More complex, will need to have two cylinders to operate this function. Multistage process.
- Sorting (Trap Door): Easy for pieces to get mixed up, requires some new/more materials (sheet metals) design constraints
- Feeding Mechanism (Gravity Rail): Unpredictable rotational orientation, geometric limitations, and specific geometric requirements.
- Transfer Part within Machine (Placed from Feeding Mech.): No guaranteed rotational orientation, complexity in clamping design.

Table F.2.4: Concept 3 Critical Subfunctions

Head Removal	Washer Removal	Sorting	Feeding Mechanism	Transfer Part within Machine
Linear Shear (Guillotine with blade)	Punch it	Trap Door	Gravity Rail	Placed from feeding mechanism

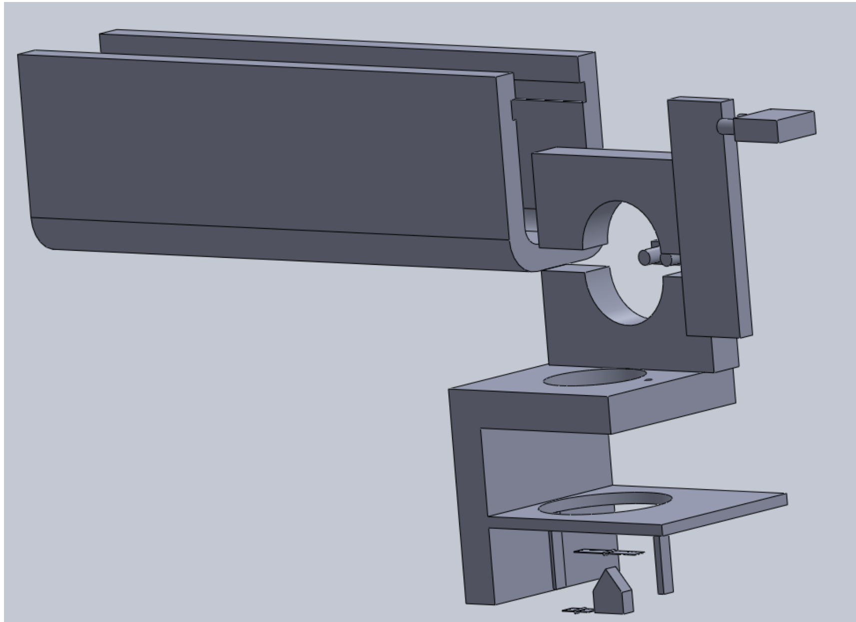


Figure F.3: Concept 3 Design

Concept 3 Description:

This concept design depicted in figure F.3 includes a head removal method using a linear shear. This head removal mechanism works similarly to a guillotine. The washer removal method is punching it, meaning an actuator will sit on the top and extend out after the head is removed. Once extended, it will come into contact with the washer and will push the washer out of its seating. The sorting function is by the means of trap doors. As each function is completed, head removal and washer removal, the pieces will fall by gravity into a trap door sorting system. The feeding mechanism is by a gravity rail. The rail is designed to the Winton solenoid piece to ensure movement restrictions. Lastly, the transfer part to the machine function is a placement mechanism.

Advantages to Concept 3 Design

- Head Removal (Linear Shear - Guillotine with blade): Simple shearing mechanism, no rotational parts
- Washer Removal (Punch it): Simple, One Cylinder needed
- Sorting (Trap Door): Easy, simplistic, not very complex.

- Feeding Mechanism (Gravity Rail): Simple, cost effective, minimal maintenance.
- Transfer Part within Machine (Placed from Feeding Mech.): Simple, correct orientation is more likely, no change in orientation from feeding mechanism to head removal placement.

Disadvantages to Concept 3 Design

- Head Removal (Linear Shear - Guillotine with blade): No mechanical advantage from pneumatic cylinders, less safety margin
- Washer Removal (Punch it): Limited access to backside of part
- Sorting (Trap Door): Easy for pieces to get mixed up, requires some new/more materials (sheet metals) design constraints
- Feeding Mechanism (Gravity Rail): Unpredictable rotational orientation, geometric limitations, and specific geometric requirements.
- Transfer Part within Machine (Placed from Feeding Mech.): No guaranteed rotational orientation, complexity in clamping design.

Table F.3.1: Concept 4 (High Fidelity Concept) Critical Subfunctions

Head Removal	Washer Removal	Sorting	Feeding Mechanism	Transfer Part within Machine
Single Axle Rotational Shear (Inverted pliers)	Punch it	Trap Door	Vibrating Rail	Separate Placement Mechanism

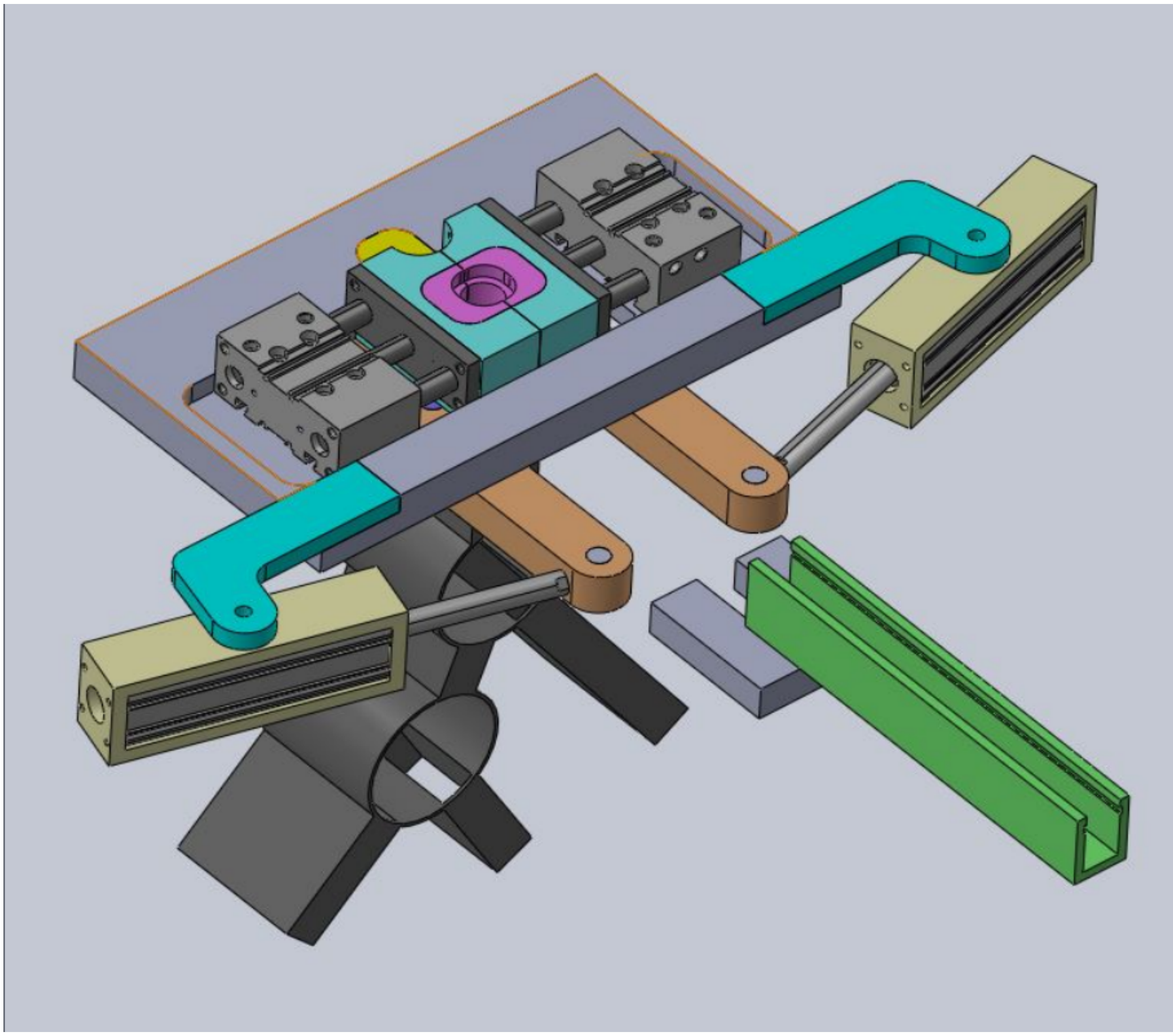


Figure F.4: Concept 4 (High Fidelity Concept) Concept Design

Concept 4 (High fidelity concept) Description:

This concept design depicted in figure F.4 includes a single axle rotational shear acting as inverted pliers. This method of head removal will effectively remove the head with a high mechanical advantage. The washer removal method is punching it, meaning an actuator will sit on the top and extend out after the head is removed. Once extended, it will come into contact with the washer and will push the washer out of it's seating. The sorting function is by the means of trap doors. As each function is completed, head removal and washer removal, the pieces will fall by gravity into a trap door sorting system. The feeding mechanism is by vibrating rail. The rail is designed to the Winton solenoid piece to ensure movement restrictions. The rail will vibrate and the pieces will shimmy along the rail. Lastly, the transfer part to the machine function is a placement mechanism. An actuator with pronged pieces will place the Winton solenoid from the vibrating rail to the clamp.

Advantages to Concept 4 Design

- Head Removal (Single Axle Rotational Shear (Inverted pliers)): Effective head removal due to mechanical advantage, more compact design, high factor of safety.
- Washer Removal (Punch it): Simple, One Cylinder needed
- Sorting (Trap Door): Easy, simplistic, not very complex.
- Feeding Mechanism (Vibrating Rail): Level delivery, currently in use a Swoboda, reliable, more controlled aspects.
- Transfer Part within Machine (Separate Placement Mech): Guarantees part orientation, simple clamp design

Disadvantages to Concept 4 Design

- Head Removal (Single Axle Rotational Shear (Inverted pliers)): Blade maintenance, blade material
- Washer Removal (Punch it): Limited access to backside of part, potential damage to washer.
- Sorting (Trap Door): Easy for pieces to get mixed up, requires some new/more materials (sheet metals) design constraints
- Feeding Mechanism (Vibrating Rail): Requires power, extra tuning, added complexity (Incorporated rail), more expensive.
- Transfer Part within Machine (Separate Placement Mech): Complex movements required, more likely for the part to slip off, complex coding required.

Pugh Matrix

Table F.3: Pugh Matrix

Value	Rank	Selection Criteria	Baseline	Concept 1	Concept 2	Concept 3	Hi-Fi Concept
5	1	Head Removal	Baseline	+	+	S	+
4	2	Part Movement		S	-	-	S
3	3	Washer		S	-	S	S
2	4	Feeding Mech.		S	-	-	S
1	5	Sorting		+	+	+	+
		SUM (+)		2	2	1	2
		SUM (-)		0	3	2	0
		SUM		2	-1	-1	2

Recommendation

Since the Sonoma Recycler, is an existing concept at Swoboda which was used as the reference for the benchmark to determine our finalized concept utilizing an evolutionary design. After continuous iterations referenced in Appendix G, the shear arm process was selected through the process of elimination.

Appendix G - Prototypes Tests

Head Removal: Shear Arm Prototype (SAP) Evolution

SAP1

The 1st shear arm iteration is heavily influenced by a guillotine. After a few tests, it was confirmed that this design was the solution to the head removal of the winton solenoid. However, due to not being able to conduct repeatable testing on the 1st iteration, it was deduced that a 2nd iteration was needed to justify the head removal process. Additional details of the results are referenced in Shear Arm Prototype 1.

SAP2

The clamping problem from the previous iteration has been addressed allowing quantifiable data collected to justify an efficient head removal process. From this test, the shearing orientation of the winton solenoid was determined – this is where the plastic molding meets the washer. This precise location will yield a clean cut over each iteration. If the right balance between the depth and orientation was not met then damage to the blade would occur. This was named 'depth B' (figure G.2.3). Finally the ideal orientations based on the result were seen to be 0, 90, 180, 270 degrees according to Table G.2.1. Additional details of the results of this test and result can be referenced in Appendix G.2.

SAP3

After discussions with the faculty advisor, it was identified that the single shear arm (guillotine method) would cause a moment on the table which would mean the chassis and table would be susceptible to movement. To counter this machine rotation, an additional arm was proposed in this prototype to balance the reaction force. Finally the clamping was refined which can be referenced in appendix G.3 using Table G.3.1.

SAP4

The fourth prototype of the shearing mechanism incorporated two separate arms that rotated about separate axes. The location of the axes with respect to the cutting edge was located on the centerline of the shearing arm as a force was applied to the location. This prototype removes the complexity associated with SAP3 and the respective need to mount 2 separately rotating members on a single shaft. Moreover, this fourth prototype was versatile in the fact that it can remove the head from the winton solenoid in either orientation. This prototype showed the successes of using a compact double shear arm design.

SAP5

The fifth shearing arm prototype achieved shearing of the head with performance comparable to shearing arm prototype 3. However, SAP5 required a large reaction force at the shear axis of the rotation to balance the applied force. The large reaction force contributed to the bending of the wings and required fastening of the entire assembly to the table. SAP5 was considered ineffective but proved the validity of a compact double member rotational shear about a single axis. Furthermore, four possible rotational orientations were possible for shearing, but only two orientations can be used as the vibrating rail limits the orientation. The key result of testing was the inability of the shear arm to remove the head from the Winton solenoid containing no washer.

It is recommended that a vibrating rail is used, considering Swoboda already uses vibrating rails for most of their feeding mechanisms. A revised model of a vibrating rail can be created that fits the profiling of the Winton Solenoid. Moreover, it is recommended that we utilize a shearing mechanism for the head removal as it will be the most efficient and simplistic method. Lastly, it is recommended to design a new sorting mechanism, as independent holes for sorting are not reliable considering parts can be sorted incorrectly. Therefore, a trap door mechanism can be thought of to eliminate any errors with sorting parts incorrectly.

G.1 -Shear Arm Prototype 1

Purpose & Background:

Shear Arm prototype 1, seen in Figure G.1.1, was an initial design which tested the general concept as to whether a rotation shear could remove the head from the Winton solenoid. Shear prototype 1 include one shear arm, made from a single piece steel, rotating about a single axis. The shear arm was approximately 20 inches in length. Also included in Shear Arm prototype 1, and shown in Figure 2, was the clamp and clamp base, a 2-piece aluminum clamp, with the lower clamp half bolted to the clamp base, and the upper clamp half bolted to the lower half.

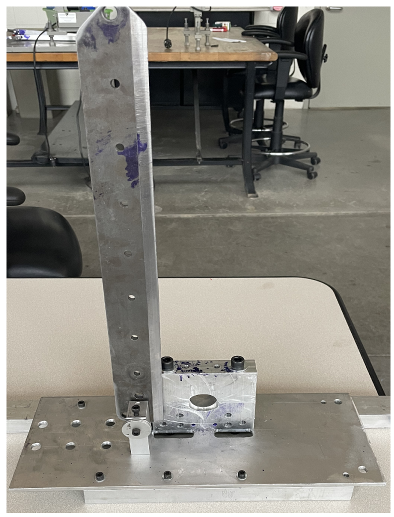


Figure G.1.1: Shear Arm Prototype 1

Figure G.1.2: Shear Arm Prototype 1 Clamp

Testing Methods and Results: Due to inability to reliably clamp Winton solenoid, testing was aborted for Shear Arm prototype 1. However, several attempts at head removal were still conducted and results showed promise with future prototypes.

Conclusions: Limitations in repeatability of clamping mechanism were found in Shear Arm prototype 1. The effectiveness of Shear Arm prototype 1 was found to be capable of removing the head. The next steps were to eliminate variability in clamping mechanism to allow for proper testing of the shear mechanism.

G.2 - Shear Arm Prototype 2

Purpose & Background: Shear Arm prototype 2, seen in Figure G.2.1, featured an update to the clamping mechanism found in shear arm prototype 1, now including hardware to properly align the clamp during operation, and a depth stop to ensure the depth of the Winton solenoid at the point of shearing would be consistent on every solenoid tested. The shear arm did not change design between revisions.

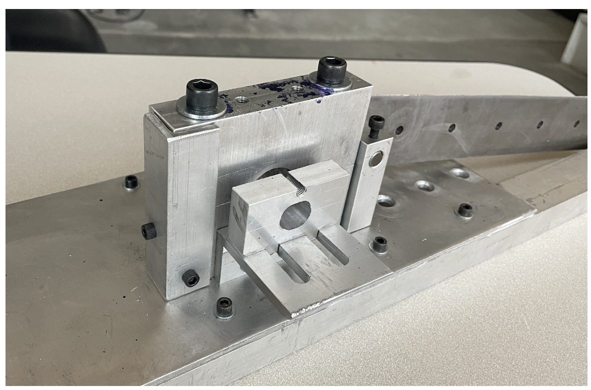


Figure G.2.1 Shear Arm Prototype 2, Highlighting Changes to Clamp

Testing: Shear Arm prototype 2 was used for initial testing of the shear arm idea. The feasibility of the shear arm idea to remove the head of the Winton solenoid was confirmed by shear arm prototype 1, but the goal of Shear Arm prototype 2 was to define two key points:

1. Does the rotational orientation of the Winton solenoid effect shearing?
2. At what depth (distance from cutting edge) should the shear occur?

The two key points were to be determined with a test conducted over 8 possible rotational orientations, seen in Figure 2, and at 3 possible depths, seen in Figure G.2.3. The 3 depths were chosen at a range suitable to the precision capable of the prototype of approximately +/- 0.1"

During testing, the following parameters, along with the reasoning, were observed:

1. Was the head removed? – [Yes/No]
    a. Critical function of machine
    b. Without head removal, washer removal not possible
2. Did the blade contact the washer? – [Yes/No]
    a. Blade damage would occur if contact occurred
    b. Damage to washer will reveal if contact occurred
    c. Depth of cut would be used to avoid contact
3. Can washer be removed with single punch? – [Number of strikes required]
    a. If enough plastic is remaining on washer face, will inhibit washer removal
    b. If washer is freed due to shearing action, 0 strikes required

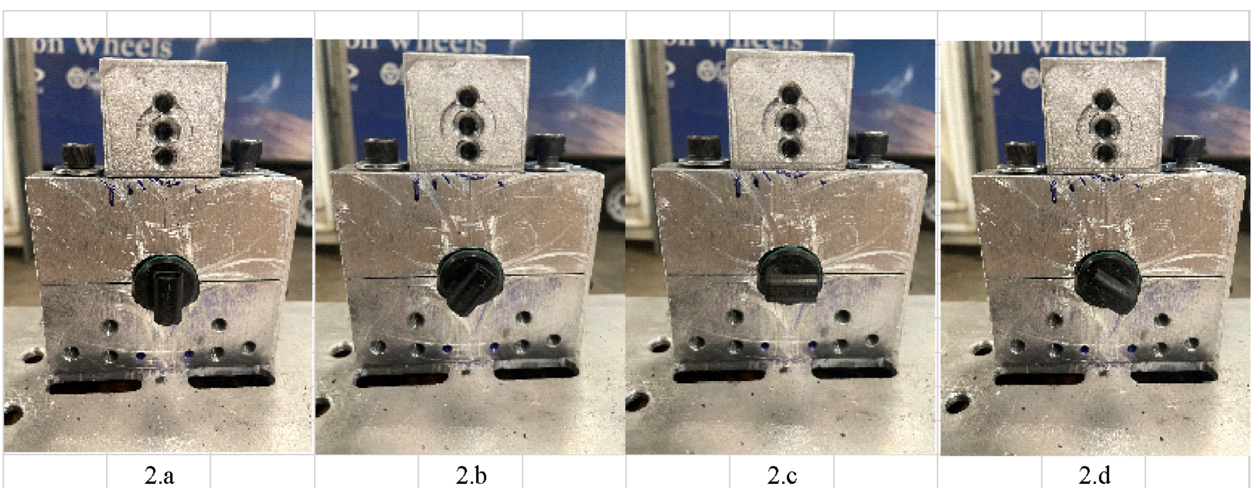


Figure G.2.2: ***The 8 Orientations Tested*****: (2.a) 0°/180° (2.b) 45°/225° (2.c) 90°/270° (2.d) 135°/315°**

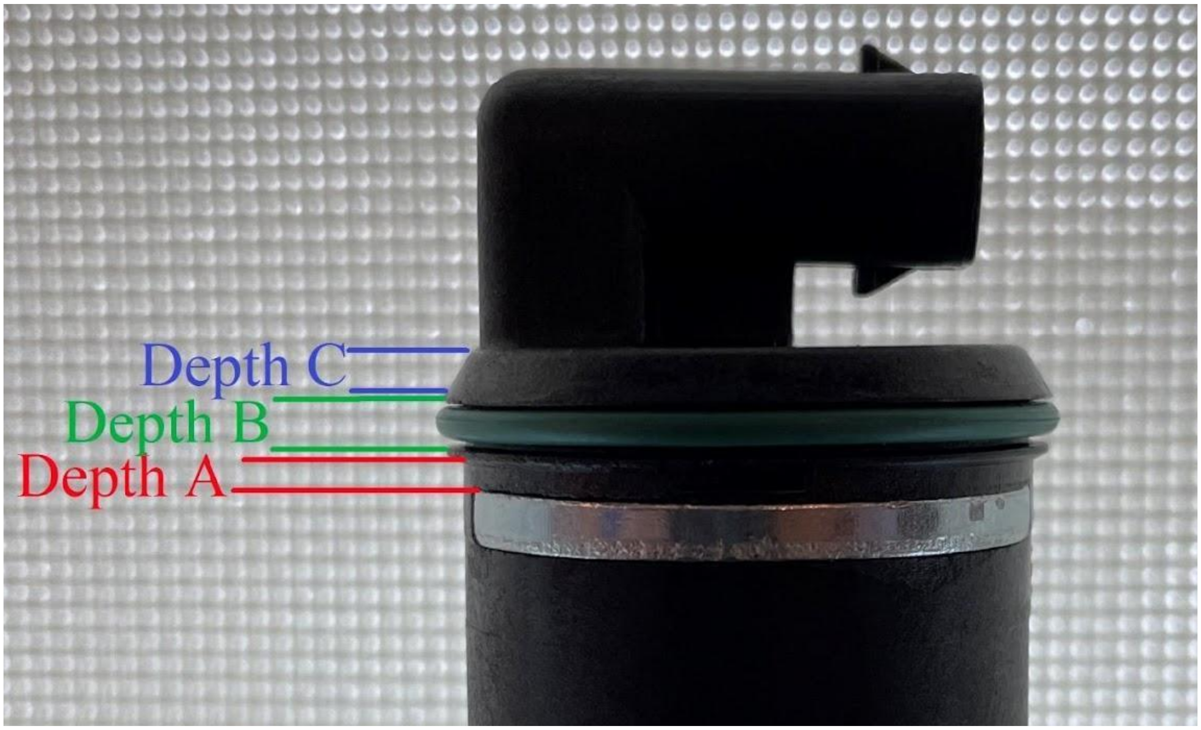


Figure G.2.3: Depths of Cut

Testing was then conducted as follows:

1. Place Winton solenoid into clamp and tighten clamp
2. Manually operate shear arm and remove head
3. Visually inspect head and washer, noting any damage to washer or excessive plastic remaining on washer face
4. Remove washer by inserting 12 mm dowel into anterior end of solenoid and tap with 1 kg hammer from 30 cm. Note the number of taps required to remove washer.
5. Rinse and repeat.

The testing was conducted once at each depth for all rotational orientations, for a total of 24 samples tested.

Results of testing are found in Table G.2.1.

Table G.2.1: Results of testing Shear Arm Prototype 2

Orientation [degrees]	*Depth [region]*	**Head Removed [y/n]**	**Washer contact [y/n]**	**Strikes to Remove Washer [number of strikes]**
0	A	y	y	1
	B	y	n	2
	C	y	n	5
45	A	y	y	0
	B	y	n	1
	C	y	n	6
90	A	y	y	1
	B	y	n	2
	C	y	n	4
135	A	y	n	0
	B	y	n	3
	C	y	n	5
180	A	y	y	0
	B	y	n	1
	C	y	n	5
225	A	y	n	1
	B	y	n	2
	C	y	n	6
270	A	y	y	0
	B	y	n	1
	C	y	n	5
315	A	y	y	0
	B	y	n	2
	C	y	n	5

From the results shown in Table G.2.1, the following observations of the data were made:

1. Orientation does not play a factor in cutting performance, as all orientations were shown to be capable of removing head.

2. Washer contact was only seen at Depth A.

3. Depth A required the least number of strikes needed to remove the washer, while Depth C required the most strikes. Depth B required at least 1 strike to remove washer.

Results & Conclusions: The updated clamping features allowed for repeatable location of the Winton solenoid in the clamp prior to shearing. The repeatability allowed for a test run of Winton solenoids to be dissembled. Testing results concluded that orientation of the solenoid is not relevant in the efficient removal of the head, however depth of shear point is crucial.

The ideal depth was found to be depth B, where a balance between plastic located on the washer after head removal and no damage to washer was found. At depth A, damage to washer occurred regularly in all orientations, and at depth C, plastic located on washer after head removal was too great for washer removal to occur. Also at depth A, due to contact between the shearing blade and washer, shearing blade damage occurred as expected.

Orientation of the head, while found to be a non-crucial parameter, was dissolved from 8 orientations to 4 orientations, with the final contenders being (0, 90, 180, 270 degrees), representing the ideal orientations for use in an automation line.

From the testing results of Shear Arm prototype 2, the procedure for future testing of advanced shear arm prototypes would be simplified and conducted using only the orientations of (0, 90, 180, 270 degrees), and only at depth B.

A final key result of testing was the inability of the shear arm to remove the head from the Winton solenoid containing no washer. Solenoid containing no washer can occur because of washer installation failure on the production line, followed by the over molding process resulting in 100 times increase in force required to shear head, due to 100 times increase in surface area, due to plastic now occupying the space where the washer once was. However, a Winton solenoid in such a state would not require head removal, as the lack of steel washer promotes the solenoid, and the solenoid can be recycled with the rest of the headless overmolded coil bodies.

G.3 - Shear Arm Prototype 3

Purpose & Background: Shear Arm Prototype 3, seen in Figure G.3.1, was an evolution of the single arm shear (Shear Arm Protype 1), replaced by two shear arms with a common axis of rotation. The 2 arms were arranged in a traditional plier configuration, with aluminum arms, and removable/replaceable blades. The idea of using 2 arms came from concerns over the entire Winton recycler machine rotating due to the unbalanced reaction forces experienced when the shearing mechanism is rotated 90 degrees and a single shear arm is used.

The shearing mechanism would be rotated 90 degrees to allow for gravity to aid in the sorting of dissembled parts as the overmolded coil body could be simply dropped from the open clamp following disassembly. A 90-degree rotation would also allow for the Winton solenoid to be held by the head during part transfer, aiding in effective gripping of the solenoid when in transit form the vibrating rail to the clamp.

To counter the potential machine rotation, 2 arms would be used to balance the reaction force (equal and opposite forces). Prototype 3 required modification to the clamping mechanism for fitment and operation. The modifications can be seen in Figure G.3.2.

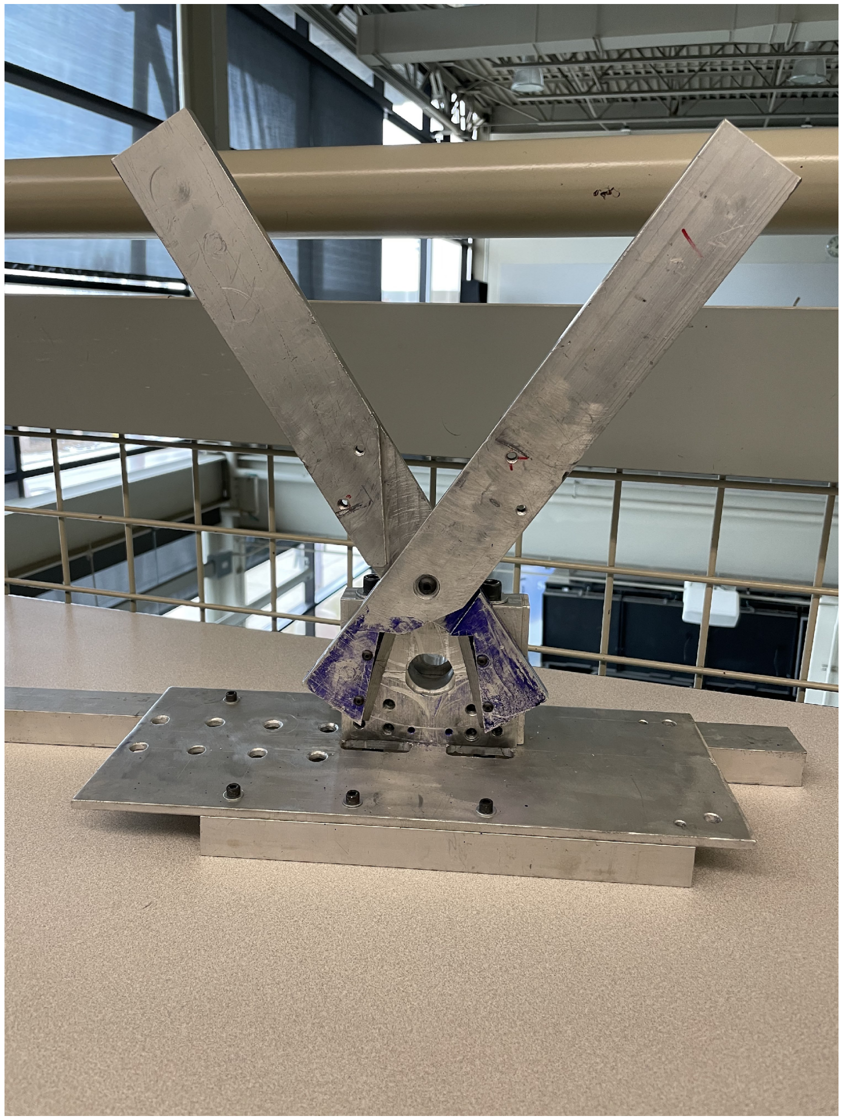


Figure G.3.1: Shear Arm Prototype 3

Figure G.3.2: Modifications to Clamping Mechanism

<u>Testing:</u> Following the success of testing from Shear Arm prototype 2 which resulted in a set depth of cut and 4 possible rotational orientations, the prototyping for the vibrating rail concluded the need for only two possible orientations, 0 and 180 degrees.

The testing goal for Shear arm prototype 3 was then to:

1. Determine which orientation was preferred
    a. Determine if either orientation displayed an advantage
2. Determine if fixing of the assembly to the ground/table was necessary for operation.
    a. If required, would demonstrate the potential rotation/movement of machine during future operation.

During testing, the following parameters, along with the reasoning, were observed:

1. Was the head removed? – [Yes/No]
    a. Critical function of machine
    b. Without head removal, washer removal not possible
2. Did the blade contact the washer? – [Yes/No]
    a. Blade damage would occur if contact occurred
    b. Damage to washer will reveal if contact occurred
    c. Depth of cut would be used to avoid contact
3. Can washer be removed with single punch? – [Number of strikes required]
    a. If enough plastic is remaining on washer face, will inhibit washer removal
    b. If washer is freed due to shearing action, 0 strikes required
4. Did the assembly require fastening to the table for operation? – [Yes/No]
    a. If fastening required, would represent potential non balanced external moment

Testing was then conducted as follows:

1. Place Winton solenoid into clamp and tighten clamp
2. Manually operate shear arm and remove head, noting if assembly requires fastening
3. Visually inspect head and washer, noting any damage to washer or excessive plastic remaining on washer face
4. Remove washer by inserting 12 mm dowel into anterior end of solenoid and tap with 1 kg hammer from 30 cm. Note the number of taps required to remove washer.
5. Rinse and repeat.

Testing was conducted for 4 total samples, the results displayed in Table 1.

Table G.3.1: Results of testing Shear Arm prototype 3

Orientation [degrees]	*Sample [i]*	Head Removed [y/n]	Washer contact [y/n]	Strikes to Remove Washer [number of strikes]	Fastening [y/n]
0	A	y	n	1	n
	B	y	n	2	n
180	A	y	n	2	n
	B	y	n	2	n

Results & Conclusions:

Shear Arm Prototype 3 could remove the head from the Winton solenoid in either orientation, with neither orientation showing a clear advantage over the other. The shearing assembly was able to be operated without the need for fastening.

The drawbacks of Shear Arm prototype 3 were the need for length added to machine due to the location of the moment arm. For packaging reasons, Shear Arm prototype 3 would need to be modified if used.

The big take aways from testing of shear arm protype 3 were the success of reaction force cancellation due to the single axis of rotation for a 2-member shear arm, and the indifference to solenoid orientation.

G.4 - Shear Arm Prototype 4

Purpose & Background: Shear Arm Prototype 4, seen in Figure G.4.1 was an evolution of the double shear arm design (Shear Arm Prototype 3), but now the two sperate arms rotated about separate axis. The location of the axis with respect to the cutting edge was located on the centerline of the shear arm, as was the force applied location. Shear Arm prototype 4 was developed to remove the complexity associated with shear arm prototype 3 and the respective need to mount 2 separately rotating members on a single shaft.

The separation of the axis would inherently introduce external moments due to the distance between the two-axis creating a moment arm, but the hope was that the distance between the axis would be negligibly small and result in no external moment.

One key design feature of shear arm prototype 4 was the compactness of the design, allowing for operation of the arms in a direction towards the feeding mechanism, which would allow for minimal distance between the center of the cutting point and the back side of the machine. The compact thinking stemmed from the results of testing Shear Arm Prototype 3.

Figure G.4.1: Shear Arm Prototype 4

Testing: Following the success of testing from Shear Arm prototype 2 which resulted in a set depth of cut and 4 possible rotational orientations, the prototyping for the vibrating rail concluded the need for only two possible orientations, 0 and 180 degrees.

The testing goal for Shear arm prototype 3 was then to:

1. Determine which orientation was preferred
    a. Determine if either orientation displayed an advantage
2. Determine if fixing of the assembly to the ground/table was necessary for operation.
    a. If required, would demonstrate the potential rotation/movement of machine during future operation.

During testing, the following parameters, along with the reasoning, were observed:

1. Was the head removed? – [Yes/No]
    a. Critical function of machine
    b. Without head removal, washer removal not possible
2. Did the blade contact the washer? – [Yes/No]

a. Blade damage would occur if contact occurred

b. Damage to washer will reveal if contact occurred

c. Depth of cut would be used to avoid contact

3. Can washer be removed with single punch? – [Number of strikes required]

a. If enough plastic is remaining on washer face, will inhibit washer removal

b. If washer is freed due to shearing action, 0 strikes required

4. Did the assembly require fastening to the table for operation? – [Yes/No]

a. If fastening required, would represent potential non balanced external moment

Testing was then conducted as follows:

1. Place Winton solenoid into clamp and tighten clamp
2. Manually operate shear arm and remove head, noting if assembly requires fastening
3. Visually inspect head and washer, noting any damage to washer or excessive plastic remaining on washer face
4. Remove washer by inserting 12 mm dowel into anterior end of solenoid and tap with 1 kg hammer from 30 cm. Note the number of taps required to remove washer.
5. Rinse and repeat.

Testing was conducted for 4 total samples, the results displayed in Table G.4.1.

Table G.4.1: Results of testing Shear Arm prototype 4

Orientation [degrees]	***Sample [i]***	**Head Removed [y/n]**	**Washer contact [y/n]**	**Strikes to Remove Washer [number of strikes]**	**Fastening [y/n]**
0	A	y	n	2	y
	B	y	n	1	y
180	A	y	n	1	y
	B	y	n	2	y

Results & Conclusions:

Shear Arm Prototype 4 could remove the head from the Winton solenoid in either orientation, with neither orientation showing a clear advantage over the other.

The drawbacks of Shear Arm prototype 4 were the need for fastening of the machine to the table during operation, demonstrating that the assumption of a small moment arm between the axis to be false.

The big take aways from testing of shear arm protype 4 were the success of the compact double shear arm design in removing the head from the solenoid, and the need for a single axis of rotation between the two shear arms.

G.5 - Shear Arm Prototype 5

Purpose & Background: Shear Arm prototype 5 was an adaptation of Shear Arm prototype 3, with modifications made to the moment arm to decrease room needed for operation of the traditional plier design. By attaching the wings, the moment arm of Shear Arm prototype 3 was effectively rotated 90 degrees, resulting in Shear Arm prototype 5.

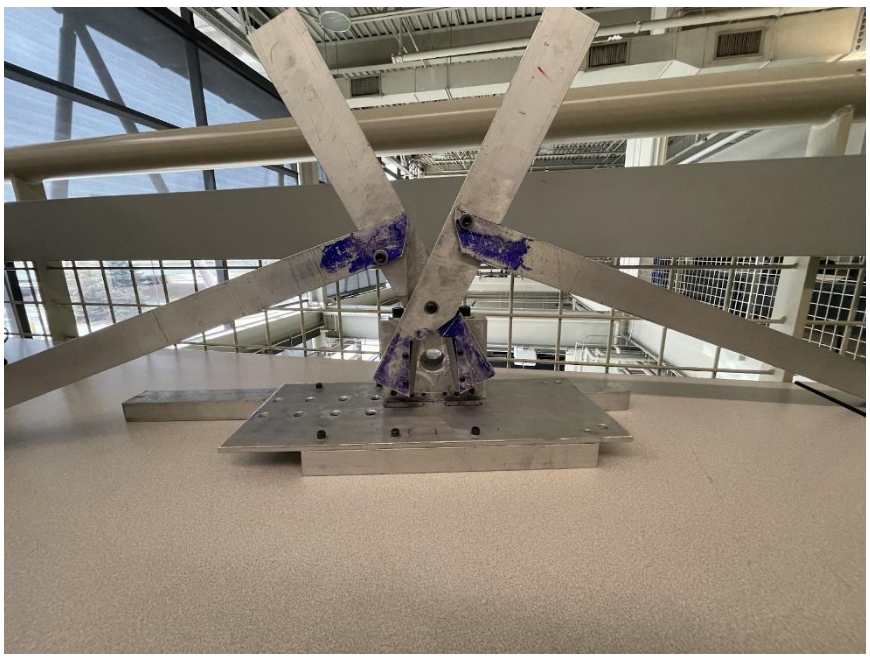


Figure G.5.1: Shear Arm Prototype 5

Testing: Following the success of testing from Shear Arm prototype 2 which resulted in a set depth of cut and 4 possible rotational orientations, the prototyping for the vibrating rail concluded the need for only two possible orientations, 0 and 180 degrees.

The testing goal for Shear arm prototype 5 was then to:

1. Determine which orientation was preferred
    a. Determine if either orientation displayed an advantage

2. Determine if fixing of the assembly to the ground/table was necessary for operation.
    a. If required, would demonstrate the potential rotation/movement of machine during future operation.

During testing, the following parameters, along with the reasoning, were observed:

1. Was the head removed? – [Yes/No]
    a. Critical function of machine
    b. Without head removal, washer removal not possible
2. Did the blade contact the washer? – [Yes/No]
    a. Blade damage would occur if contact occurred
    b. Damage to washer will reveal if contact occurred
    c. Depth of cut would be used to avoid contact
3. Can washer be removed with single punch? – [Number of strikes required]
    a. If enough plastic is remaining on washer face, will inhibit washer removal
    b. If washer is freed due to shearing action, 0 strikes required
4. Did the assembly require fastening to the table for operation? – [Yes/No]
    a. If fastening required, would represent potential non balanced external moment

Testing was then conducted as follows:

1. Place Winton solenoid into clamp and tighten clamp
2. Manually operate shear arm and remove head, noting if assembly requires fastening
3. Visually inspect head and washer, noting any damage to washer or excessive plastic remaining on washer face
4. Remove washer by inserting 12 mm dowel into anterior end of solenoid and tap with 12 oz hammer from 1 foot. Note the number of taps required to remove washer.
5. Rinse and repeat.

Testing was conducted for 4 total samples, the results displayed in Table 1.

Table G.5.1: Results of testing Shear Arm prototype 5

Orientation [degrees]	*Sample [i]*	Head Removed [y/n]	Washer contact [y/n]	Strikes to Remove Washer [number of strikes]	Fastening [y/n]
0	A	y	n	2	y
	B	y	n	1	y
180	A	y	n	2	y
	B	y	n	1	y

Results & Conclusions: Shear Arm Prototype 5 did achieve shearing of the head with performance comparable to Shear Arm prototype 3, but Shear Arm Protype 5 required a large reaction force at the shear axis of rotation to balance the applied force. The large reaction force contributed to the bending of the wings and required fastening of the entire assembly to the table. Shear Arm Prototype 5 was considered ineffective but proved the validity of a compact double member rotational shear about a single axis.

G.6 - Gravity Rail Prototype

Purpose & Background: In determining the feeding mechanism for the Winton Solenoid disassembly device, a gravity rail was prototyped where potential energy could be harnessed to deliver the Winton solenoid instead of using mechanical energy. The benefit of using gravity is that no energy needs to be inputted into the system, effectively making the design simple and cost effective.

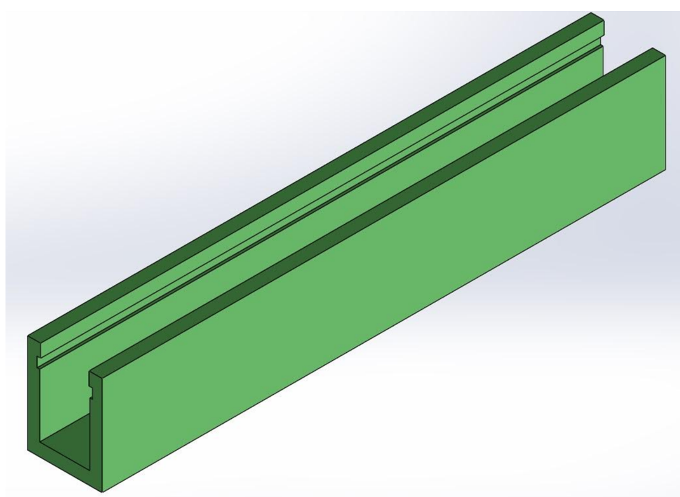


Figure G.6.1: Gravity Rail Prototype

<u>Testing:</u> Using a gravity rail entail inserting the Winton solenoid into the inlet and letting gravity do the rest. A Winton solenoid would be inserted into the inlet, and only gravity will act on the Winton solenoid, effectively causing the piece to glide down the rail into the clamping mechanism. The goal of the gravity rail was to define two points:

1. Does the rotational orientation of the Winton solenoid change as it glides down the rail?

2. How tight do the tolerances of the design need to be to correctly deliver the Winton solenoid in its proper orientation?

The two key points were to be determined by simply testing the gravity rail with the Winton solenoid in its proper orientation. Due to the material used, the solenoid was limited to one of two positions (, and the side pieces kept it restrained from tipping over. Then, the rail was simulated by only letting gravity move the Winton solenoid.

During testing, the following parameters, along with the reasoning, were observed:

1. Did the solenoid tip over – [Yes/No]
    a. Essential as if the solenoid tips over, the line needs to be fixed by an operator.
2. Did the solenoid move down the rail – [Yes/No]
    a. The solenoid has to move down the rail to even be delivered to the clamping mechanism.

Testing was then conducted as follows:

1. Place Winton solenoid into gravity rail

2. Let gravity act on the solenoid

3. Visually inspect if the solenoid shimmy's down the rail

4. Visually inspect if the Winton solenoid changes in orientation

5. Rinse and repeat.

The testing was conducted several times for it to be determined that this prototype does not work.

Results & Conclusions: This prototype of the gravity rail was the first and last. It was determined that this prototype does not work. Although it is advantageous to use gravity, which requires net zero inputted energy, it is far too ineffective. Some of the issues that arose while testing was that the device would get stuck in the channels of the rail, it would tip or slant to an improper orientation, and it wasn't practical at effectively delivering the Winton solenoid's to the clamp.

One of the most important aspects of the entire project design is effectively and efficiently delivering the Winton solenoid to the clamping mechanism. The gravity rail failed at delivering pieces at a consistent rate and consistent orientation. As the pieces would slide down the gravity rail, there was a tendency for the pieces to get stuck via slanting or change in orientation. Therefore, this design was no longer ideated and a vibrating rail design was found to be the best alternative.

G.7 - Trap Door

Purpose & Background: The trap door prototype, seen in Figure G.7.2, featured the use use of trap doors to allow for the best sorting function of the device. Cardboard and duct tape was used to show how the trap door would be simulated and used to sort the pieces correctly. A piece of cardboard was used to signify the "doors" turning which would be controlled by some air cylinders and the PLC.

Figure G.7.1: Cardboard Trap Door Prototype

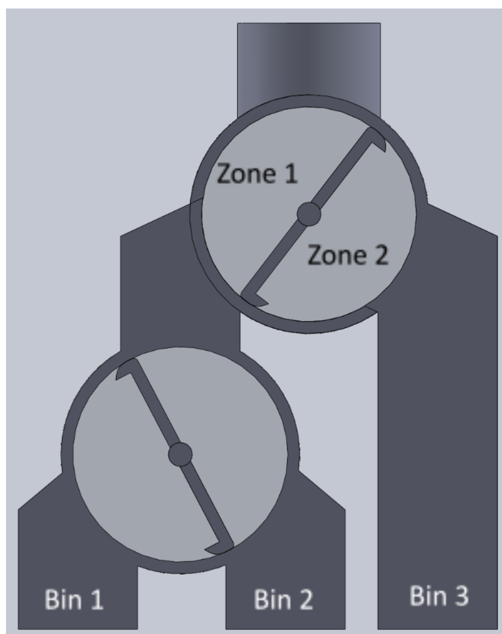


Figure G.7.2: Solidworks Model of Prototype

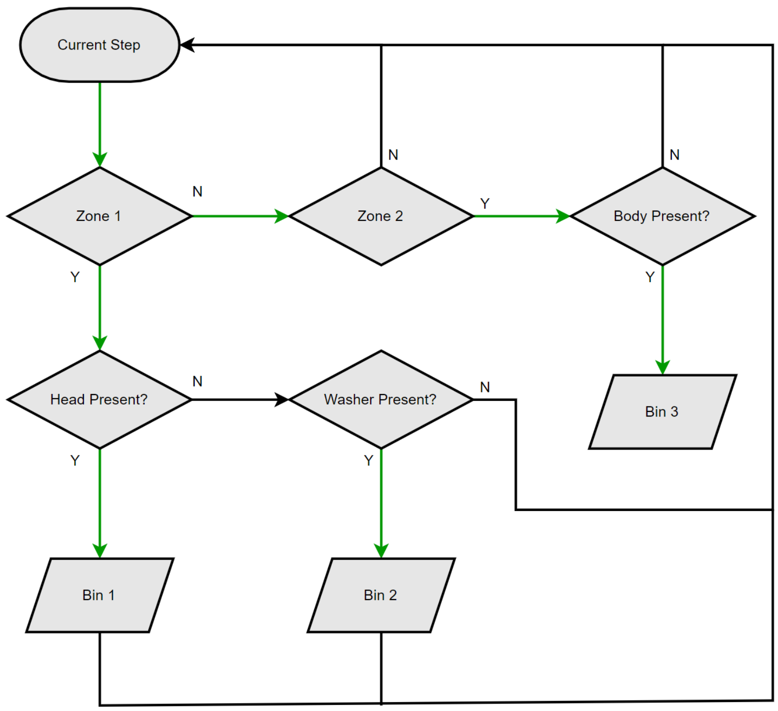


Figure G.7.3: Flow Diagram of the Zones and Bins.

Testing:

During testing, the following parameters, along with the reasoning, were observed:

Was the head able to move through the door system without being caught? – [Yes/No]

Critical function of machine

Without the sorting function the machine will have to sort through the pieces to recycle.

Was there enough room for a reasonable size bin to sit below? – [Yes/No]

Smaller bins will cause an operator to be there constantly

Can a full-sized part fall through the body sized trap door? – [Yes/No]

If there isn't a steel washer then the part cannot be separated and therefore will need to be dropped as a whole.

Testing was then conducted as follows:

Manually place the doors of the prototype to zone 1 bin 1

Drop a sheared head down the top chute to allow the part to fall.

Manually turn the cardboard door to zone 1, bin 2.

Drop a steel washer down the top of the chute.

Manually turn the cardboard door to zone 2, bin 3.

Place a sheared body down the chute and see if it drops in the correct bin.

Drop a fully assembled part through the zone 2 bin 3 function.

Repeat steps 1-7.

Conclusions:

The 65-degree angle that is used works very well to allow the parts to drop.

Tubing for the path to the bins may be slightly too small, there may need to be an increase in size to ensure that if a full body is dropped through.

A possible upgrade to the design would be to make it so the openings to the chutes were square rather than circular so that the parts do not get caught up.

Appendix H - Mechanical BOM

Attached next.

swoboda
technologies

Sub-Assembly Bill of Material

Name:	ME B.O.M	**Sub-Asm Status, Incl. Reviews:**	
Rack #:	ME B.O.M		
Cell #:	ME B.O.M		
Date:	05-02-22		
Created by:	Lance Deemter		
	Reviewer:	**Date: 04/26/22**	**PASS/FAIL**
Design Review	0		0

In Stock	**Complete**
Order	**In-Process**
On Order	
Received	

TOTAL/EXT **$2,962.52**

#	PART NAME	Description	VENDOR PART #	VENDOR	MANUF.	QTY	QTY SPARE	TOTAL QTY	COST	EXT COST	ORDER STATUS	COMMENTS
	Assembly Qty:	**1**	**1**									
1	45x90x2100		-	-	-	2		2	$0.00	$0.00	In Stock	
2	90x90x810		-	-	-	6		6	$0.00	$0.00	In Stock	
3	45x90x820		-	-	-	4		4	$0.00	$0.00	In Stock	
4	45x90x1300		-	-	-	2		2	$0.00	$0.00	In Stock	
5	45x90x720		-	-	-	3		3	$0.00	$0.00	In Stock	
6	45x45x810		-	-	-	4		4	$0.00	$0.00	In Stock	
7	45x45x1150_Blank		-	-	-	2		2	$0.00	$0.00	In Stock	
8	45x45x360		-	-	-	2		2	$0.00	$0.00	In Stock	
9	45x45x415		-	-	-	2		2	$0.00	$0.00	In Stock	
10	45x45x770		-	-	-	2		2	$0.00	$0.00	In Stock	
11	45x90x315		-	-	-	2		2	$0.00	$0.00	In Stock	
12	45x45x915		-	-	-	2		2	$0.00	$0.00	In Stock	
13	45x45x715		-	-	-	2		2	$0.00	$0.00	In Stock	
14	Hinge Plate.STEP	x	x	x	x	8		8	$0.00	$0.00	In Stock	
15	M6x20 Countersunk Screw_45 series.STEP	x	x	x	x	8		8	$0.00	$0.00	In Stock	
16	10mm T Nut.STEP	x	x	x	x	8		8	$0.00	$0.00	In Stock	
17	Hinge Pin.STEP	x	x	x	x	4		4	$0.00	$0.00	In Stock	
18	Handle 160 mm		-	-	-	2		2	$0.00	$0.00	In Stock	
19	45x45x1100		-	-		2		2	$0.00	$0.00	In Stock	
20	45x45x245		-	-		2		2	$0.00	$0.00	In Stock	
21	Top Plastic Plate		-	-	-	1		1	$0.00	$0.00	In Stock	
22	Bottom Plastic Plate		-	-	-	1		1	$0.00	$0.00	In Stock	
23	2407T73	Cart-Smart Caster	2407T73	McMaster-Carr	McMaster-Carr	4		4	$0.00	$0.00	In Stock	
24	46991.stp	NOT SPECIFIED	x	x	x	2		2	$0.00	$0.00	In Stock	
25	46992.stp	NOT SPECIFIED	x	x	x	2		2	$0.00	$0.00	In Stock	
26	HMI Enclosure.stp		x	x	x	1		1	$0.00	$0.00	In Stock	
27	6785K21_Emergency Stop Enclosed Push-Button Switch	Emergency Stop Enclosed	6785K21	McMaster-Carr	McMaster-Carr	1		1	$0.00	$0.00	In Stock	
28	Electrical Cabinet/ Enclousure	Stainless Steel Corrosion-	6942K26	McMaster-Carr	McMaster-Carr	1		1	$0.00	$0.00	In Stock	
29	45x45x508	aluminum profile				2		2	$0.00	$0.00	In Stock	
30	_123866 CPV10-GE-FB-8---(E_8).stp	Valve Bank Face	x	x	x	2		2	$0.00	$0.00	In Stock	
31	_161415 CPV-10-M1H-5JS-M7---(0.3_M1H).stp	Air Valve	x	x	x	16		16	$0.00	$0.00	In Stock	
32	_161377 CPV10-EPR-G---(0_0_Y.stp	Valve Bank Ends	x	x	x	4		4	$0.00	$0.00	In Stock	
33	Rack Bin Large	18x11x10 Plastic Bin				1		1	$0.00	$0.00	In Stock	
34	bin	x	x	x	x	1		1	$0.00	$0.00	In Stock	
35	Rexroth-3842524986-DEFAULT_BALL_DETENT_LATCH_OO4.stp	x	x	x	x	2		2	$0.00	$0.00	In Stock	
36	Rexroth-3842524986-DEFAULT_BALL_DETENT_LATCH-FIX4.stp	x	x	x	x	2		2	$0.00	$0.00	In Stock	
37	A40-1400-11-011-001 Upper Shear Arm Base	Upper Shear Arm Base	-	-	Swoboda	1		1	$0.00	$0.00	Complete	
38	1161N86_Double X-Profile O-RingProfile Oil-Resistant Buna-N O-Ring	1161N86	1161N86	McMaster-Carr	McMaster-Carr	3	3	6	$5.69	$34.14	Complete	
39	NSFRBE_D48_L31_5_M12_T68_Q40_N12(misumi) Shear Shaft	Shear Shaft	NSFRBE-D48-L31-M12-	MISUMI	MISUMI	1		1	TBD	TBD	Complete	
40	NSK 22208EAE4C3	ID:40 OD:80 Speherical	NSK_22208_EAE4_C3	MISUMI	NSK	2		2	$154.18	$308.36	Complete	
41	A40-1400-11-011-005 Lower Shear Arm Base		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
42	MXQ16_100_0_0__3	part trasnfer cyl	MXQ16_100	MISUMI	SMC Corporation	1		1	$0.00	$0.00	In Stock	
43	A40-1400-11-011-006 Grpper Cyl Base	config 4	-	-	Swoboda	1		1	$0.00	$0.00	Complete	
44	MHZ2_25D_33_3_0__6	clamp cyl	-	-	Swoboda	1		1	$0.00	$0.00	In Stock	
45	MHZ2_25D_33_3_0__3	clamp cyl	MHZ2-25D	MISUMI	SMC Corporation	2		2	$0.00	$0.00	In Stock	
46	A40-1400-11-011-008 Gripper Right		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
47	A40-1400-11-011-007 Gripper Left		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
48	BUTT_HD_ HEX_ SCR_M5_X_45	91239A244	91239A244	McMaster-Carr	-	2		2	$6.43	$6.43	Complete	
49	HEX_SOC_CAP_SCR_M5_X_14	91290A230	91290A230	McMaster-Carr	-	2		2	$16.38	$16.38	Complete	
50	HEX_SOC_CAP_SCR_M5_X_25	91290A252	91290A252	McMaster-Carr	-	4		4	$10.30	$10.30	Complete	
51	LOW_PROF_HEX_SOC_CAP_SCR_M4_X_18	90358A129	90358A129	McMaster-Carr	-	4		4	$4.70	$4.70	Complete	
52	DOWEL_M5_X_14	91595A348	91595A348	McMaster-Carr	-	2		2	$16.42	$2.00	Complete	
53	CLBPB40_49_10(misumi)	ID:40 OD:49 L:10 Shear Shaft	CLBPB40-49-10	MISUMI	MISUMI	1		1	$29.60	$29.60	Complete	
54	CLBPB40_49_12(misumi)	ID:40 OD:49 L:12 Shear Shaft	CLBPB40-49-12	MISUMI	MISUMI	1		1	$29.60	$29.60	Complete	
55	A40-1400-11-011-009 Clamp Base Right		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
56	A40-1400-11-011-010 Clamp Base Left		-	-	Swoboda	1		1	$0.00	$0.00	Complete	

57	MGPL32_25Z_body				Swoboda	2		2	$0.00	$0.00	In Stock	
58	A40-1400-11-011-011 Shear Base Upright		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
59	A40-1400-11-011-012 Base Plate		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
60	NSFRBE-D30-L31.5-M12-T68-Q25-N12	Tert. Shaft	NSFRBE-D30-L31.5-M12	Misumi	Misumi	2		2	$29.45	$58.90	Complete	
61	NSK 22205CE4S11	ID:25 OD:52 Sphereical	NSK 22205CE4S11	MISUMI	NSK	4		4	$110.48	$441.92	Complete	
62	A40-1400-11-012-004 Tert Upper Support		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
63	A40-1400-11-012-005 Tert Lower Support		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
64	1161N74_Double X-Profile Oil-Resistant Buna-N O-Ring	1161N74	1161N74	McMaster-Carr		4	4	8	$3.42	$27.36	Complete	
65	CLBPB25_31_12(misumi)	ID:25 OD:31 L:12 Tert Shaft	CLBPB25-31-12	MISUMI	MISUMI	2		2	$24.28	$48.56	Complete	
66	CLBUB25_31_20(misumi)	ID:25 OD:31 L:20 Tert Shaft	CLBPB25-31-20	MISUMI	MISUMI	2		2	$24.28	$48.56	Complete	
67	A40-1400-11-011-013 Tertiary Link Upright		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
68	MXQ16_100_0_0__5	part trasnfer cyl	MXQ16-100	MISUMI	SMC Corporation	1		1	$0.00	$0.00	In Stock	
69	A40-1400-11-015-001 Clamp Insert Left		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
70	MGPL32_25Z_0_0_0__6		MGPM32-25Z	MISUMI	MISUMI	2		2	$0.00	$0.00	In Stock	
71	A40-1400-11-015-002 Ejector Pin	90224A138_M2 Tool Steel	90224A138_M2 Tool	McMaster-Carr	Swoboda	4	4	8	$9.58	$76.64	Complete	
72	9657K623_Compression Spring	9657K623	9657K623	McMaster-Carr	McMaster-Carr	4		4	$12.84	$12.84	Complete	
73	SET_SCR_M10_X_8	91390A555	91390A555	McMaster-Carr	McMaster-Carr	4		4	$8.70	$8.70	Complete	
~~74~~	~~DW-AD-501-04.step~~	~~Inductive Proximity Sensor~~	~~x~~	~~x~~	~~x~~	~~2~~		~~2~~	~~$0.00~~	~~$0.00~~	In Stock	
75	SET_SCR_M4_X_10	91390A114	91390A114	McMaster-Carr	McMaster-Carr	2		2	$6.67	$6.67	Complete	
76	A40-1400-11-015-003 Clamp Hard Stop		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
77	BUTT_HD_HEX_SCR_M6_X_20	91239A326	91239A326	McMaster-Carr	McMaster-Carr	4		4	$16.82	$16.82	Complete	
78	BUTT_HD_HEX_SCR_M6_X_30	91239A328	91239A328	McMaster-Carr	McMaster-Carr	4		4	$12.82	$12.82	Complete	
79	RB1412_Rb-Body	shock Absorber	RB1412	SMC	SMC Corporation	2		2	$44.84	$89.68	Complete	
~~80~~	~~1412~~	~~x~~	~~x~~	~~x~~	~~x~~	~~2~~		~~2~~	~~$0.00~~	~~$0.00~~	Complete	
~~81~~	~~14~~	~~x~~	~~x~~	~~x~~	~~x~~	~~4~~		~~4~~	~~$0.00~~	~~$0.00~~	Complete	
82	A40-1400-11-016-001 Clamp Insert Right		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
83	A40-1400-11-018-001 Washer Removal Base		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
84	CDQ2B32_50DZ_0_1_0__5	Washer Removal cyl(Body)	CDQ2B32-50DZ	Misumi	SMC Corporation	1		1	$0.00	$0.00	In Stock	
85	A40-1400-11-018-002 L support		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
86	A40-1400-11-018-003 Straight Support		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
87	A40-1400-11-018-004 Blast Gate Cyl Support		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
88	MXS8_50B_0_0__20	End Stop cyl	MXS8-50B	MISUMI	SMC Corporation	1		1	$0.00	$0.00	In Stock	
~~89~~	~~MXS8_50B_0_0__18~~					~~1~~		~~1~~	~~$0.00~~	~~$0.00~~	~~In Stock~~	
90	A40-1400-11-018-005 End Stop Cyl Attachment		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
91	A40-1400-11-018-006 Pre Stop Lower Adjustment		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
92	A40-1400-11-018-007 Pre Stop Upper Adjustment		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
93	A40-1400-11-018-008 End Stop Adjustment Block		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
94	A40-1400-11-018-009 End Stop Steel Plate		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
95	CDQ2B32_50DZ_0_1_0__3	Washer Removal cyl(internal	CDQ2B32-50DZ	MISUMI	SMC Corporation	1		1	$0.00	$0.00	In Stock	
96	THRD_ROD_M8_x_25	93675A250	93675A250	McMaster-Carr	McMaster-Carr	1		1	$3.44	$3.44	Complete	
97	MXS_BT8_X12	Shock Absorber				1		1	$0.00	$0.00	In Stock	
98	MXS_BS8	Extension End				1		1	$0.00	$0.00	In Stock	
99	MXS_8	Table Mount				1		1	$0.00	$0.00	In Stock	
100	MXS_8_2	Table Mount				1		1	$0.00	$0.00	In Stock	
101	MXS_B8_NUT	Nut				2		2	$0.00	$0.00	In Stock	
102	MXS_BS8_X12	Shock Absorber				1		1	$0.00	$0.00	In Stock	
103	MXS_BT8	Retraction End				1		1	$0.00	$0.00	In Stock	
104	HEX_SOC_CAP_SCR_M4_X_12	91290A148	91290A148	McMaster-Carr	McMaster-Carr	26		26	$11.54	$11.54	Complete	
105	DOWEL_M3_X_8	91595A104	91595A104	McMaster-Carr	McMaster-Carr	2		2	$17.18	$17.18	Complete	
106	HEX_SOC_CAP_SCR_M5_X_85	91290A105	91290A105	McMaster-Carr	McMaster-Carr	4		4	$14.15	$14.15	Complete	
107	DOWEL_M4_X_20	91595A167	91595A167	McMaster-Carr	McMaster-Carr	18		18	$15.10	$15.10	Complete	
108	HEX_SOC_CAP_SCR_M5_X_20	91290A242	91290A242	McMaster-Carr	McMaster-Carr	4		4	$16.44	$16.44	Complete	
109	HEX_SOC_CAP_SCR_M5_X_50	91290A262	91290A262	McMaster-Carr	McMaster-Carr	2		2	$17.65	$17.65	Complete	
110	HEX_SOC_CAP_SCR_M4_X_35	91290A182	91290A182	McMaster-Carr	McMaster-Carr	3		3	$11.43	$11.43	Complete	
111	FLAT_WASH_M4	98269A430	98269A430	McMaster-Carr	McMaster-Carr	5		5	$3.13	$3.13	Complete	
112	HEX_SOC_CAP_SCR_M4_X_15	91290A306	91290A306	McMaster-Carr	McMaster-Carr	2		2	$11.62	$11.62	Complete	
113	HEX_SOC_CAP_SCR_M4_X_18	91290A164	91290A164	McMaster-Carr	McMaster-Carr	2		2	$15.38	$15.38	Complete	
114	BUTT_HD_SCR_M3_X_15	91239A811	91239A811	McMaster-Carr	McMaster-Carr	2		2	$6.40	$6.40	Complete	
115	DOWEL_M3_X_14	91595A114	91595A114	McMaster-Carr	McMaster-Carr	2		2	$15.56	$15.56	Complete	
116	CDQ2B12_15DCZ_0_1_0__8	Pre Stop cyl	CDQ2B12-15DCZ	SMC	SMC Corporation	1		1	$27.35	$27.35	Complete	
117	HEX_SOC_CAP_SCR_M3_X_45	91290A079	91290A079	McMaster-Carr	McMaster-Carr	2		2	$4.57	$4.57	Complete	
~~118~~	~~CDQ2B12_15DCZ_0_1_0__6~~		~~CDQ2B12-15DCZ~~	~~MISUMI~~	~~SMC Corporation~~	~~0~~		~~0~~	~~$0.00~~	~~$0.00~~	In Stock	
119	FPSFJTB_D12_L20_N3_J5 (Misumi)	12 x 20 Pre Stop Plug	FPSFJTB-D12-L20-N3-J5	Misumi	Misumi	1		1	$40.70	$40.70	Complete	
120	THRD_ROD_M3_x_12	93805A629	93805A629	McMaster-Carr	McMaster-Carr	1		1	$9.62	$9.62	Complete	
121	PSFGZ15_45_M8_N10_SC22(Misumi)	15 x 45 Washer Removal	PSFGZ15-45-M8-N10-S	Misumi	Misumi	1		1	$27.72	$27.72	Complete	
122	HEX_SOC_CAP_SCR_M10_X_14	91290A127	91290A127	McMaster-Carr	McMaster-Carr	1		1	$9.94	$9.94	Complete	
123	A40-1400-11-013-001 Upper Right Shear Arm					1		1	$0.00	$0.00	Complete	
124	A40-1400-11-013-002 Blade					2		2	$0.00	$0.00	Complete	
125	BUTT_HD_SCR_M5_X_30	91239A236	91239A236	McMaster-Carr	McMaster-Carr	4		4	$16.87	$16.87	Complete	
126	DOWEL_M5_X_20	91595A356	91595A356	McMaster-Carr	McMaster-Carr	4		4	$9.98	$9.98	Complete	
127	A40-1400-11-011-014 Shroud Right		-	-	GVSU	1		1	$0.00	$0.00	Complete	
128	A40-1400-11-011-015 Shroud Middle		-	-	GVSU	1		1	$0.00	$0.00	Complete	
129	A40-1400-11-011-016 Shroud Left		-	-	GVSU	1		1	$0.00	$0.00	Complete	
130	A40-1400-11-011-017 Transfer Gaurd		-	-	SWOBODA	1		1	$0.00	$0.00	Complete	
131	FLAT_HD_HEX_CAP_M12_X_35	91294A358	91294A358	McMaster-Carr	McMaster-Carr	6		6	$11.35	$11.35	Complete	
132	HEX_SOC_CAP_SCR_M8_X_35	91290A438	91290A438	McMaster-Carr	McMaster-Carr	22		22	$11.03	$11.03	Complete	

133	DOWEL_M8_X_28	91595A566	91595A566	McMaster-Carr	McMaster-Carr	10		10	$9.55	$9.55	Complete	
134	HEX_SOC_CAP_SCR_M8_X_20	91294A284	91294A284	McMaster-Carr	McMaster-Carr	8		8	$12.72	$12.72	Complete	
135	HEX_SOC_CAP_SCR_M6_X_18	91290A323	91290A323	McMaster-Carr	McMaster-Carr	4		4	$18.84	$18.84	Complete	
136	DOWEL_M5_X_16	91595A352	91595A352	McMaster-Carr	McMaster-Carr	2		2	$17.63	$17.63	Complete	
137	BUTT_HD_SCR_M4_X_8	91239A140	91239A140	McMaster-Carr	McMaster-Carr	15		15	$12.91	$12.91	Complete	
~~138~~	~~214322.stp~~	~~NOT SPECIFIED~~	~~NOT SPECIFIED~~			~~2~~		~~2~~	~~$0.00~~	~~$0.00~~	In Stock	
139	A40-1400-11-014 Lower Left Shear Arm		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
140	A40-1400-11-011-018 Tert Link		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
141	A40-1400-11-017-001 Turn Buckle	8416N25	8416N25	McMaster-Carr	Swoboda	2		2	$22.16	$44.32	Complete	
142	A40-1400-11-017-003 Heim Joint RH	60645K981	60645K981	McMaster-Carr	Swoboda	2		2	$17.87	$35.74	Complete	
143	A40-1400-11-017-002 Heim Joint LF	60645K982	60645K982	McMaster-Carr	Swoboda	2		2	$17.87	$35.74	Complete	
144	CQ-D080_Clevis32-100	Double Rear Clevis	CQ-D080	SMC	SMC Corporation	2		2	$18.60	$37.20	Complete	
145	PHS22_3	Rod End	PHS22	Misumi		2		2	$40.95	$81.90	Complete	
~~146~~	~~PHS22_5~~					~~2~~		~~2~~	~~$0.00~~	~~$0.00~~	In Stock	
~~147~~	~~CDQ2A80_250DCMZ_0_1_0__3~~					~~0~~		~~0~~	~~$0.00~~	~~$0.00~~	In Stock	
148	CDQ2A80_200DCMZ_0_1_0__3	Shear Cyl	CDQ2A80-200DCMZ	SMC	SMC Corporation	2		2	$160.80	$321.60	Complete	
~~149~~	~~CDQ2A80_200DCMZ_0_1_0__5~~					~~0~~		~~0~~	~~$0.00~~	~~$0.00~~	In Stock	
~~150~~	~~CDQ2A80_200DCMZ_0_1_0__7~~					~~0~~		~~0~~	~~$0.00~~	~~$0.00~~	In Stock	
151	HEX_SOC_CAP_SCR_M12_X_30	91290A618	91290A618	McMaster-Carr	McMaster-Carr	8		8	$12.31	$12.31	Complete	
152	HEX_SOC_CAP_SCR_M8_X_18	91290A422	91290A422	McMaster-Carr	McMaster-Carr	4		4	$5.07	$5.07	Complete	
153	ULTRA_LOW_PROF_HEX_SOC_CAP_SCR_M6_X_12	90358A017	90358A017	McMaster-Carr	McMaster-Carr	3		3	$4.47	$13.41	Complete	
154	16BS	Shock Absorber	x	Misumi	SMC Corporation	1		1	$0.00	$0.00	In Stock	
155	16	x	x	x	x	1		1	$0.00	$0.00	In Stock	
156	16BT	Shock Absorber	x	Misumi	SMC Corporation	1		1	$0.00	$0.00	In Stock	
157	16	x	x	x	x	1		1	$0.00	$0.00	In Stock	
158	OVERSIZE_CLIP_WASH_M5_x_18	93409A133	93409A133	McMaster-Carr	McMaster-Carr	6		6	$13.53	$13.53	Complete	
159	BUTT_HD_SCR_M5_X_10	91239A224	91239A224	McMaster-Carr	McMaster-Carr	6		6	$10.82	$10.82	Complete	
160	FPSFJBA_D14_L60_M5(misumi)	14 x 60 shaft	FPSFJBA-D14-L60-M5	Misumi	Misumi	4		4	$17.30	$69.20	Complete	
161	SFR22_60(misumi)	22 x 60 Shaft	SFR22-60	Misumi	Misumi	2		2	$25.01	$50.02	Complete	
162	DOWEL_M4_x_12	Dowel Pin	91595A155	McMaster-Carr		2		2	$12.38	$12.38	Complete	
163	A40-1600-04-030-001	Vibe Base Plate	-	-	Swoboda	1		1	$0.00	$0.00	Complete	
164	plain_washer_m10_r	x	x	x	x	3		3	$0.00	$0.00	In Stock	
165	hex_soc_cap_scr_m10_x_110		-	-	-	3		3	$0.00	$0.00	In Stock	
166	hex_soc_cap_scr_m5_x_25		-	-	-	3		3	$0.00	$0.00	In Stock	
167	Dowel 5x10	x	x	x	x	2		2	$0.00	$0.00	In Stock	
168	Wash 15OD-5.3ID-T3					3		3	$0.00	$0.00	In Stock	
169	A40-1600-04-030-008		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
170	A40-1400-11-019-001 Rail Base		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
171	A40-1400-11-019-004 Bracket		-	-	Swoboda	4		4	$0.00	$0.00	Complete	
172	A40-1400-11-019-005 Angled Bracket		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
173	A40-1400-11-019-002 Side Rail		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
174	A40-1400-11-019-003 Top Rail		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
175	A40-1400-11-019-006 Side End Rail		-	-	Swoboda	2		2	$0.00	$0.00	Complete	
176	A40-1400-11-019-007 Top End Rail		-	-	Swoboda	1		1	$0.00	$0.00	Complete	
177	HEX_SOC_CAP_SCR_M4_X_8	91290A140	91290A140	McMaster-Carr	McMaster-Carr	20		20	$12.43	$12.43	Complete	
178	A40-1400-11-019-009 Vibe_Top_Connector.stp	Re-Manuf Exisiting piece	-	-	Swoboda	1		1	$0.00	$0.00	Complete	
~~179~~	~~A40-1400-11-011-021 Shear Cyl Attachment Plate~~		-	-	~~Swoboda~~	4		4	~~$0.00~~	~~$0.00~~	In Stock	
~~180~~	~~A40-1400-11-011-022 Shear Cyl Pivot~~		-	-	~~Swoboda~~	4		4	~~$0.00~~	~~$0.00~~	In Stock	
181	HEX_SOC_CAP_SCR_M10_X_18	91290A514	91290A514	McMaster-Carr	McMaster-Carr	4		4	$9.84	$9.84	Complete	
182	FLAT_WASH_od20_id10.	93475A280	93475A280	McMaster-Carr	McMaster-Carr	4		4	$7.78	$7.78	Complete	
183	A40-1400-11-030-001		-	-	GVSU	1		1	$0.00	$0.00	Complete	
184	A40-1400-11-030-002		-	-	GVSU	2		2	$0.00	$0.00	Complete	
185	A40-1400-11-030-003		-	-	GVSU	1		1	$0.00	$0.00	Complete	
186	A40-1400-11-030-005		-	-	GVSU	2		2	$0.00	$0.00	Complete	
187	A40-1400-11-030-004		-	-	GVSU	1		1	$0.00	$0.00	Complete	
188	A40-1400-11-030-006		-	-	GVSU	2		2	$0.00	$0.00	Complete	
189	A40-1400-11-030-007				GVSU	1		1	$0.00	$0.00	Complete	
190	HEX_SOC_CAP_SCR_M4_x_8		90358A126	McMaster-Carr		31		31	$12.43	$12.43	Complete	
191	A40-1400-11-030-008	Trap door cyl. Sheet metal			GVSU	2		2	$0.00	$0.00	Complete	
192	A40-1400-11-030-010	Trap Door lever arm			Swoboda	2		2	$0.00	$0.00	Complete	
193	CD85N16_125_A_0__1_0__9					2		2	$0.00	$0.00	In Stock	
194	CD85N16_125_A_0__1_0__7					2		2	$0.00	$0.00	In Stock	
195	FNTS6_1_0_D6_B6_U20	Knuckle Joint	FNTS6-1.0-D6-B6-U20	Misumi		2		2	$48.24	$96.48	Complete	
196	A40-1400-11-030-009		-	-	GVSU	2		2	$0.00	$0.00	Complete	
197	HCLGN6_12_0_3	Shouldered pin	HCLGN6-12	Misumi		2		2	$20.27	$40.54	Complete	
198	HCLGN6_12_0_5	Shouldered pin	HCLGN6-12	Misumi		2		2	$0.00	$0.00	Complete	
199	HCLGN6_22_0_3	Shouldered pin	HCLGN6-22	Misumi		2		2	$20.27	$40.54	Complete	
200	HCLGN6_22_0_5	Shouldered pin	HCLGN6-22	Misumi		2		2	$0.00	$0.00	Complete	
201	SFLC626ZZ	ID:6 OD19: Flanged bearing	SFLC626ZZ	MISUMI	MISUMI	2		2	$13.67	$27.34	Complete	
202	SFLC698ZZ	ID:8 OD19 Flanged Bearing	SFLC698ZZ	MISUMI	MISUMI	2		2	$14.04	$28.08	Complete	
203	A40-1400-11-030-012 Trap Door Shaft	Trap Door Shaft	PSFGG8-135-F6-P6-M3	Misumi	SWOBODA	2		2	$26.82	$53.64	Complete	
204	HEX_SOC_CAP_SCR_M3_x_10	Black-Oxide Alloy Steel	91290A115	McMaster-Carr		2		2	$9.54	$9.54	Complete	
205	OVERSIZE_WASHER_M3_x_3.2ID_9OD	18-8 Stainless Steel	91116A120	McMaster-Carr		2		2	$4.40	$4.40	Complete	
206	SHOULDER_BOLT_M3_x_d4_x_L8	Alloy Steel Shoulder Screws	92981A142	McMaster-Carr		4		4	$3.17	$12.68	Complete	
207	SHOULDER_BOLT_M3_x_d4_x_L12	Alloy Steel Shoulder Screws	92981A143	McMaster-Carr		1		1	$3.20	$3.20	Complete	
208	SHOULDER_BOLT_M3_x_d4_x_L15	Alloy Steel Shoulder Screws	92981A743	McMaster-Carr		1		1	$3.21	$3.21	Complete	

209	A40-1400-11-030-011		-	-	Swoboda	4		4	$0.00	$0.00	Complete	
210	A40-1400-11-011-023 Inline Ter Stop					4		4	$0.00	$0.00	Complete	
211	Rubber Bumper_M8_x_40_x_20	Rubber stop	3810N145	McMaster-Carr		4	2	6	$6.12	$36.72	Complete	
212	HFRW20_169_2_M8_N8(misumi)	Shear Cyl Shaft	HFRW20_169_2_M8_N	Misumi	misumi	2		2	$60.12	$120.24	Complete	
213	HEX_SOC_CAP_SCR_M8_x_25		91290A432	McMaster-Carr		36		36	$9.41	$9.41	Complete	
214	A40-1400-11-011-021 Shear cyl Plate				Swoboda	4		4	$0.00	$0.00	Complete	
215	CLBUB20-25-27	Shear Cyl shaft spacer	CLBUB20-25-27	Misumi	Misumi	2		2	$23.62	$47.24	Complete	
216	CLBUB20-25-59.5	Shear Cyl shaft spacer	CLBUB20-25-59.5	Misumi	Misumi	2		2	$30.27	$60.54	Complete	

Appendix I - Electrical BOM

Attached next.

swoboda technologies

Sub-Assembly Bill of Material

Name:	A40-1400-11-000-000 ME B.O(FINAL)		**Sub-Asm Status, Incl. Reviews:**		
Rack #:	A40-1400-11-000-000				
Cell #:	A40-1400-11				
Date:	05-02-22				
Created by:	Lance Deemter				
	Reviewer:	**Date: 04/26/22**	**PASS/FAIL**		
Design Review	0			0	

In Stock	**Complete**
Order	**In-Process**
On Order	
Received	

TOTAL/EXT **$1,527.33** #SPILL!

#	PART NAME	Description	VENDOR PART #	VENDOR	MANUF.	QTY	QTY SPARE	TOTAL QTY	COST	EXT COST	ORDER STATUS	COMMENTS
	Assembly Qty:	1	1									
1	Photo Eye, Emitter, 24 DC, PNP, Opposed		HEE-00-3A	Automation Direct	Automation Direct	1		1	$37.00	$37.00	Complete	
2	Photo Eye Receiver		HER-CP-3A	Automation Direct	Automation Direct	1		1	$58.00	$58.00	Complete	
3	Inductive Prox, 24 DC, PNP		DW-AD-503-04	Automation Direct	CONTRINEX	2		2	$99.00	$198.00	Complete	
4	Inductive Prox, 24 DC, PNP		SMC D-M9N	SMC Pneumatics	SMC Pneumatics	22		22	$37.57	$826.54	Complete	
5	Power supply unit		PSB24-120S-3	Automation Direct	RHINO	1		1	$266.14	$0.00	In Stock	
7	35 mm DIN Rails (2m)		2511120	Mouser	Altech Corp	3		3	$6.80	$0.00	In Stock	
8	Siemens Simatic S7-300, PNP		6ES73152EH140AB0	Siemens	Siemens	1		1	$2,200.00	$0.00	In Stock	
9	HMI KTP400 Comfort		6AV21242DC010AX0	Siemens	Siemens	1		1	$755.75	$0.00	In Stock	
10	Node		CP-FB13-E	Radwell	Festo	1		1	$564.00	$0.00	In Stock	
11	Input Bank, PNP		CP–E16–M8	Festo	Festo	2		2	$748.74	$0.00	In Stock	
12	N Type Valve		MS6-EM1-1/2-S	Festo	Festo	1		1	$96.54	$0.00	In Stock	
13	J Valve		J-5/2-D-3-C	Radwell	Festo	8		8	$259.00	$0.00	In Stock	
14	Output Valve Bank		cpv10-GE-FB-8	Rgbautomation	Festo	2		2	$540.00	$0.00	In Stock	
15	Relay Contactor 4PST 10A 24V	x	J7KNA-AR-31 24	Digikey	Omron	3		3	$92.37	$277.11	Complete	
16	SM321, Source (PNP) 16DI, 24V DC	x	6ES7321-1BH01-0AA0	Siemens	Siemens	1		1	$309.00	$0.00	In Stock	
17	SM322, Source (PNP) 16DO 24V DC, 0.5A	x	6ES7322-1BF01-0AA0	Siemens	Siemens	1		1	$1,360.00	$0.00	In Stock	
18	Safety Controller, 22 Inputs, 10 Status Outputs	x	SC22-3-CU1	Banner Engineering	Banner Engineering	1		1	$1,509.00	$0.00	In Stock	
19	Distribution Block		TBD	TBD	TBD	2		2	$1.00	$0.00	In Stock	
20	Circuit Breaker, 1 Pole, 1 Amp, 127V		C32H-DC C1A	Maxodeals	Merlin Gerin	1		1	$5.90	$5.90	In Stock	
21	Fuse Holder (2 each)		1DZ15	Grainger	Bussman	2		2	$38.99	$77.98	In Stock	
22	1A Fuse		1CP16	Grainger	Bussman	3		3	$11.70	$35.10	In Stock	
23	2A Fuse		1CP22	Grainger	Bussman	1		1	$11.70	$11.70	In Stock	
24	24 V Distr. Blocks, 4 pin connected, GRAY		3038875	Digikey	Pheonix Contact	3		3	$6.67	$0.00	In Stock	
25	24 V Distr. Blocks, 4 pin connected, BLU		3211775	Digikey	Pheonix Contact	4		4	$2.78	$0.00	In Stock	
26	Terminal Block Connector DIN Rail Ground Spring Cage 28-12AWG		3031322	Alliedelec	Pheonix Contact	2		2	$11.58	$0.00	In Stock	
27	Terminal Block Covers		3047426	Alliedelec	Pheonix Contact	NA		1	$1.76	$0.00	In Stock	
28	Enclosure		6942K26	McMaster	-	1		1	-	$0.00	In Stock	
29	Fan		GDT12025B24V2P2.54AP	Amazon	GDSTIME	1		1	$16.99	$0.00	In Stock	
30	Coupling Relay		AD-SSR810-DC-28Z	Automation Direct	Automation Direct	1		1	$23.00	$0.00	In Stock	
31	24 AWG MTW Wire , 500 ft		MTW22BK	Automation Direct	Automation Direct	1		1	$24.50	$0.00	In Stock	
32	Insulated Wire Ferrules		11181350	Sacelec	Crimp Supply	10		10	$31.69	$0.00	In Stock	
33	wire way		CWST260	Hammond Manufacturing	Hammond Manufacturing	1		1	$41.19	$0.00	In Stock	
34	DoorSafety Magnets		SI-MAGB2MM	Banner Engineering	Banner Engineering	2		2	$18.00	$0.00	In Stock	
35	Door Saety Interlock		SI-MAGB2SM	Banner Engineering	Banner Engineering	2		2	$46.00	$0.00	In Stock	
36	24v light bar cable 285mm		WLS28-2XW285SQ	Banner Engineering	Banner Engineering	1		1	$206.00	$0.00	In-Stock	
37	24v light bar 285mm		WLS28-2XW285XQ	Banner Engineering	Banner Engineering	1		1	$158.00	$0.00	In-Stock	
38	Plug from PLC to Node		FBS-SUB-9-GS-DP-B	RsDelivers	Festo	1		1	$101.32	$0.00	In-Stock	
39	Air Hose, 4ft per Cyl, 4mm		PUN-H-4X0 (50m)	Alliedelec	Festo	1		1	$39.50	$0.00	In-Stock	
40	Push-In Fitting, M5 Thread		AS1301F-M5-04	SMC Pneumatics	Festo	NA		1	$2.89	$0.00	In-Stock	
41	Vibrating controller		ET15RY LM1CC	Feeding Concepts INC	Feeding Concepts INC	1		1	$7.35	$0.00	In-Stock	
42	Vibrating electronic		E-0383	Feeding Concepts INC	Feeding Concepts INC	1		1	$400.00	$0.00	In-Stock	
43	Estop		61-6441.4057	Digikey	EAO	1		1	$56.14	$0.00	In Stock	
44	Start Button / Power ON		HB-H60-063	Parts Town	Precision Mixer	1		1	$104.27	$0.00	In Stock	
45	Filter Regulator		MSB6-1/2:C3:J1:D14-WP	Festo	Festo	1		1	$737.33	$0.00	In Stock	
46	Profibus piggy back		700-972-0BB50	Helmholz	Helmholz	1		1	$58.00	$0.00	In Stock	
47	Power cord to node		NEBU-M12 W8	Uk.rs online	Festo	1		1	$19.22	$0.00	In Stock	
48	Power cord to ouput modules		NEBU-M12 W8	Uk.rs online	Festo	2		2	$19.22	$0.00	In Stock	
49	Powercord to input modules		NEBU-M12 W8	Uk.rs online	Festo	2		2	$19.22	$0.00	In Stock	

Appendix J - Faculty Presentation Slides

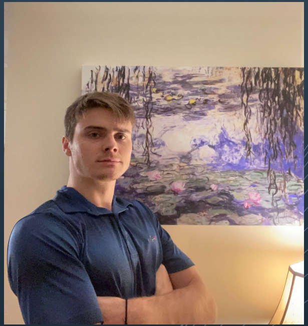
Attached next.

Team 20: Swoboda

Winton Recycler Automation

Meet the Team

Lance Deemter
Sponsor Correspondent



Daniel Weller
Secretary

Aziz Gram Sarhan Jr.
Team Captain

Crystal Kinney
Faculty Correspondent

Jordan Hayes
Floater

swoboda technologies

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

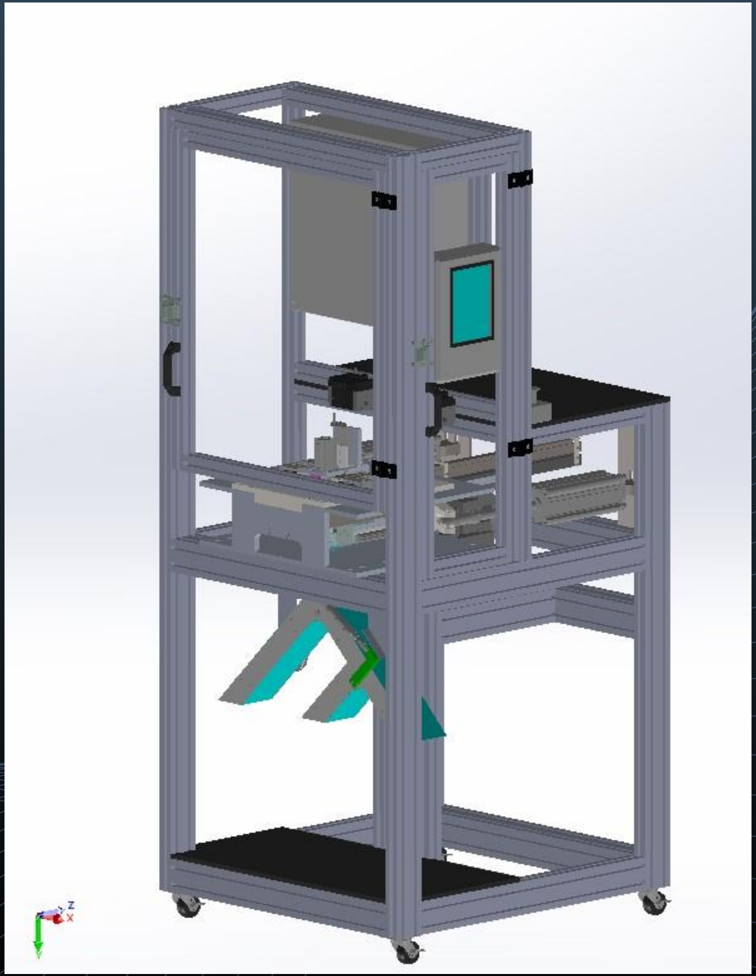
Head

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

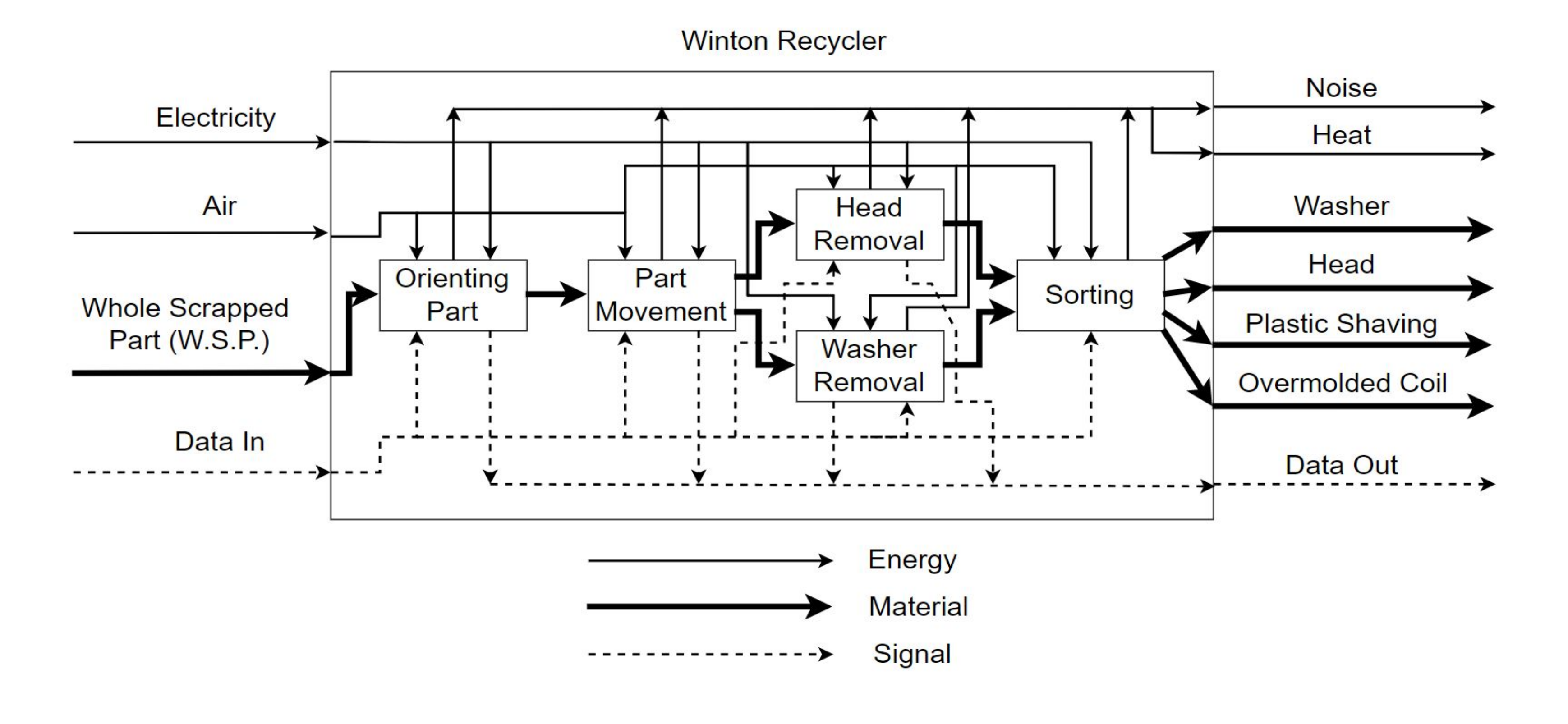
Specifications Summary

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/0 and HMI via ProfiBUS	Required	-	-	Yes/No
I/0 achieved with Festo CPI valve banks and input blocks	Required	-	-	Yes/No
PLC Control	Required	-	-	Yes/No

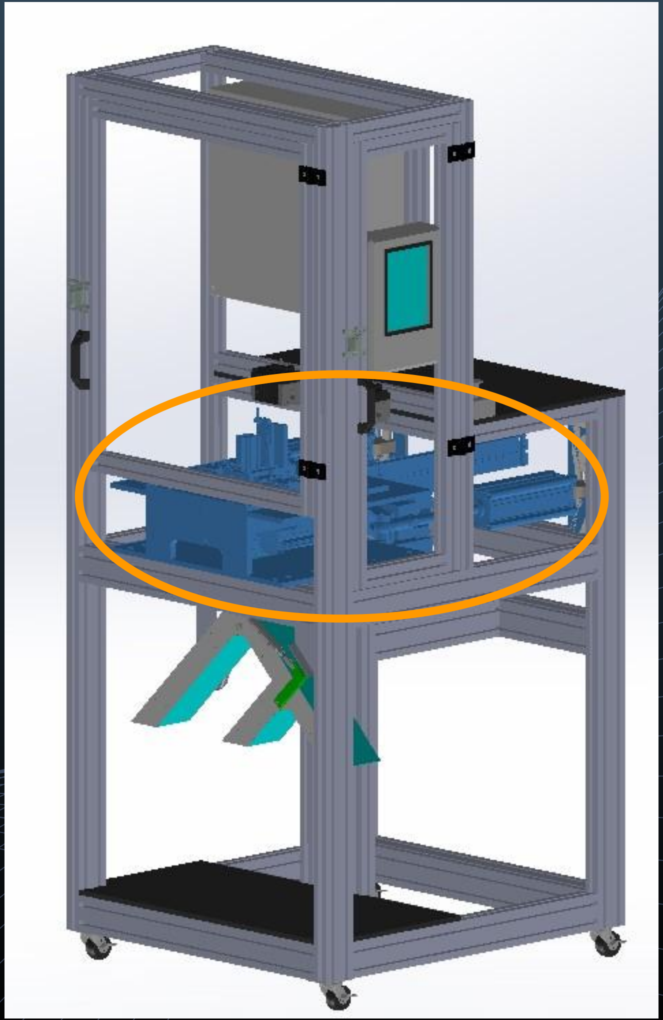
Function Structure Diagram



Mechanical Aspect

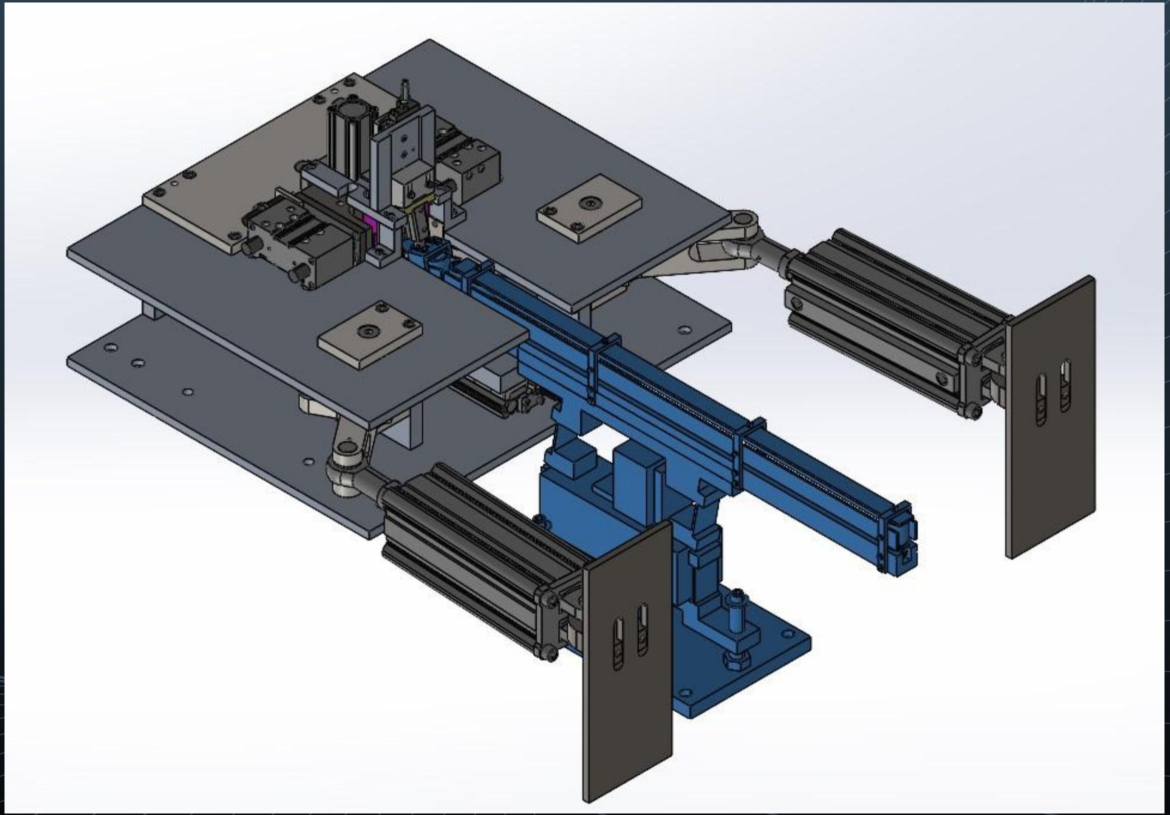
Location of :

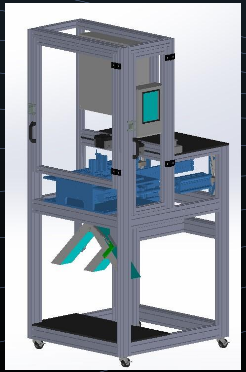
- Orienting Part
- Part Transfer
- Head Removal
- Washer Removal

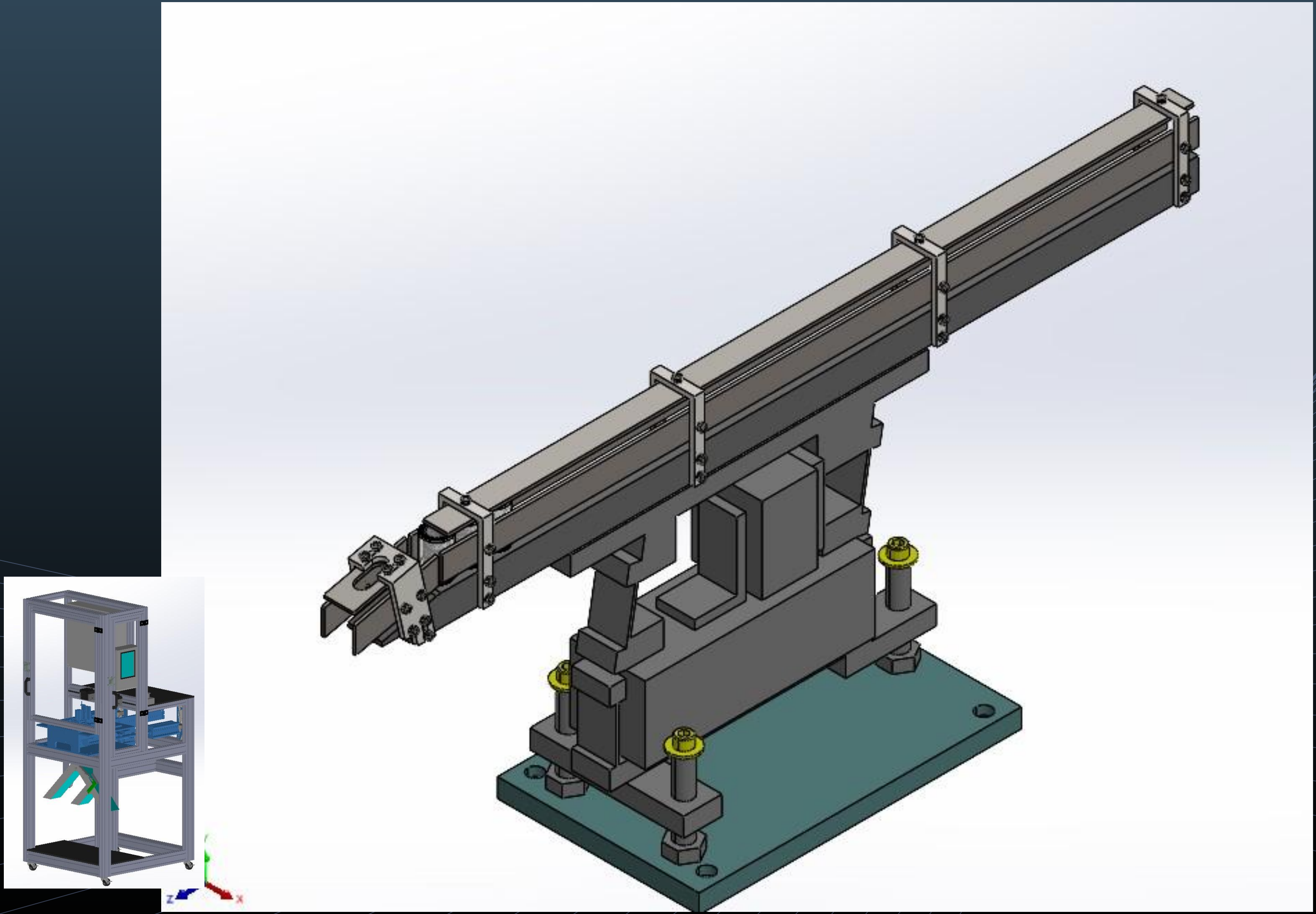


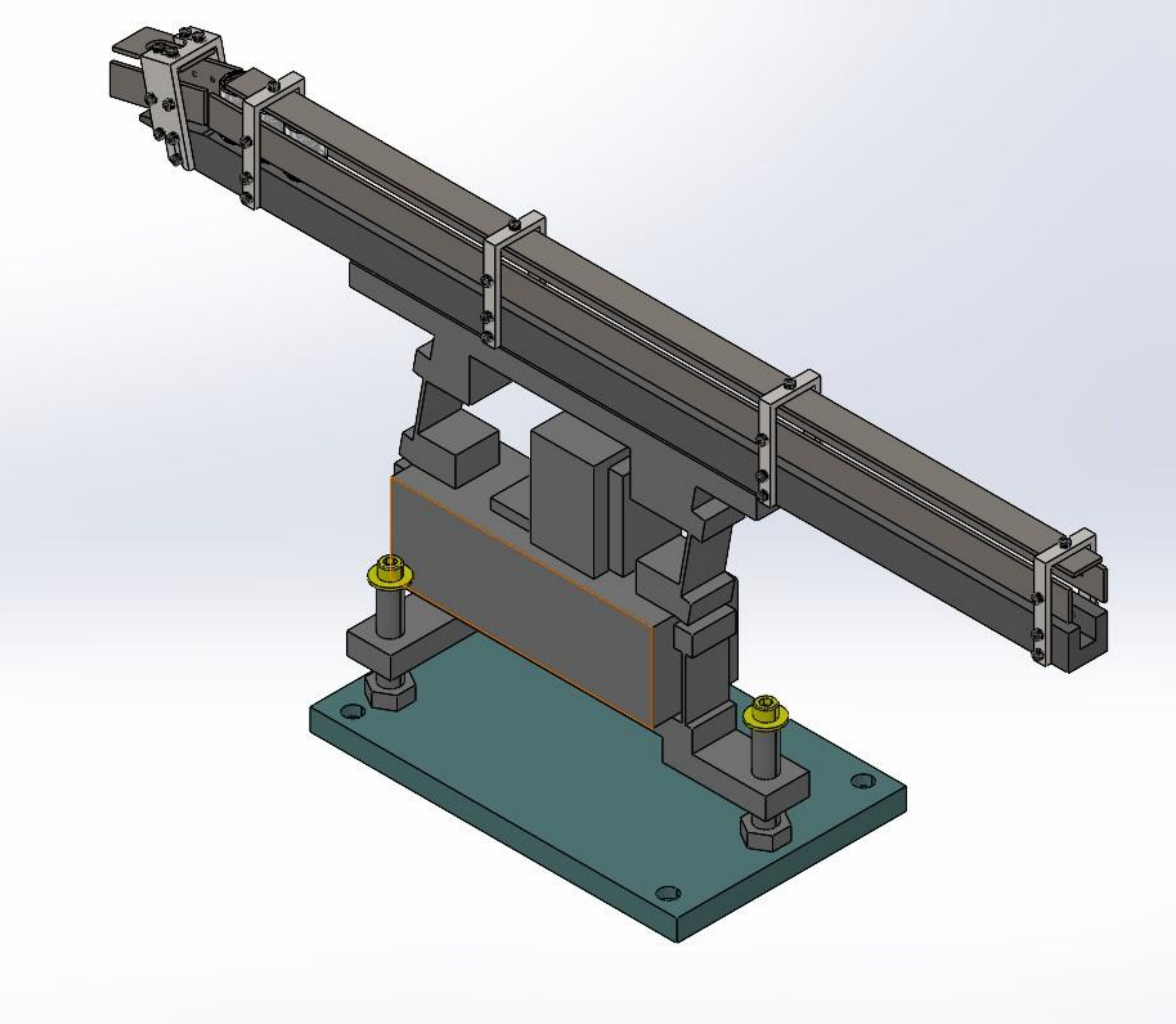
Orienting Part

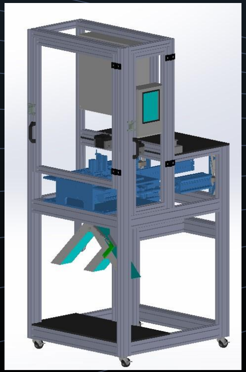
- Vibratory unit
- Similar to current feeding mechanisms
- Re-use old line components





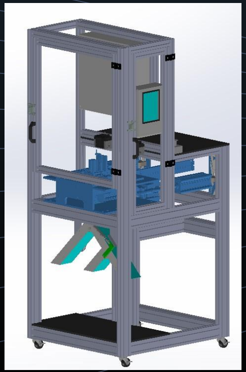


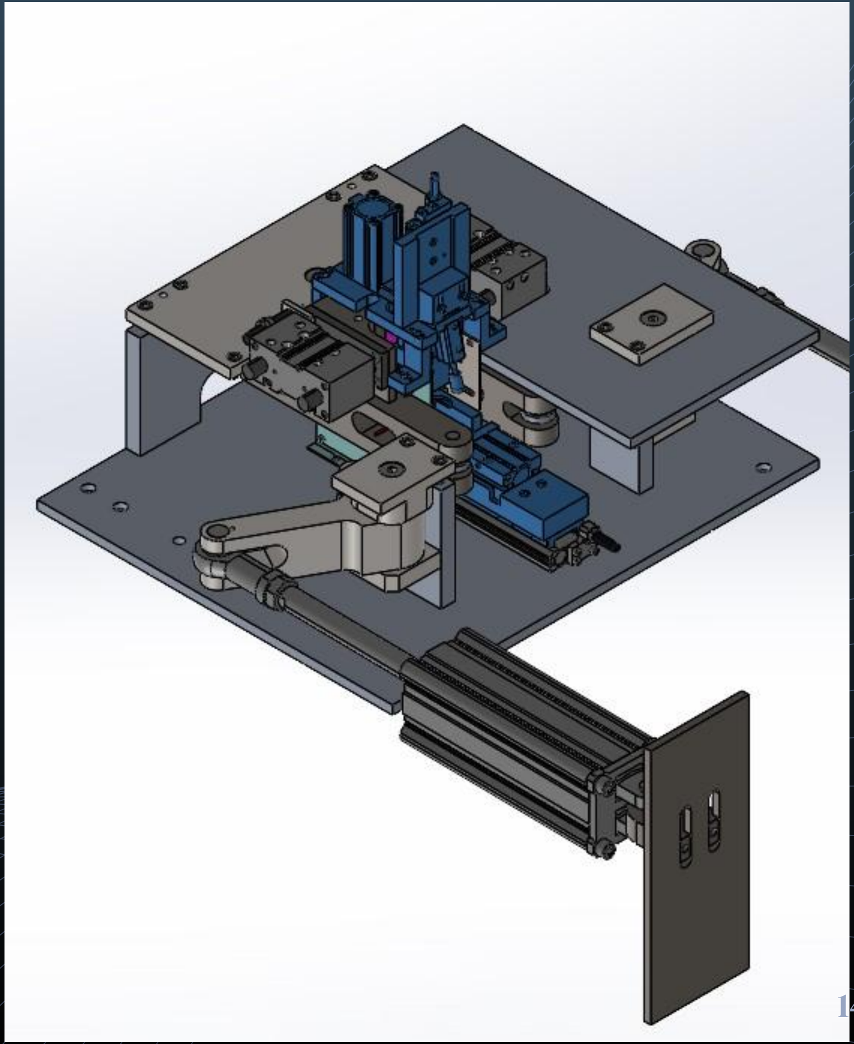


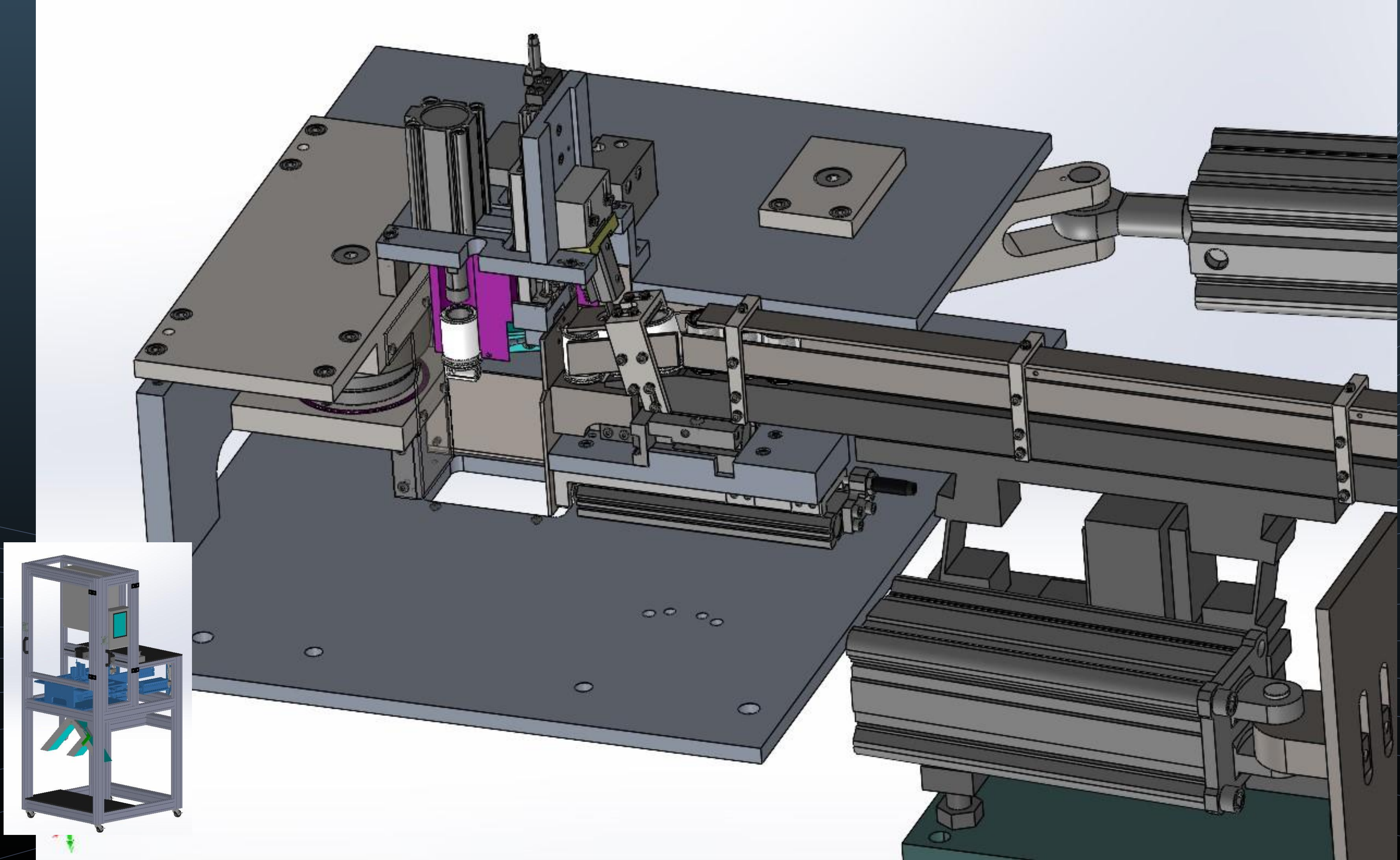


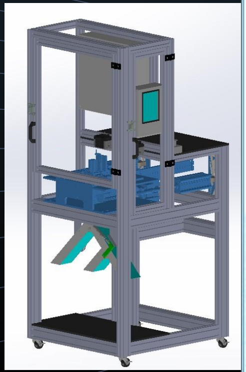
Part Movement

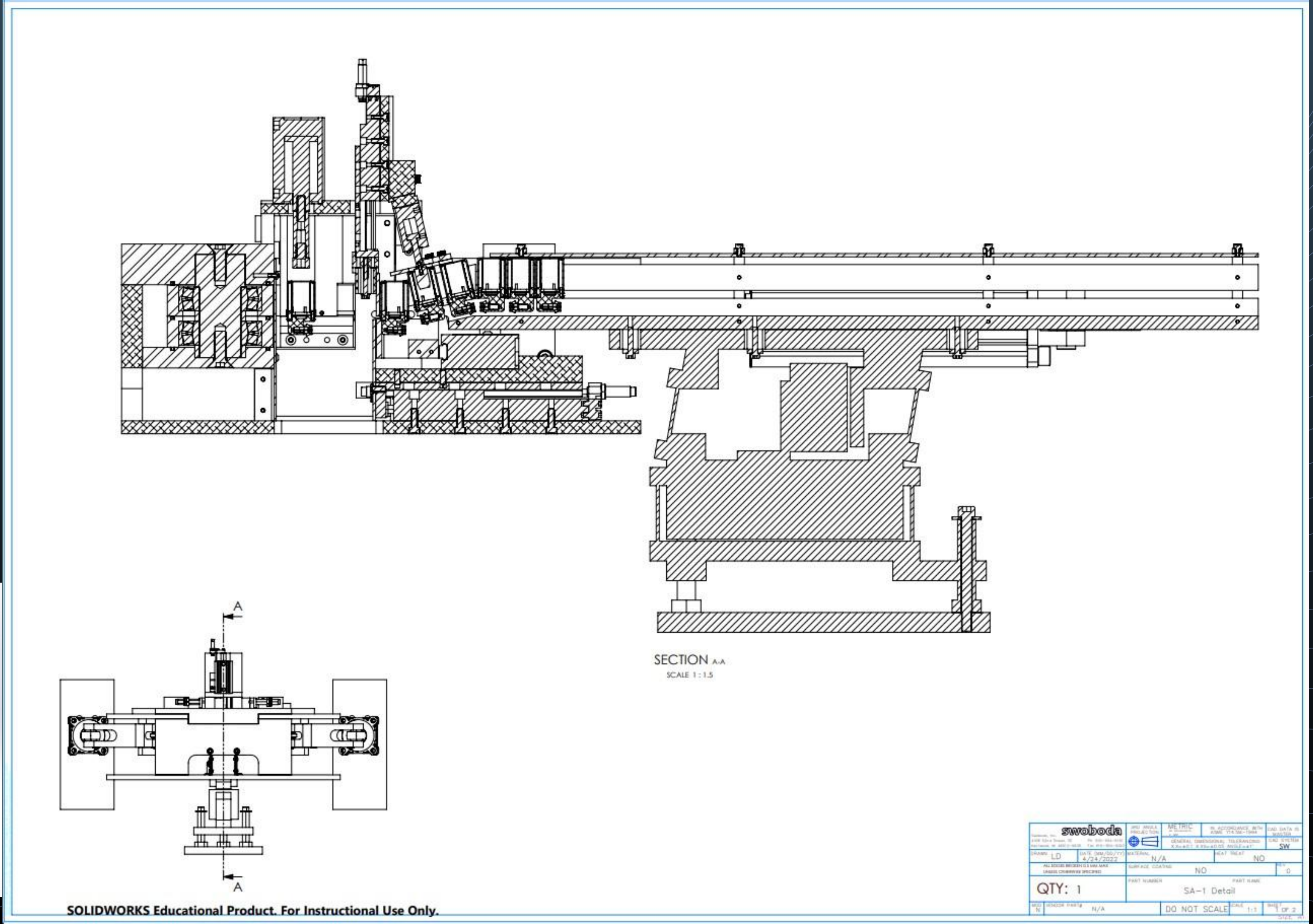
- Utilizes dead nest
- Pre stop & End stop
- Clamping mech.











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swoboda
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CAD SYSTEM SW
DRAWN LD
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HEAT TREAT NO
SURFACE COATING NO
REV 0
QTY: 1
PART NUMBER
PART NAME
SA-1 Detail
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DO NOT SCALE
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SHEET 1 OF 2
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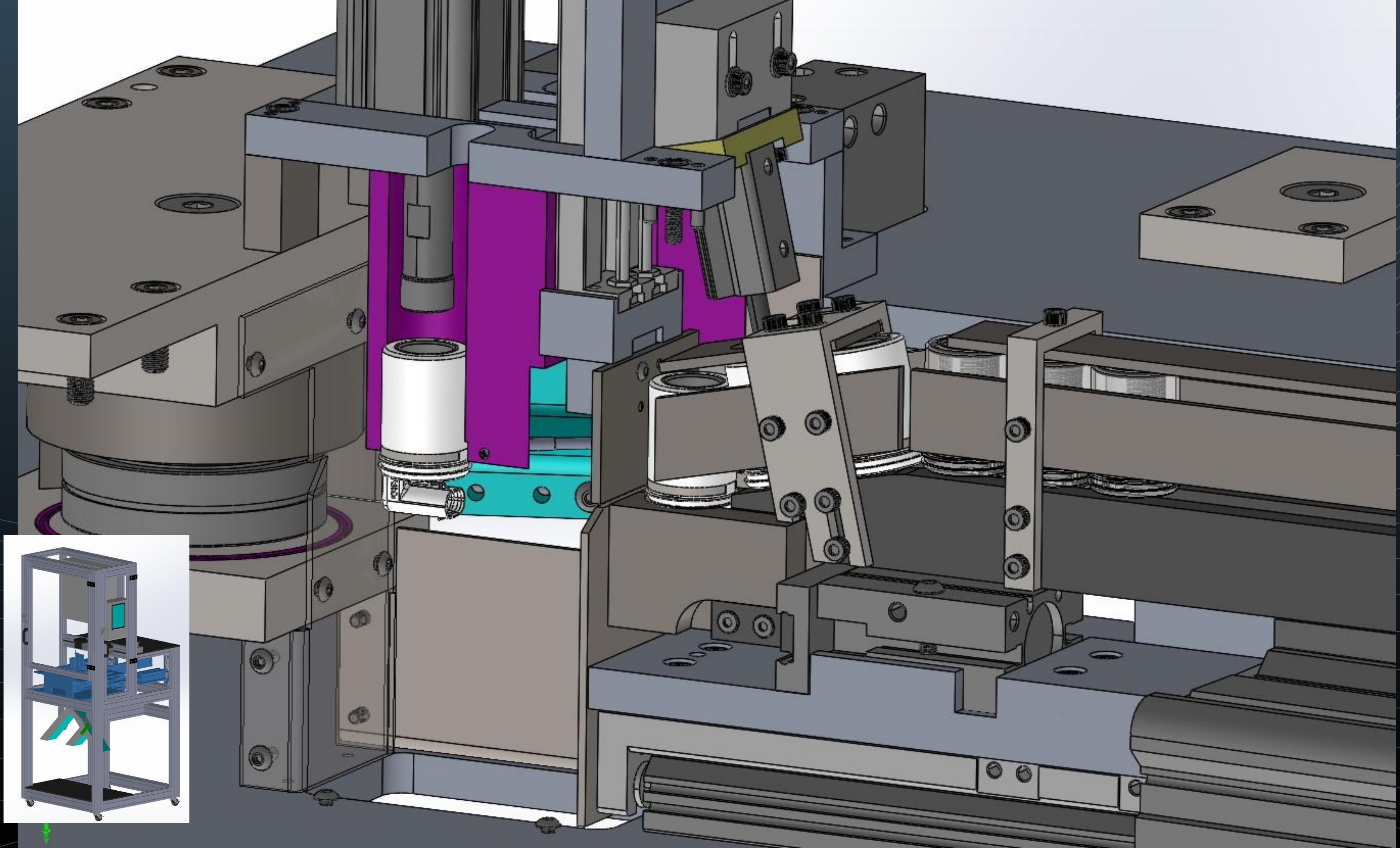
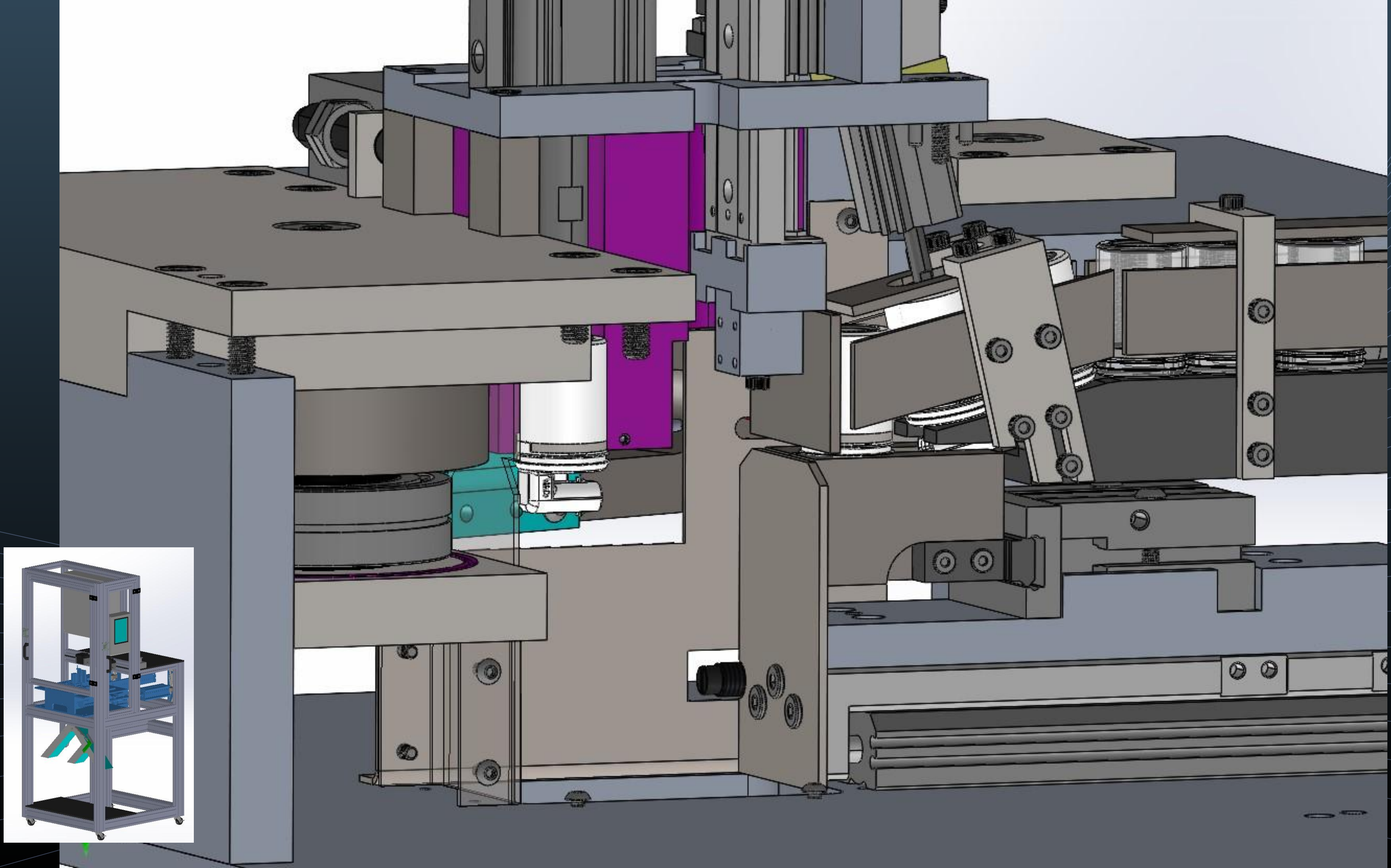
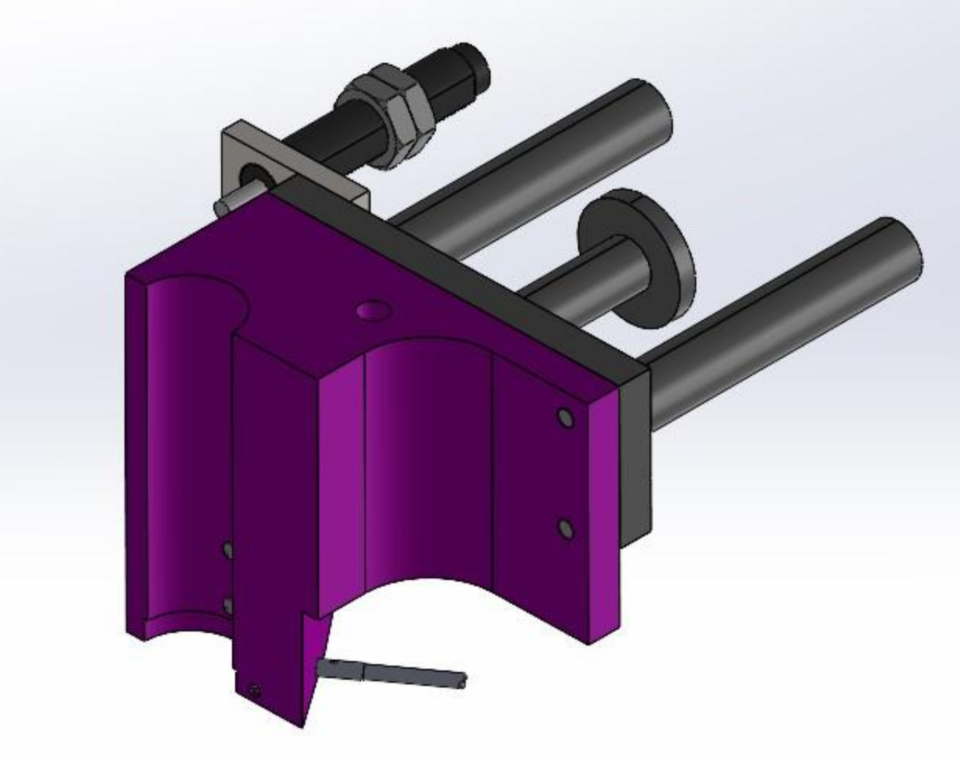
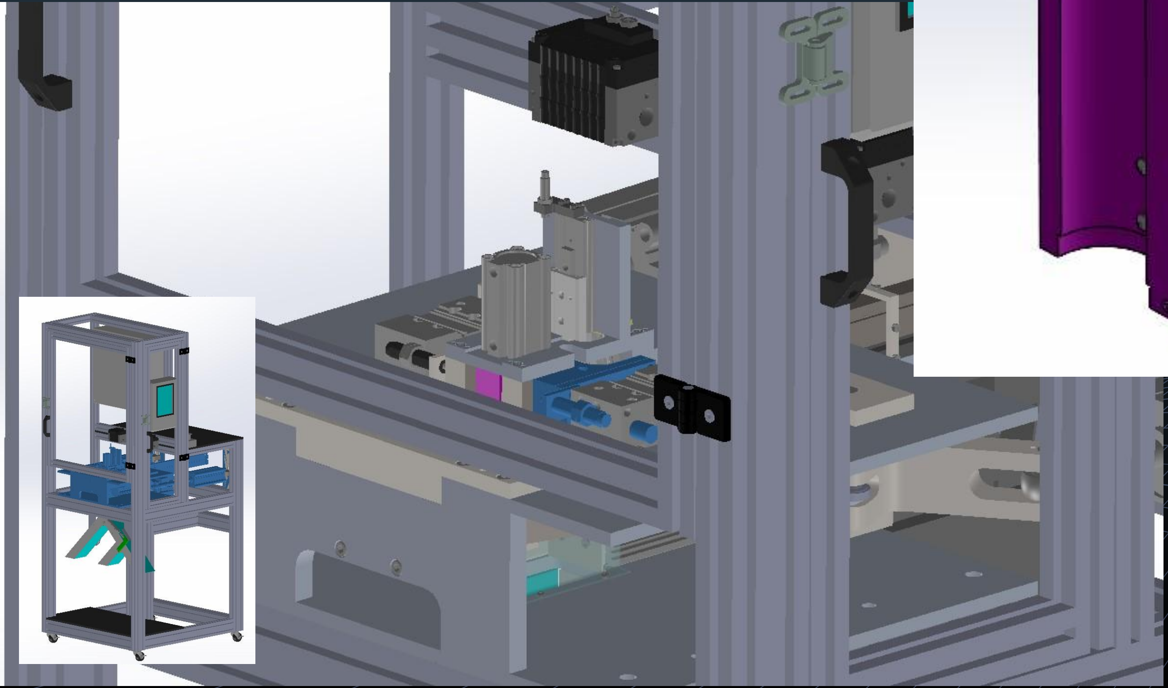
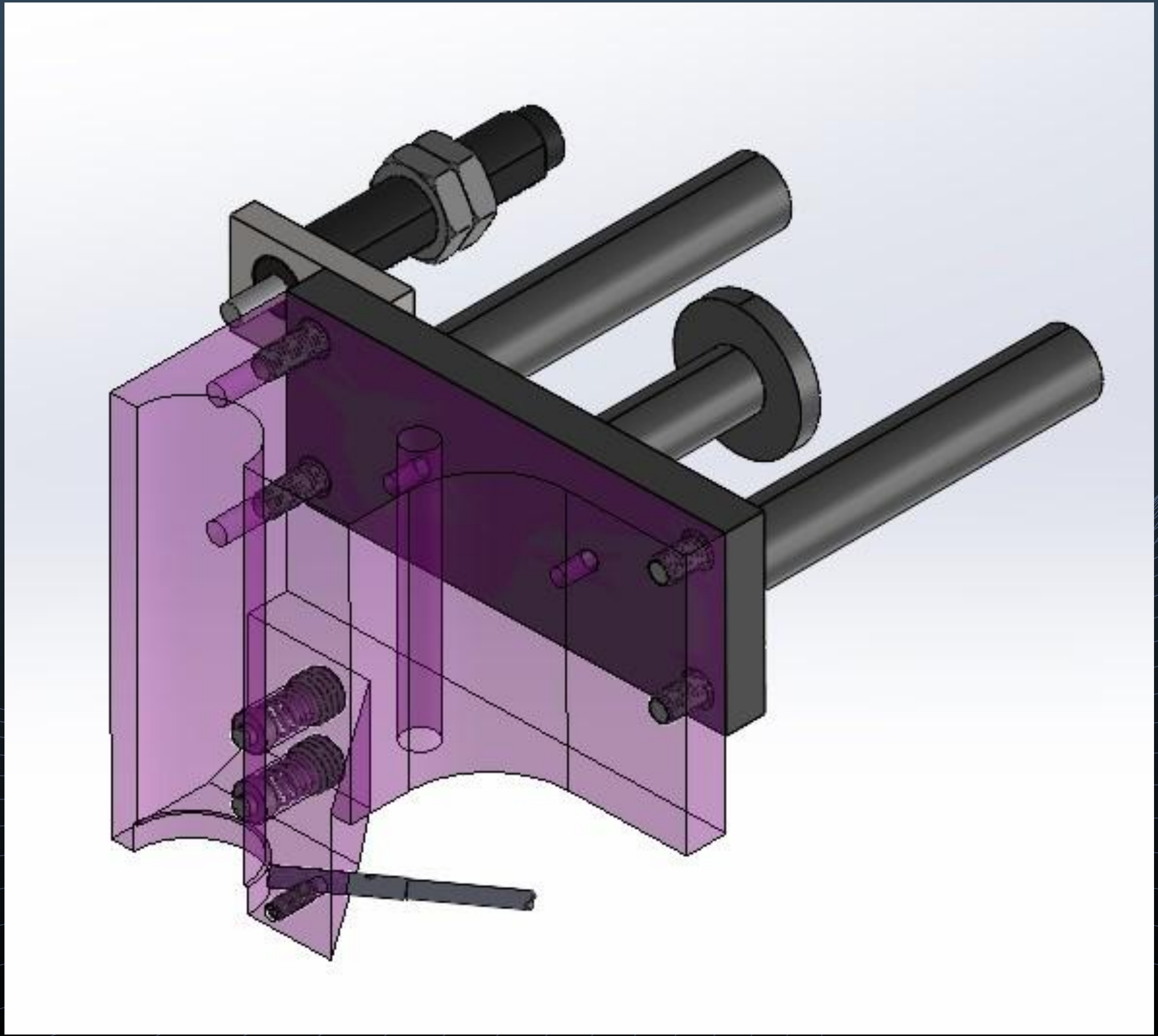


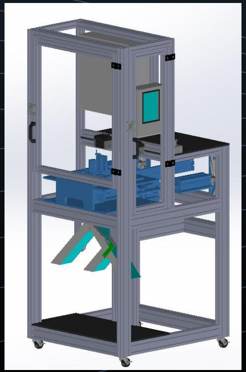


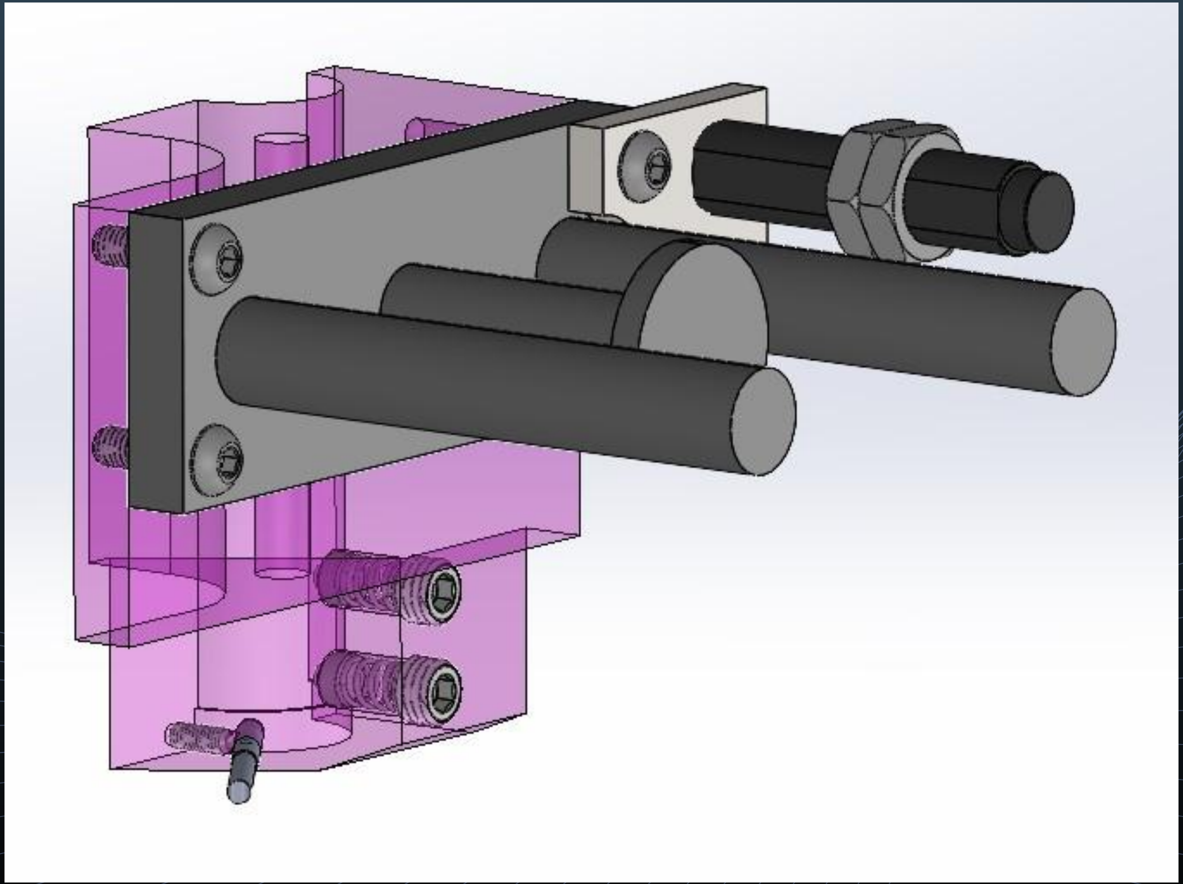
Part Movement, Clamping Mechanism

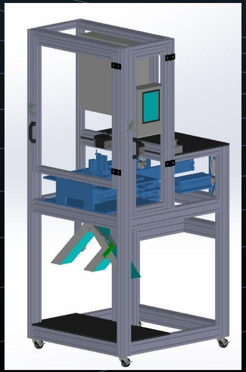


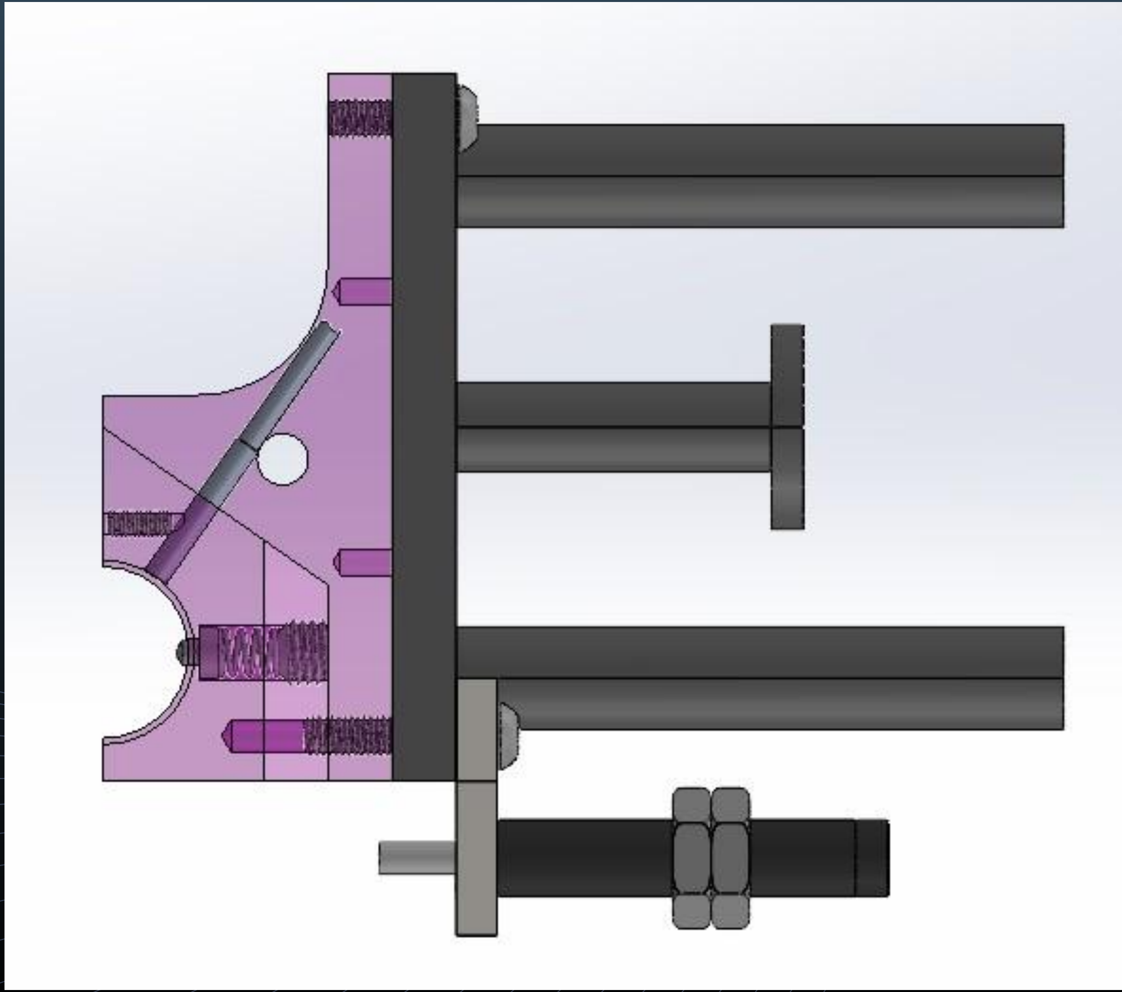


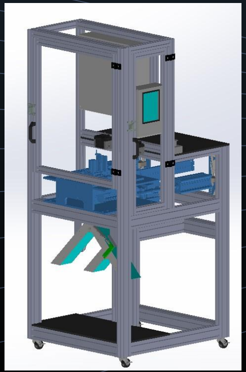






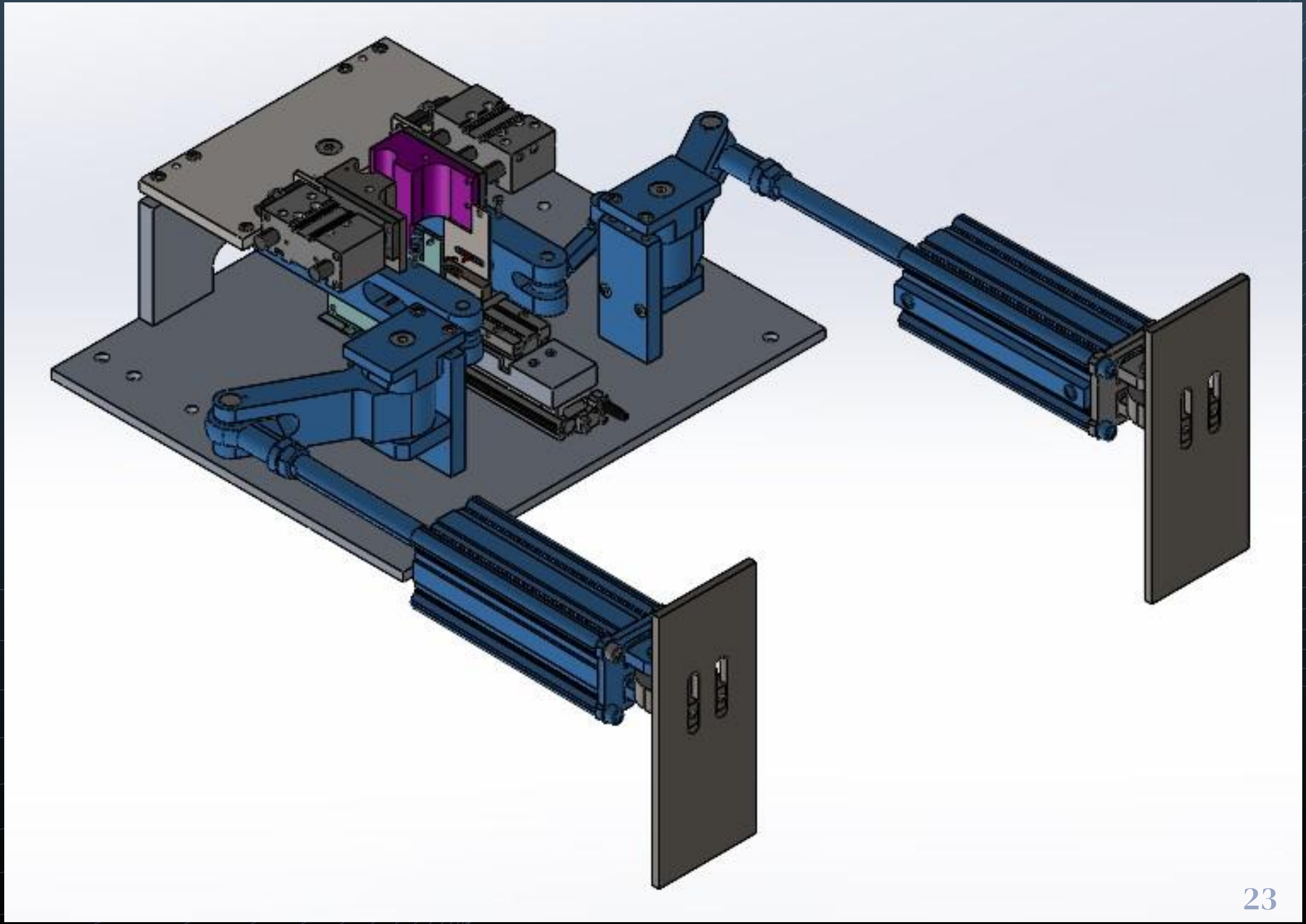


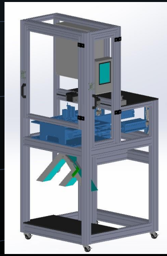


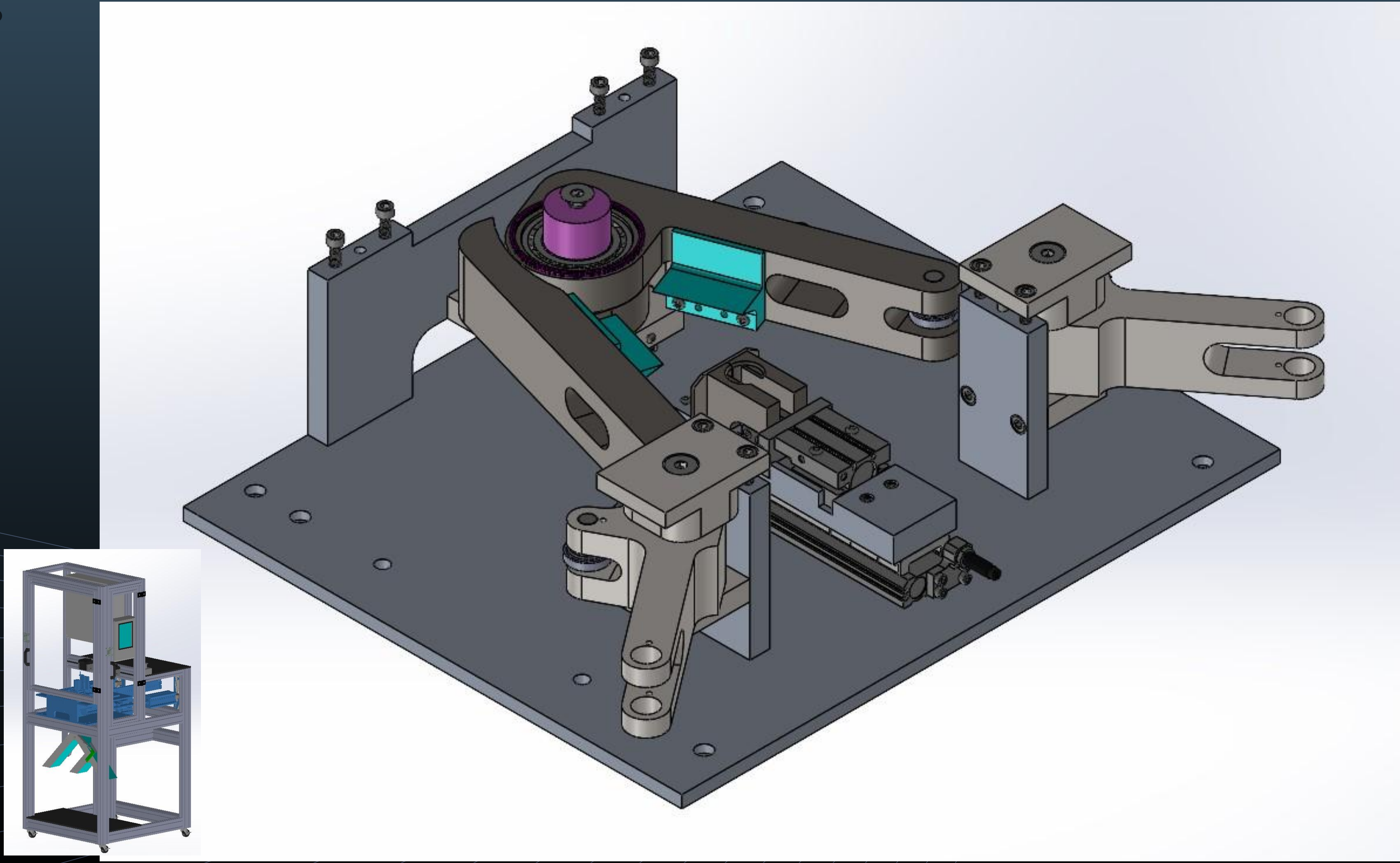


Head Removal - Mechanical

-





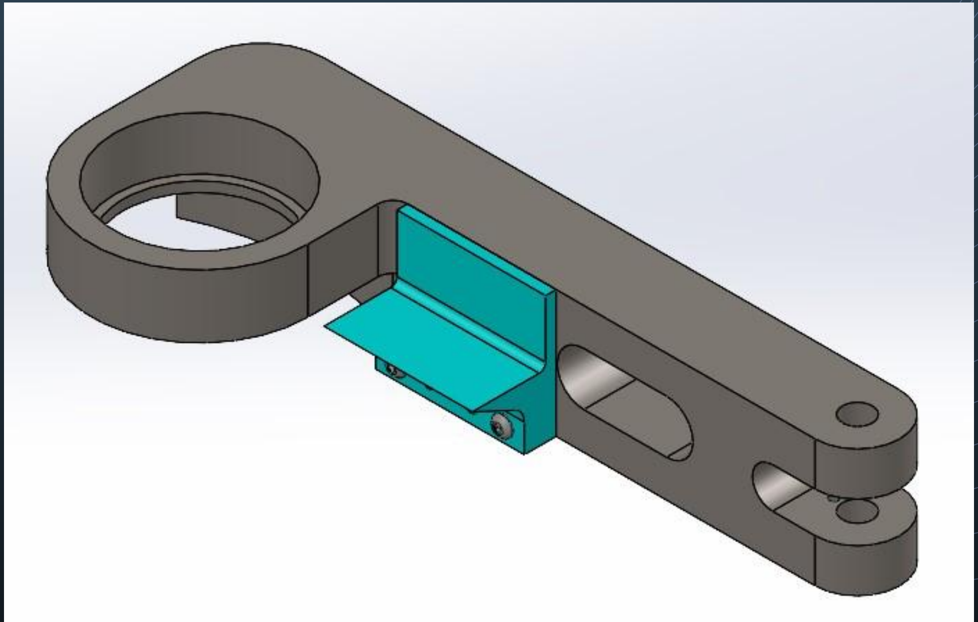


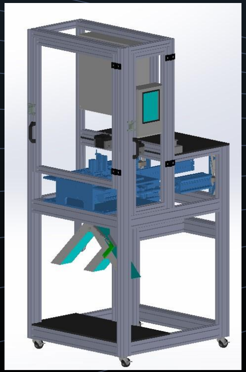
Shear arm design

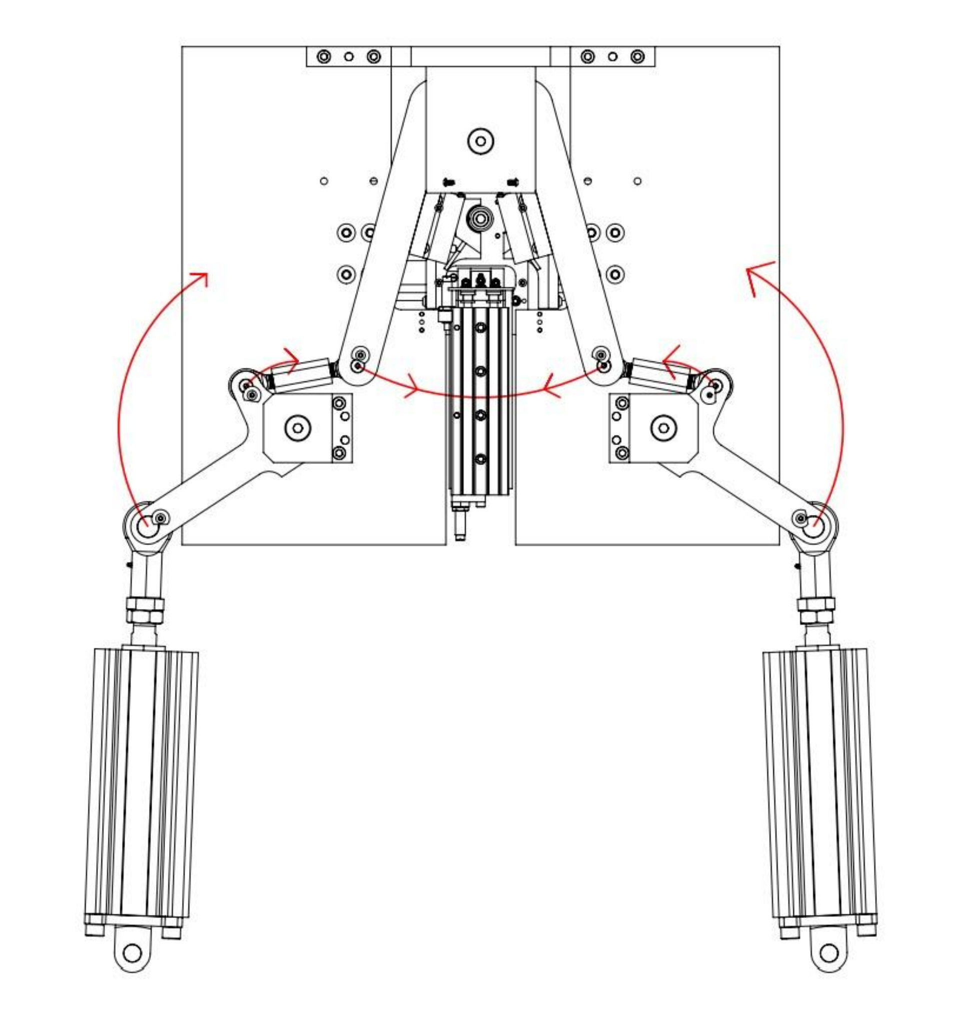
- 1018 CRS
- Cutout for clearance of part presence sensor
- Designed so cutting action occurs at midline
- 0.2mm clearance between shear arms

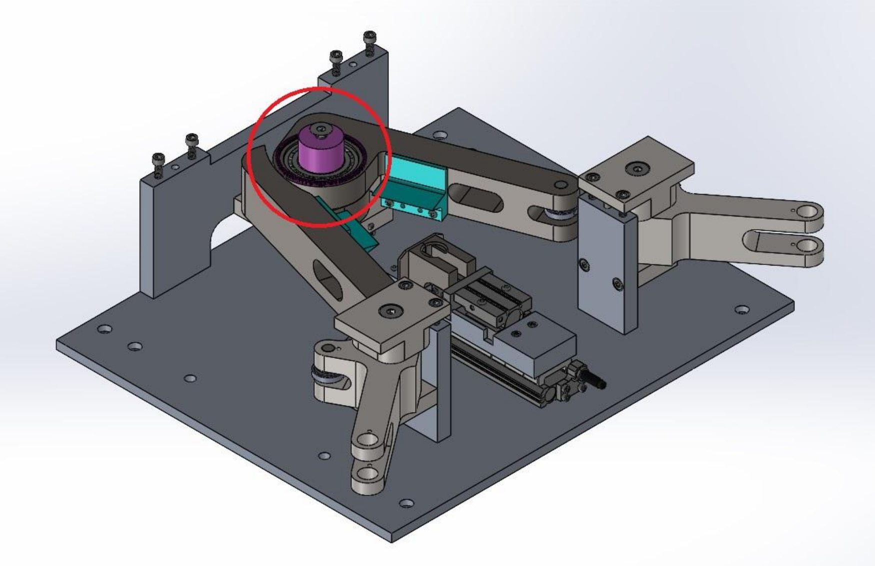
Blade design

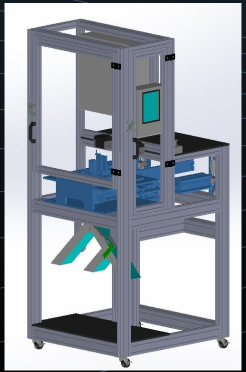
- Replaceable
- D2 Steel
    - Used for shears and knives
    - Good impact resistance
    - Holds edge
- 25 degree chamber
    - Adds Strength
    - Wedge shape acts to increase force acting to remove head
        - Wood splitter inspired

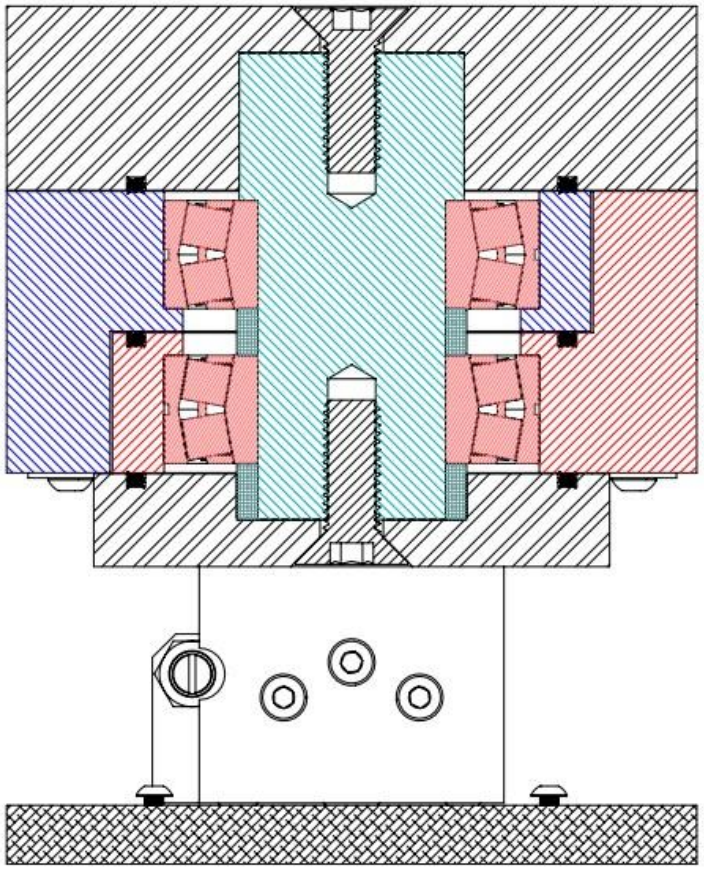












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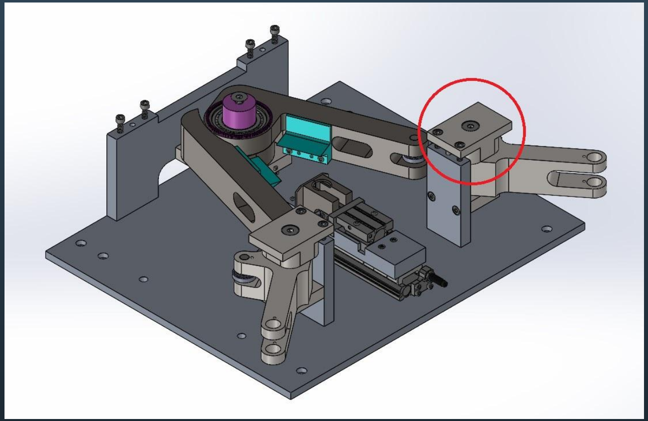
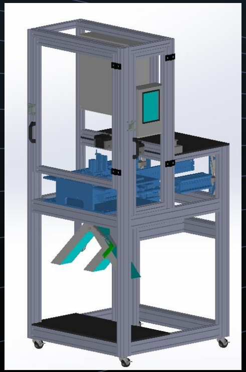
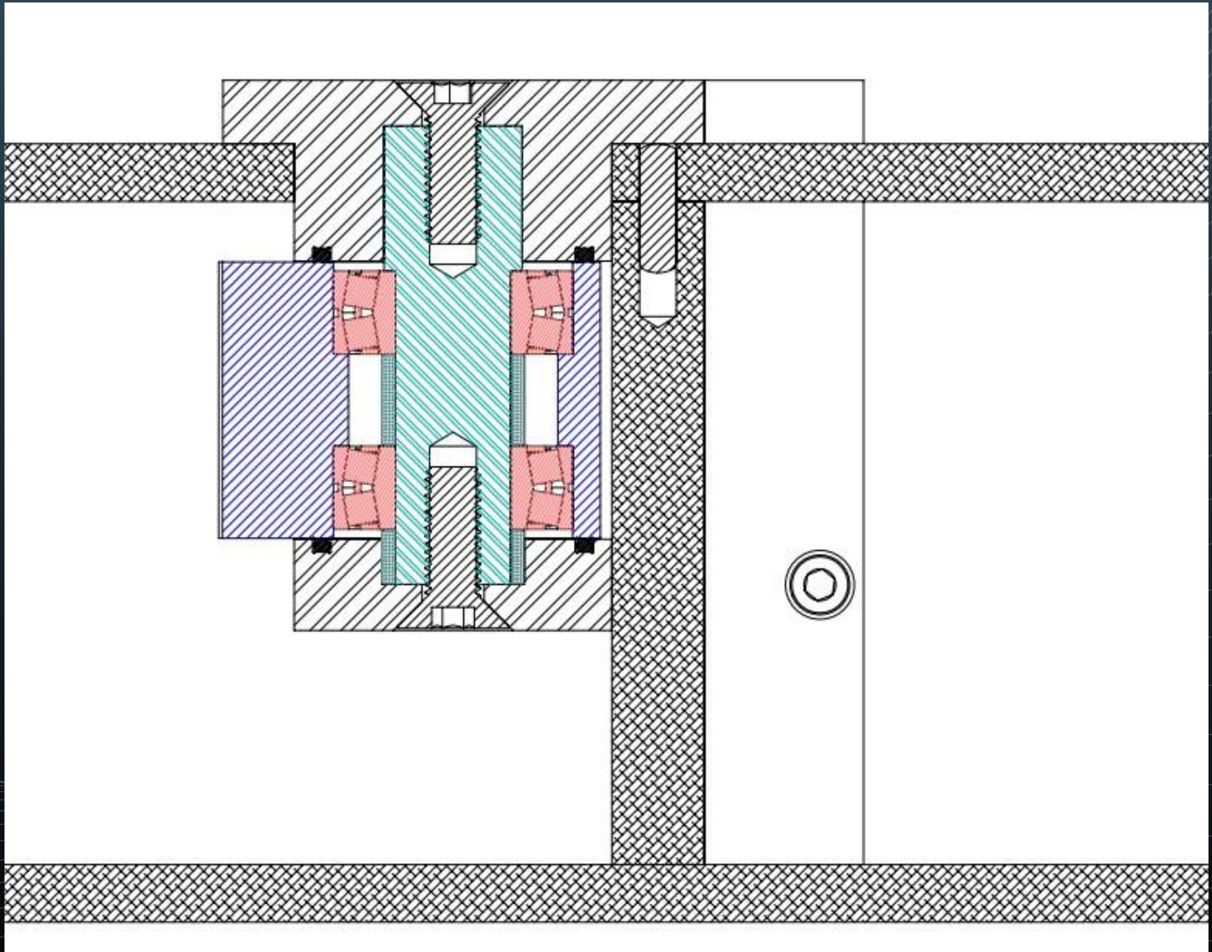


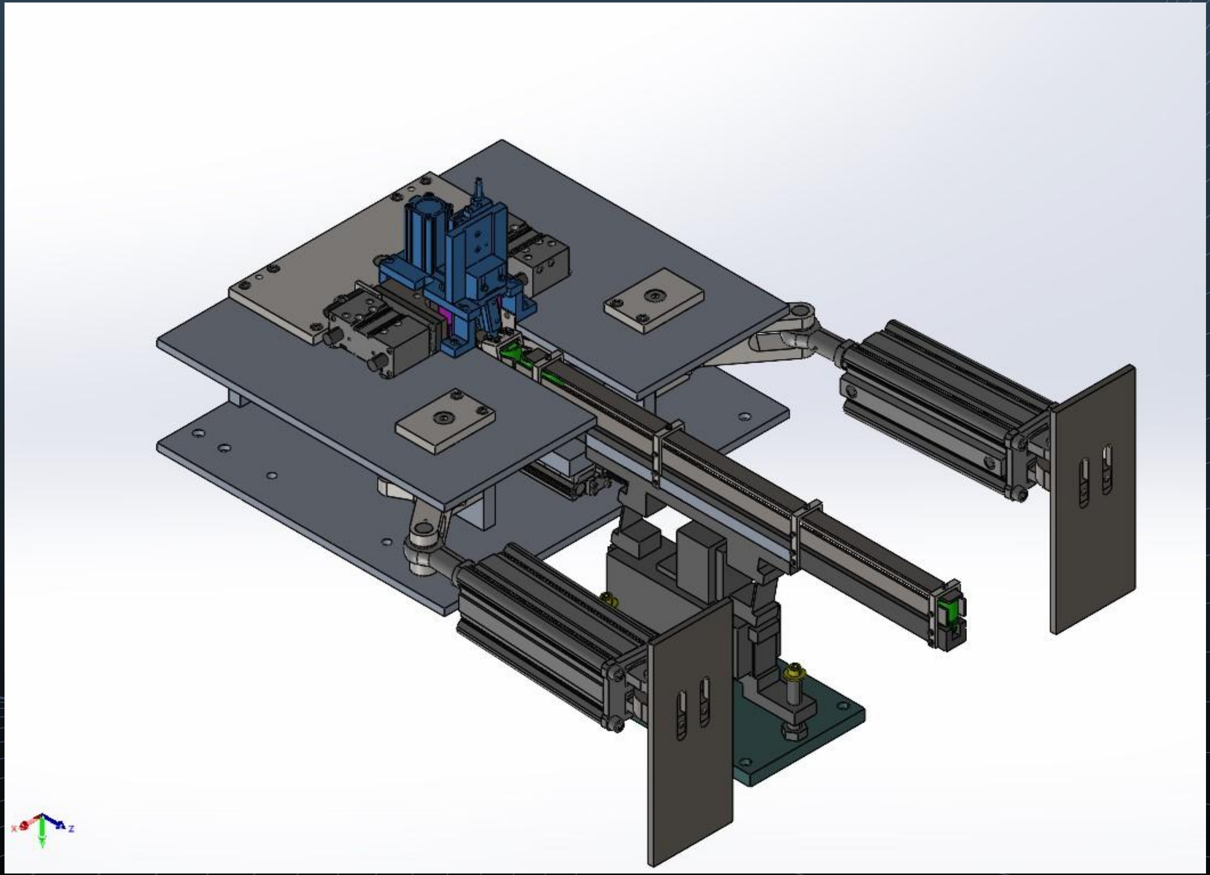


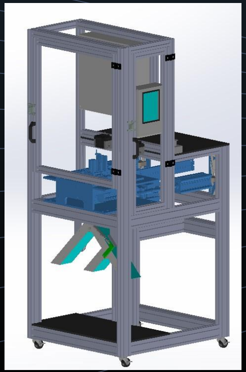


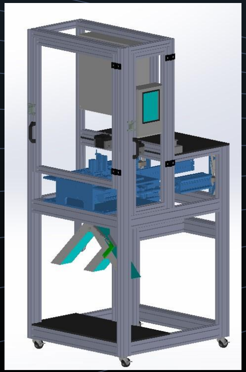
SECTION B-B
SCALE 2 : 1

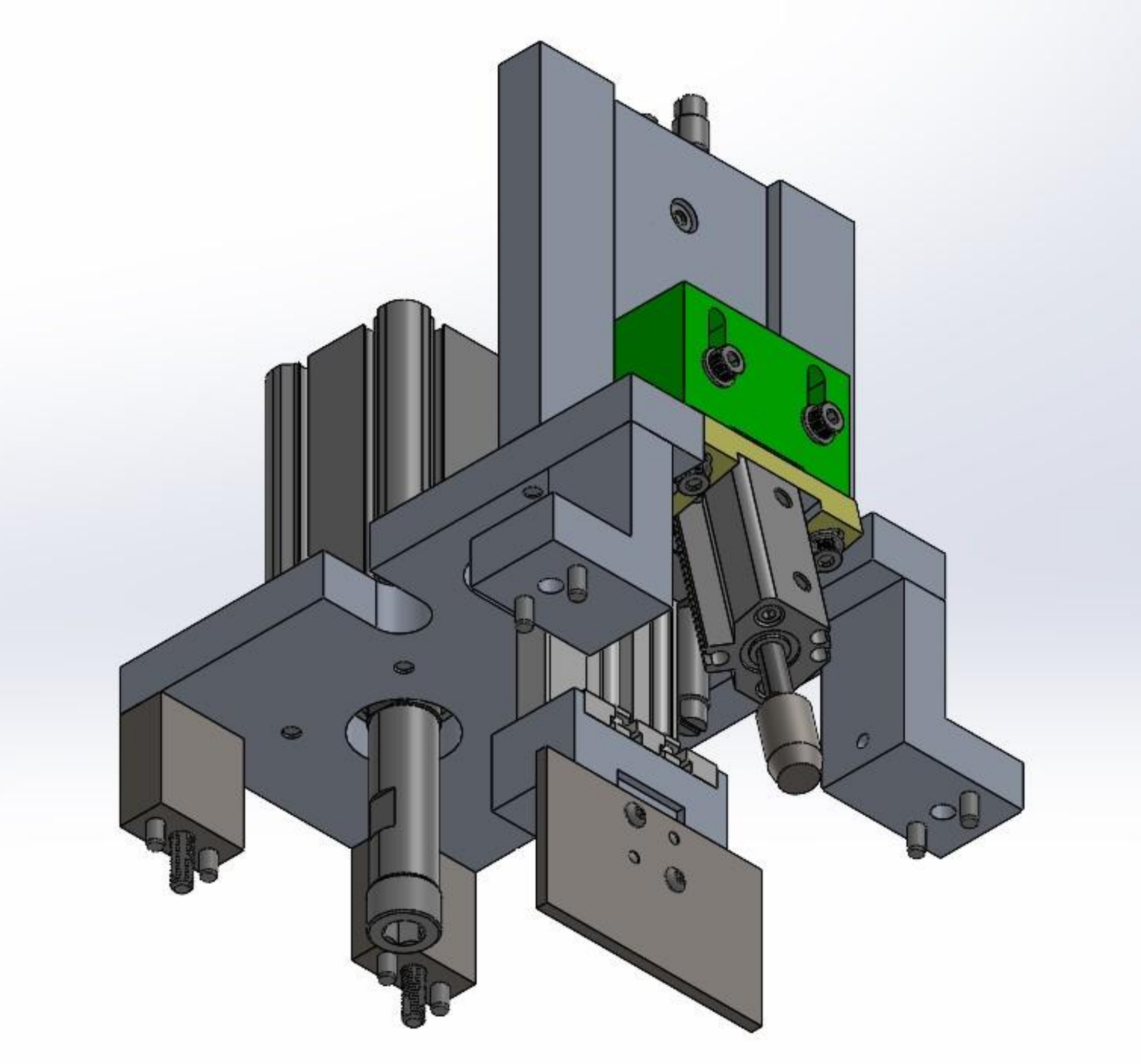
Washer Removal

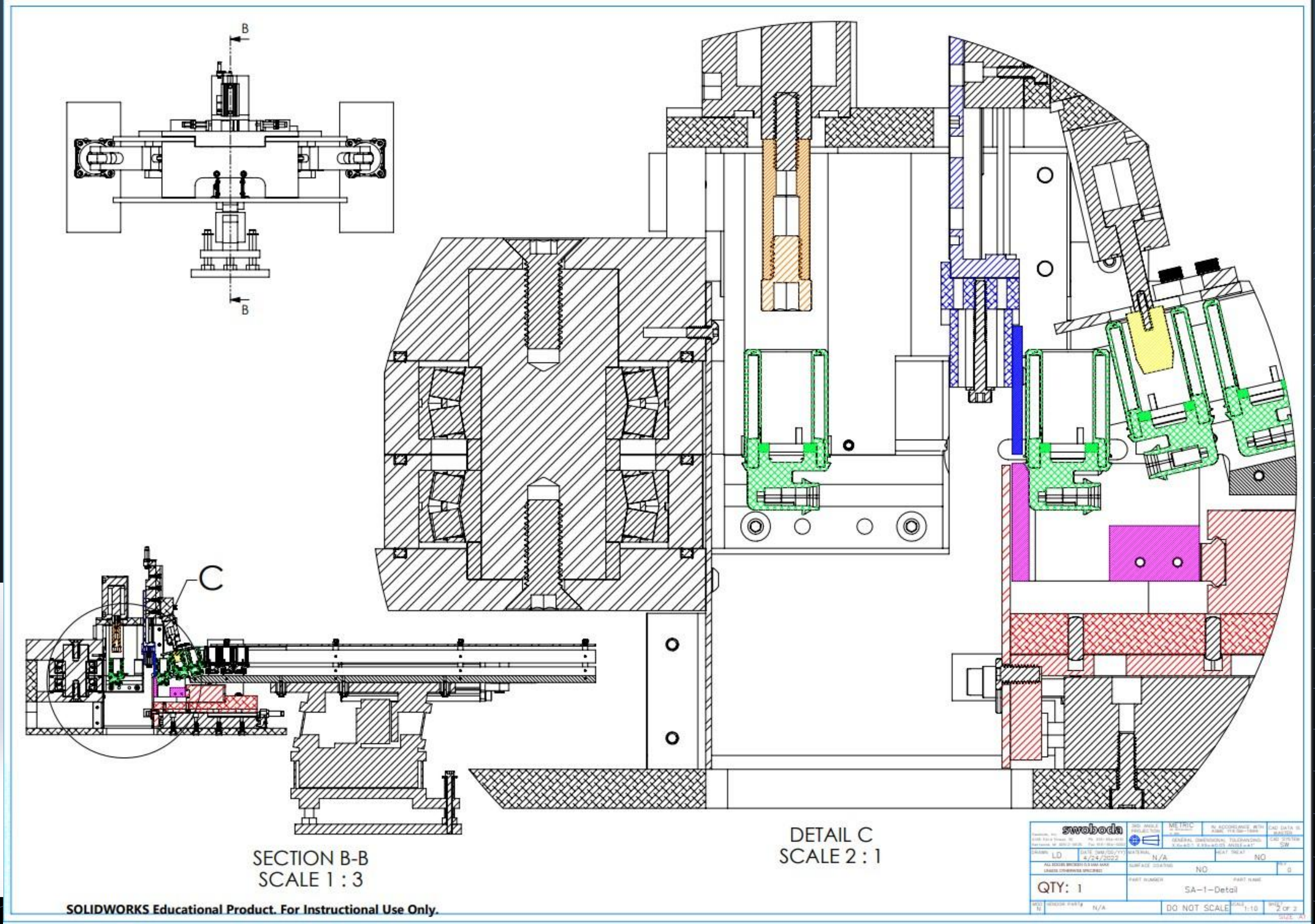
- Integrated into part movement base
- Simple cylinder punch
- Socket Head Cap Screw as punch tip
  - Easily replaceable










B
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C
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DETAIL C
SCALE 2 : 1
swoboda
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DRAWN LD
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SURFACE COATING NO
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SIZE A1
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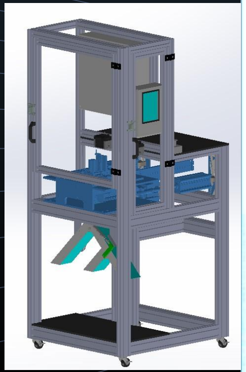
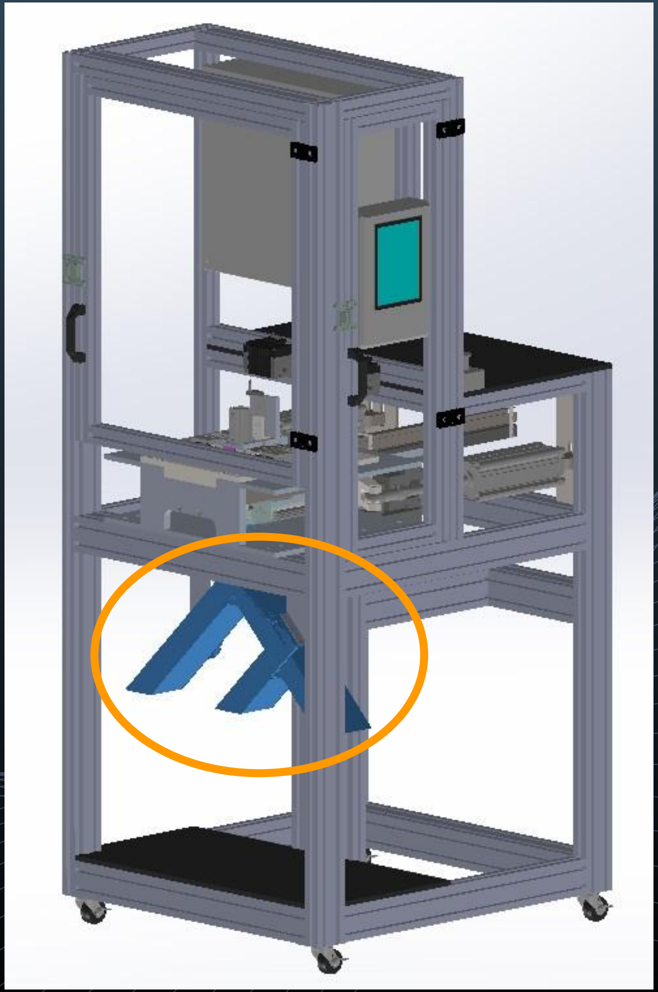
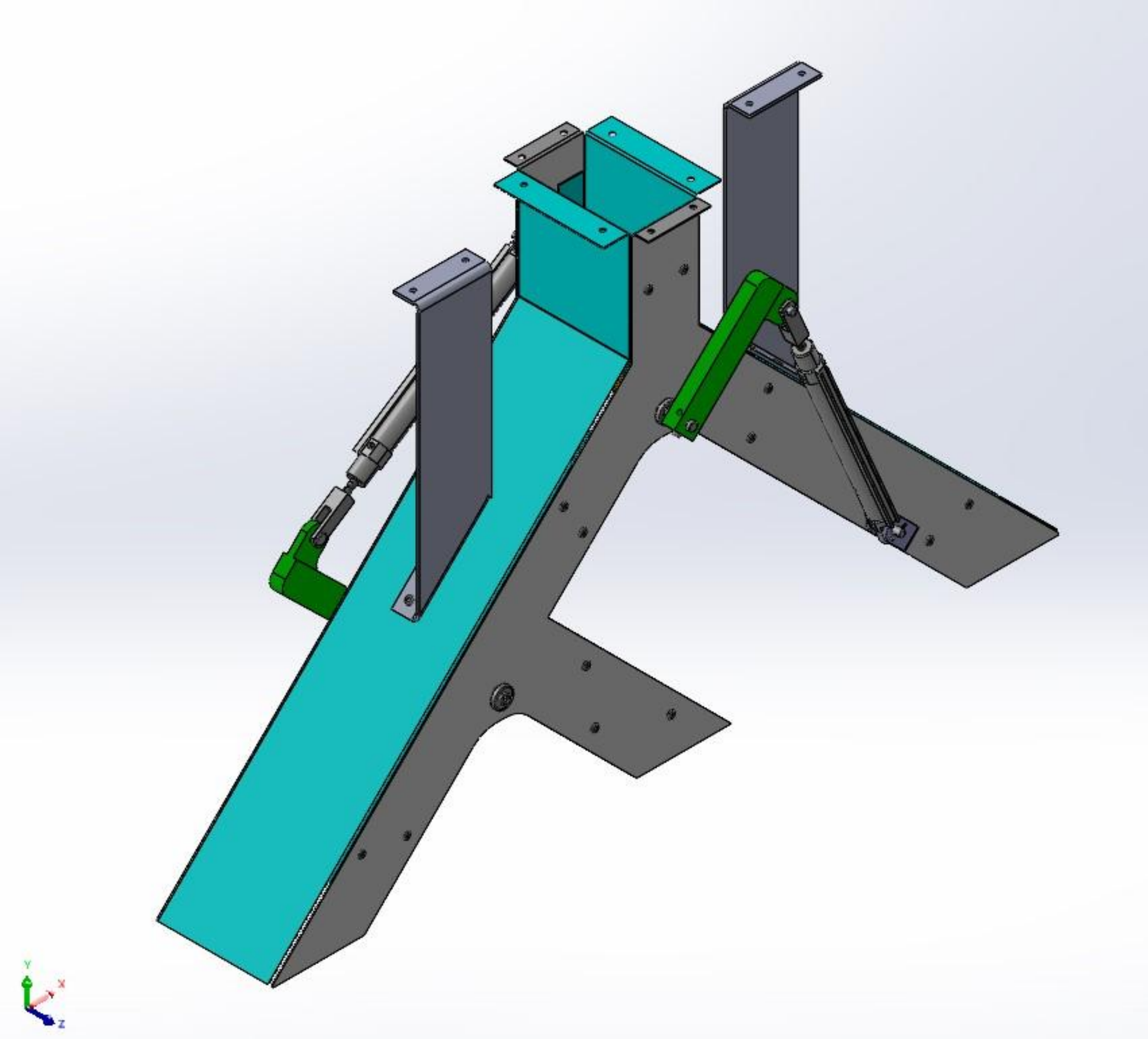


Sorting

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

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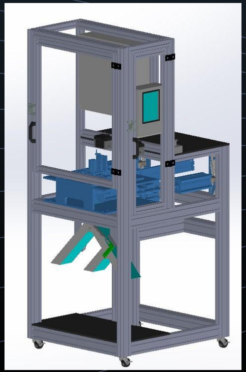
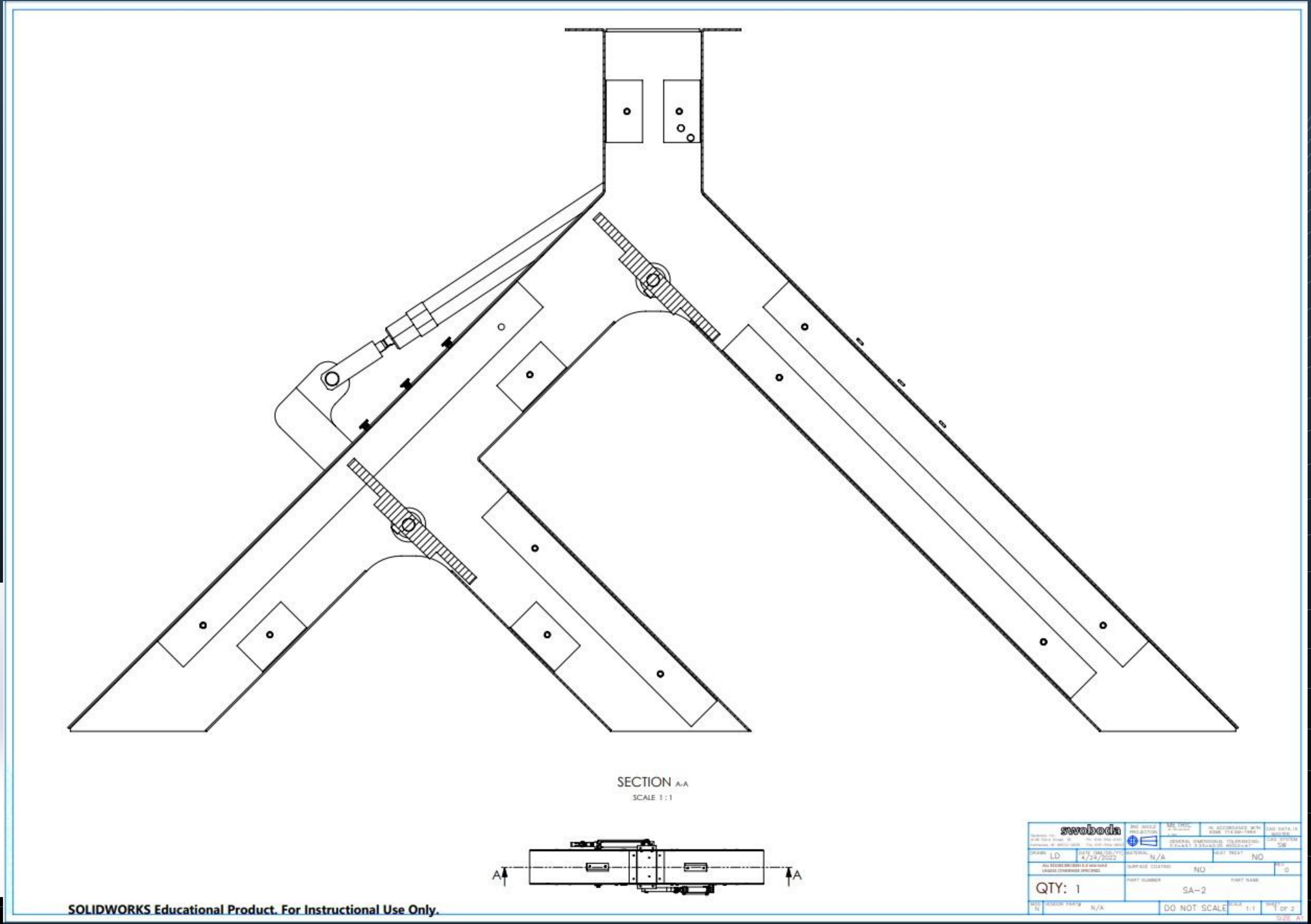
X
Z





SECTION A-A
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swoboda
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4/24/2022
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PART NUMBER
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1:1
1 OF 2
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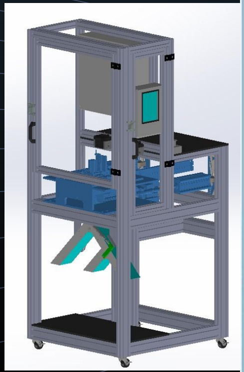
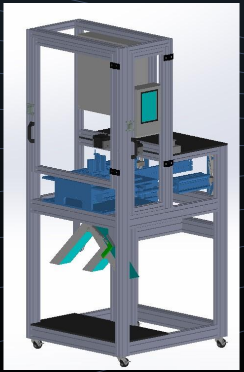
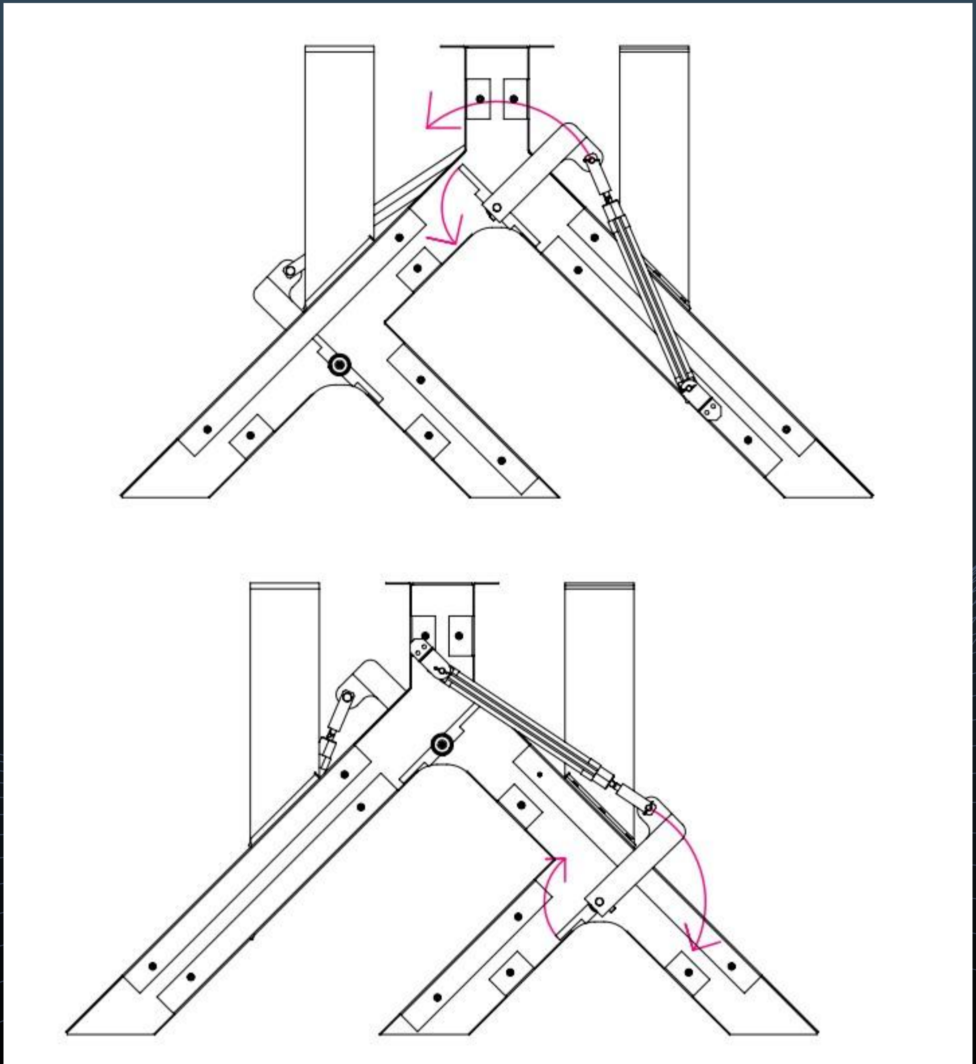
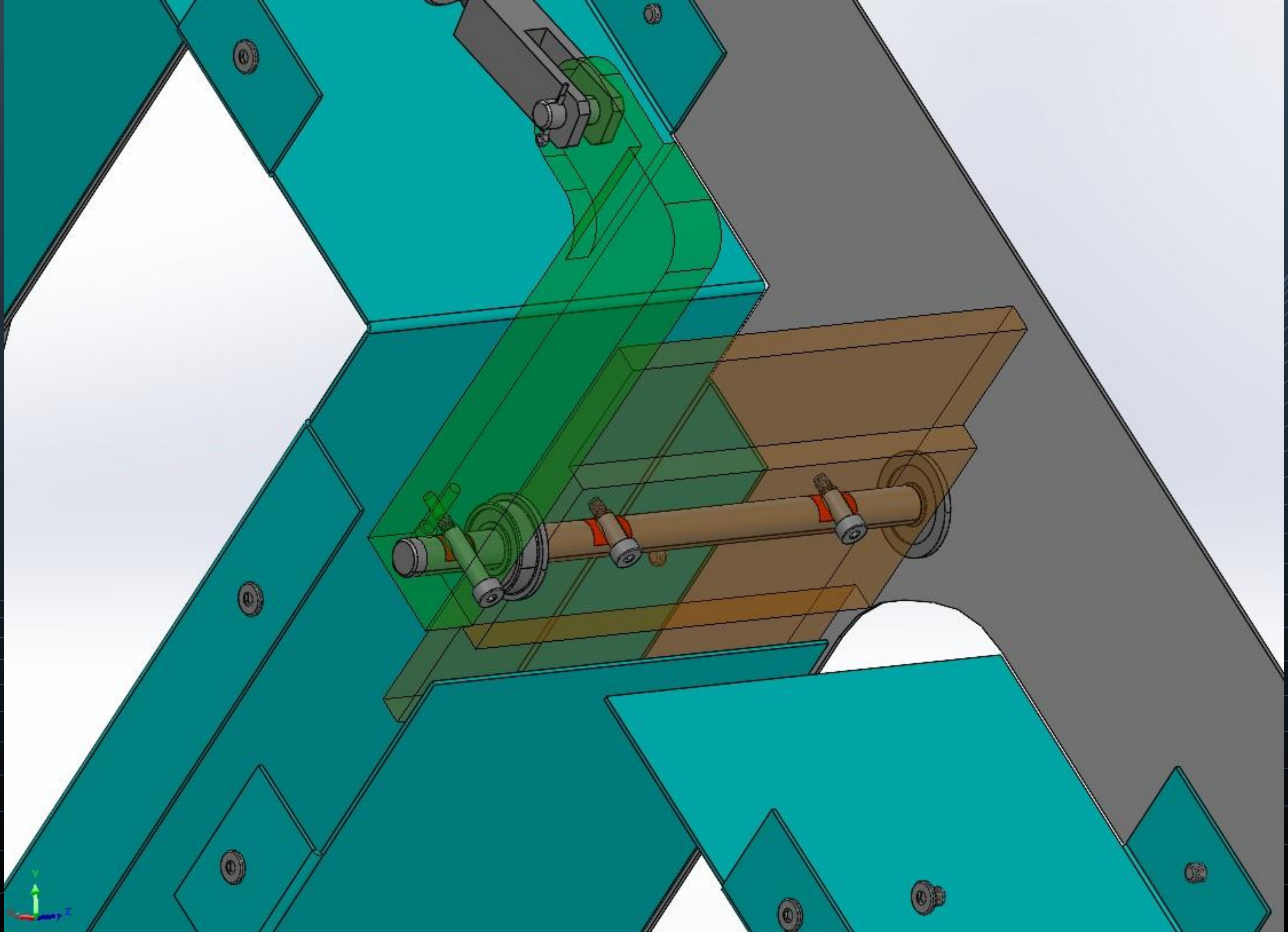
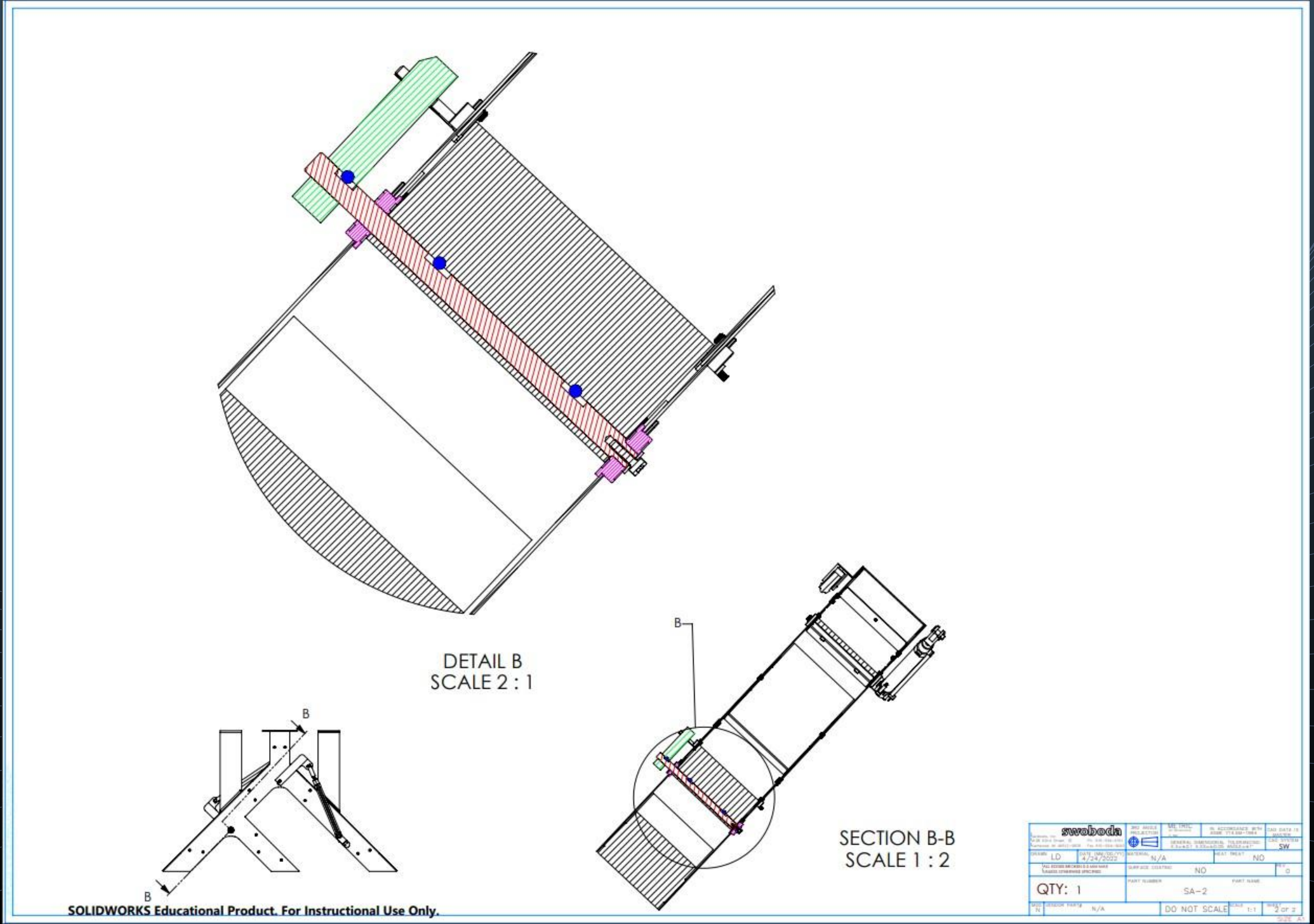




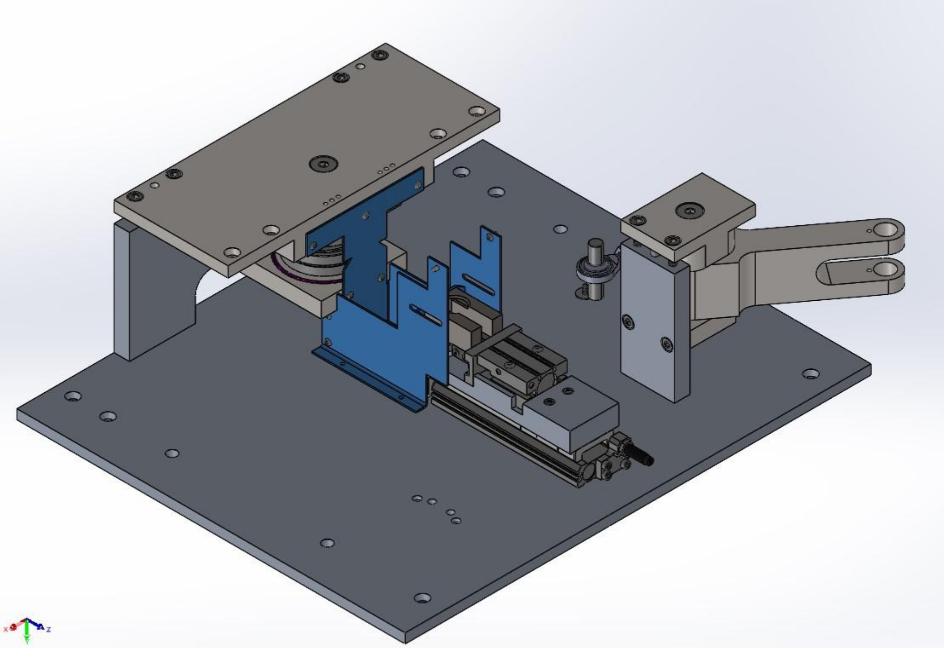


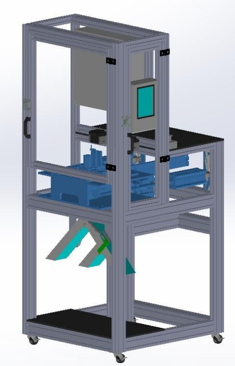


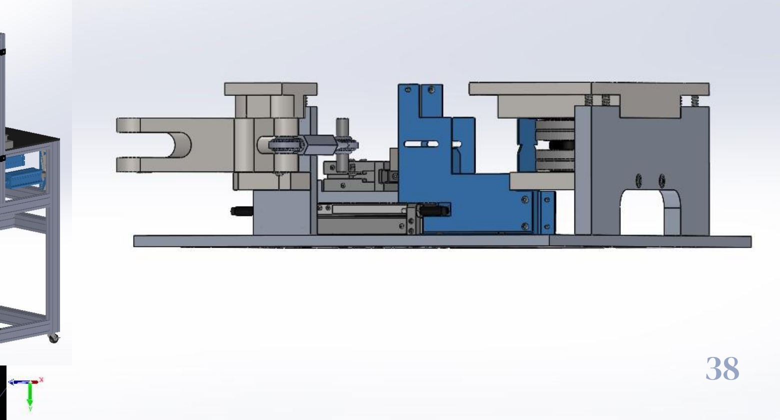

DETAIL B
SCALE 2 : 1
B
B
B
SECTION B-B
SCALE 1 : 2
SOLIDWORKS Educational Product. For Instructional Use Only.
swoboda
DRAWN LD
4/24/2022
MATERIAL N/A
HEAT TREAT NO
SURFACE COATING NO
QTY: 1
SA-2
DO NOT SCALE
1:1
2 OF 2

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





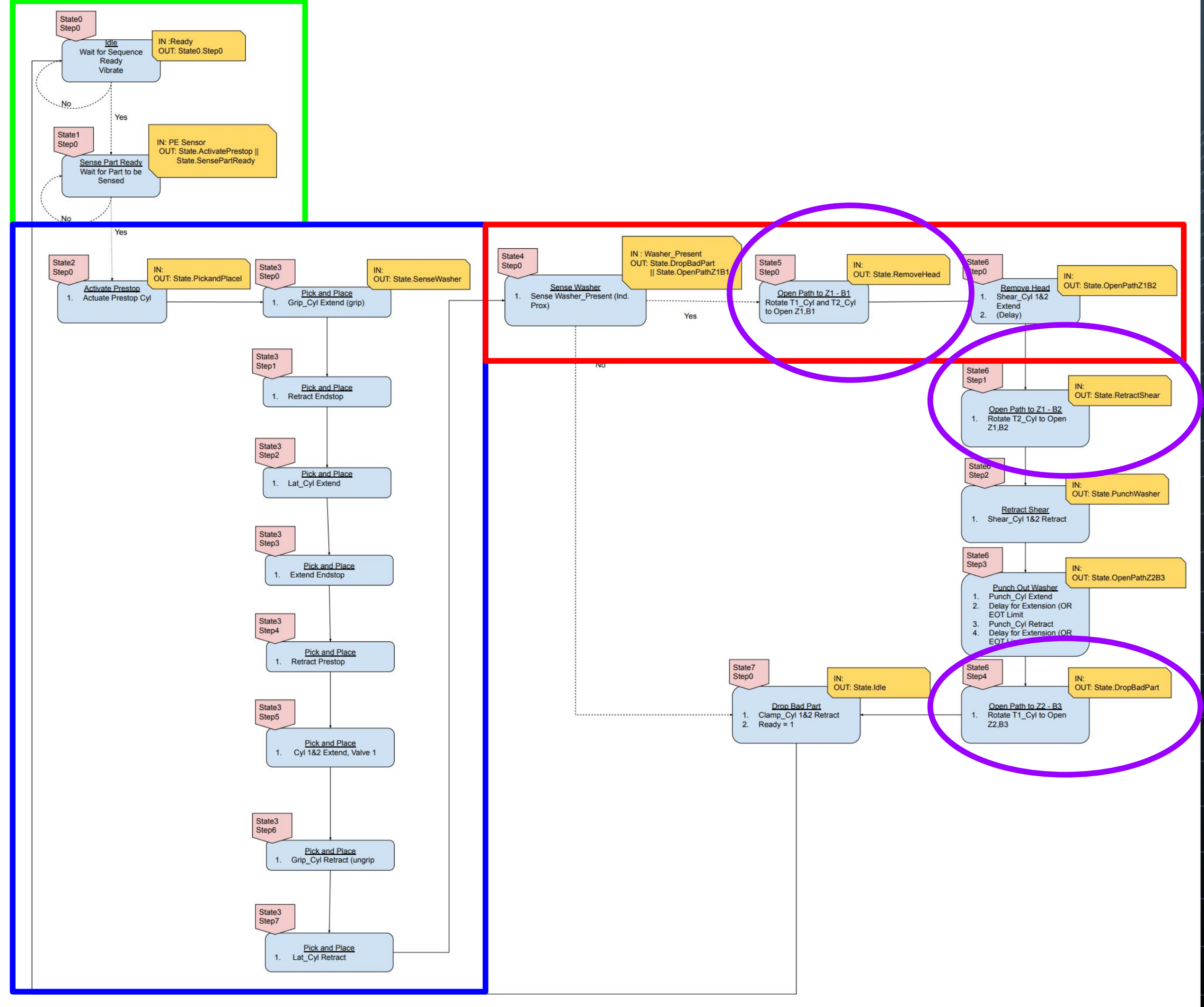


Electrical Aspect

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



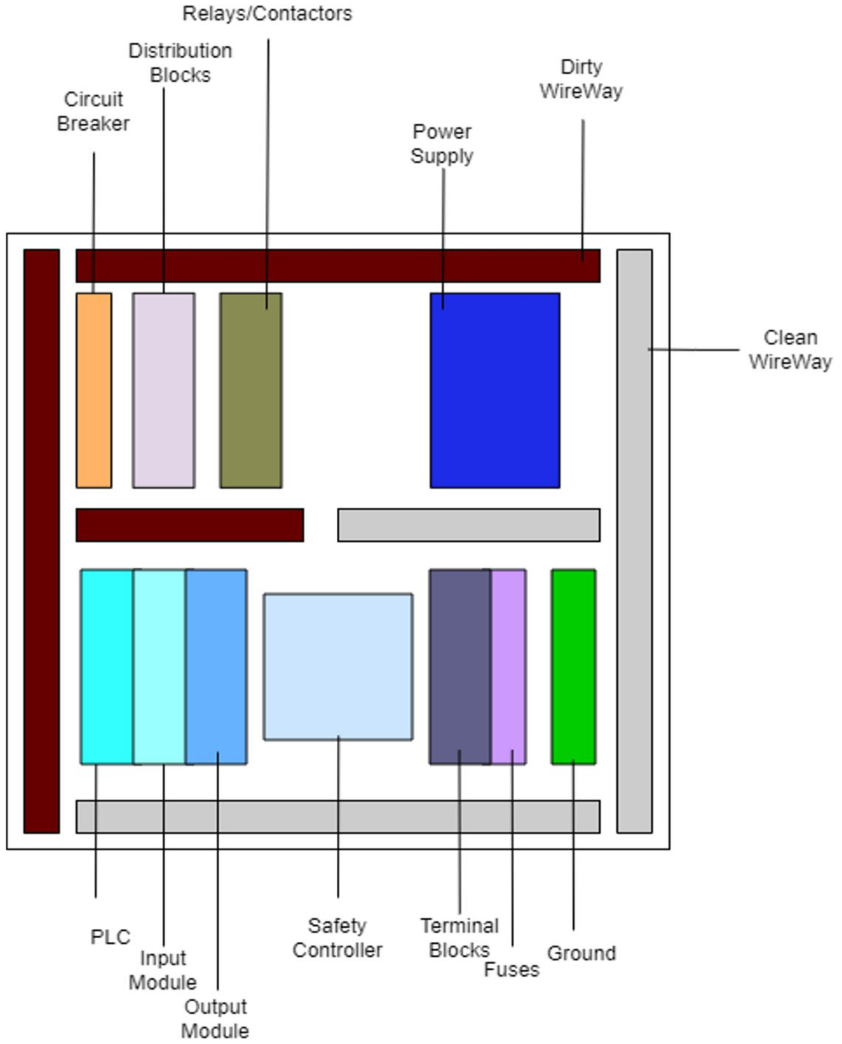
Program Overview

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

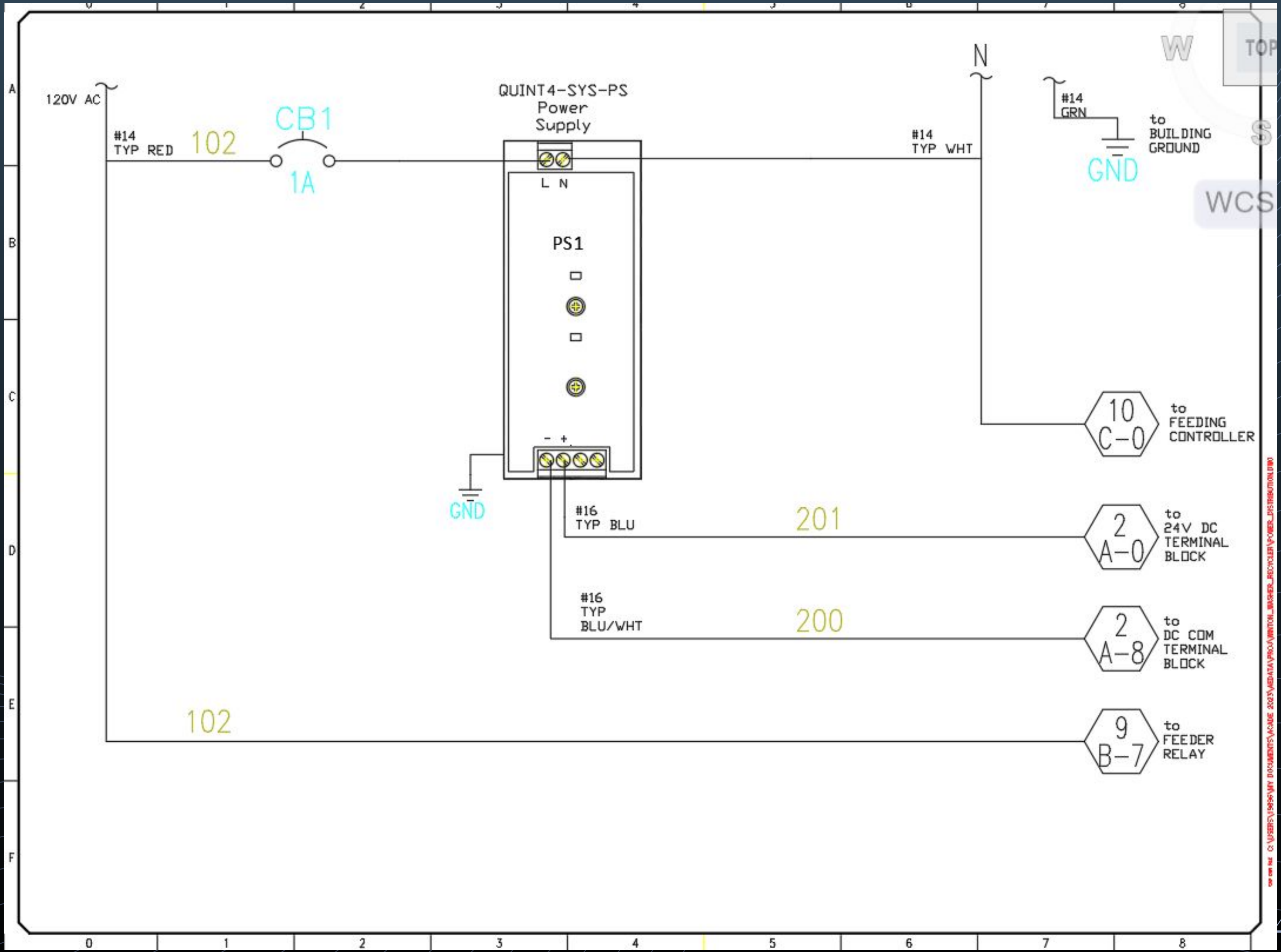
Panel Overview

Approximate Locations for:

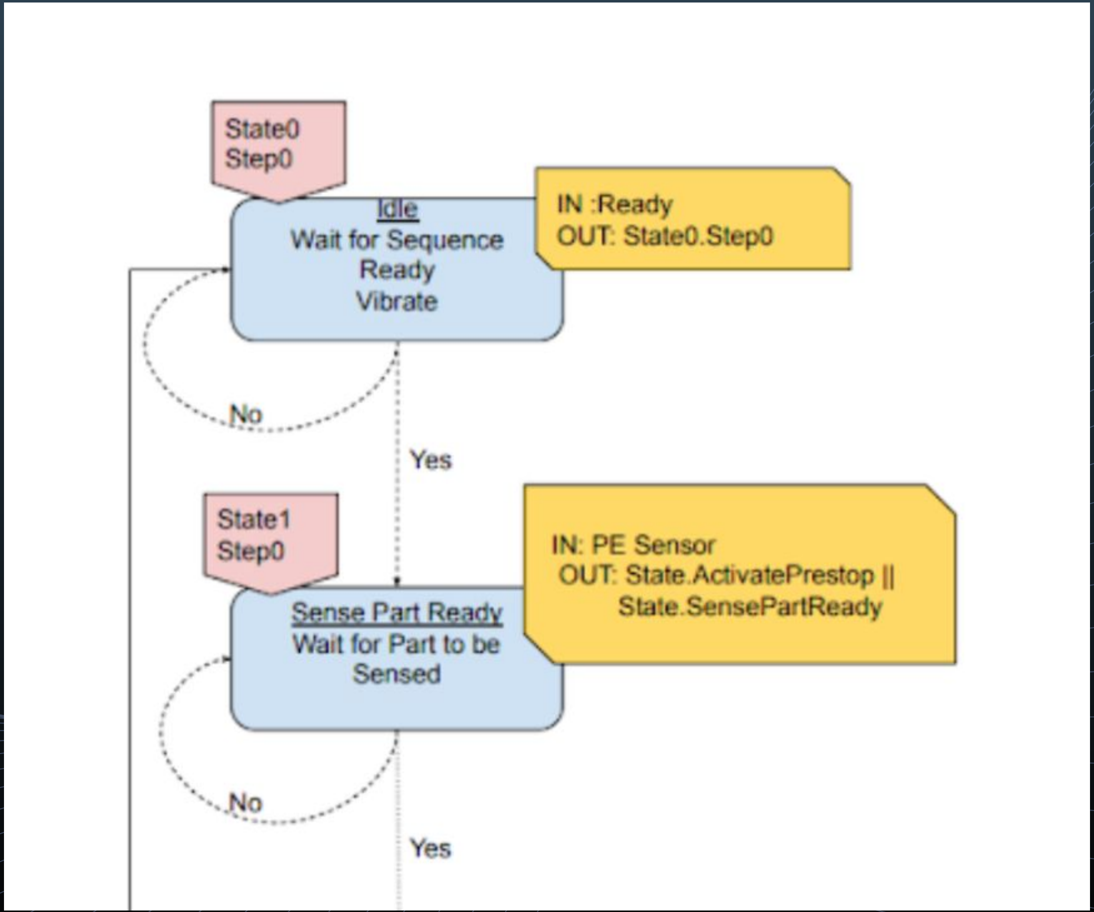
- Circuit Breaker
- Distribution Blocks
- Relays/Contractors
- Power Supply
- PLC
- Input Module
- Output Module
- Safety Controller
- Terminal Blocks
- Fuses
- Ground
- Dirty WireWay
- Clean WireWay

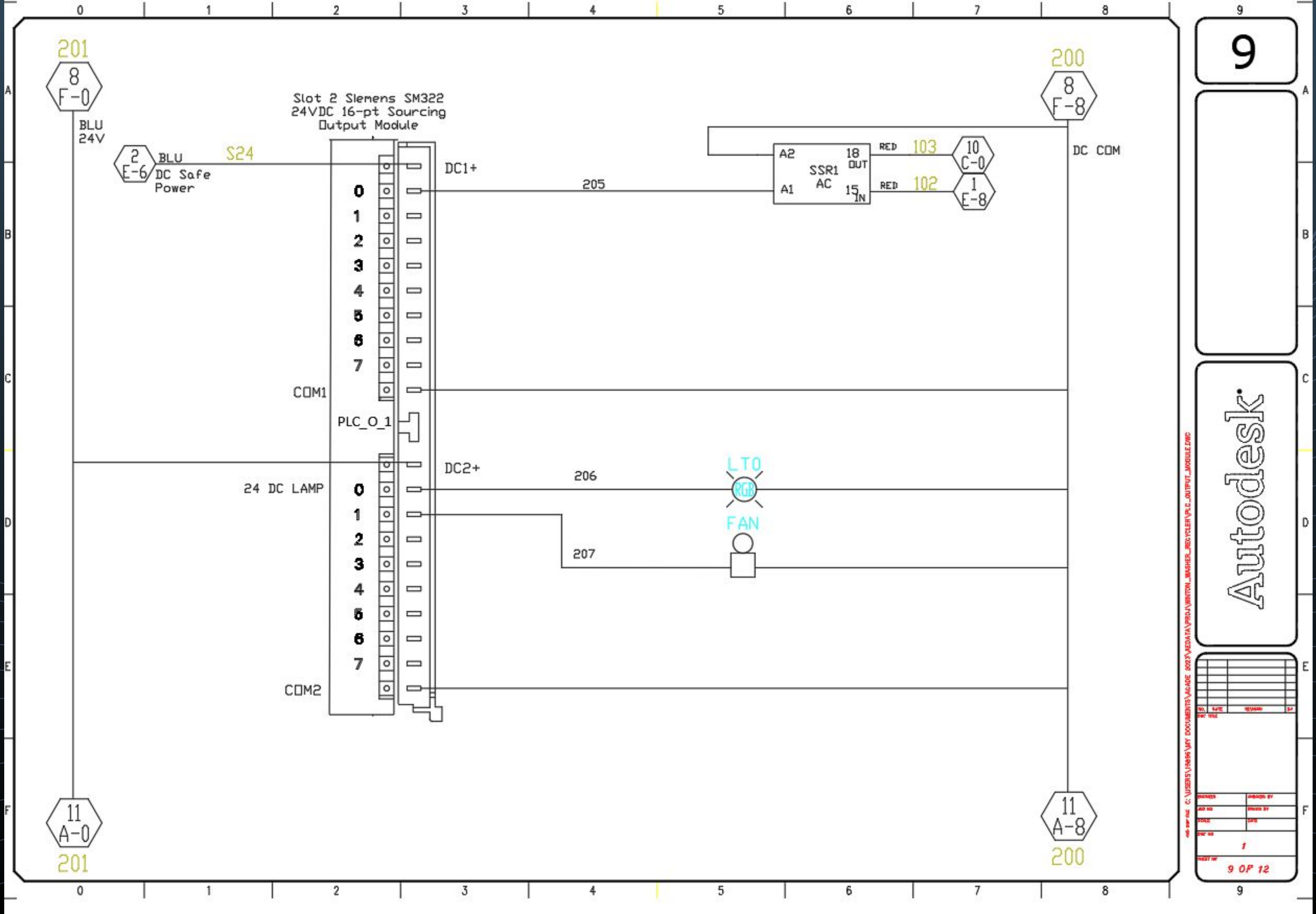


Power Distribution

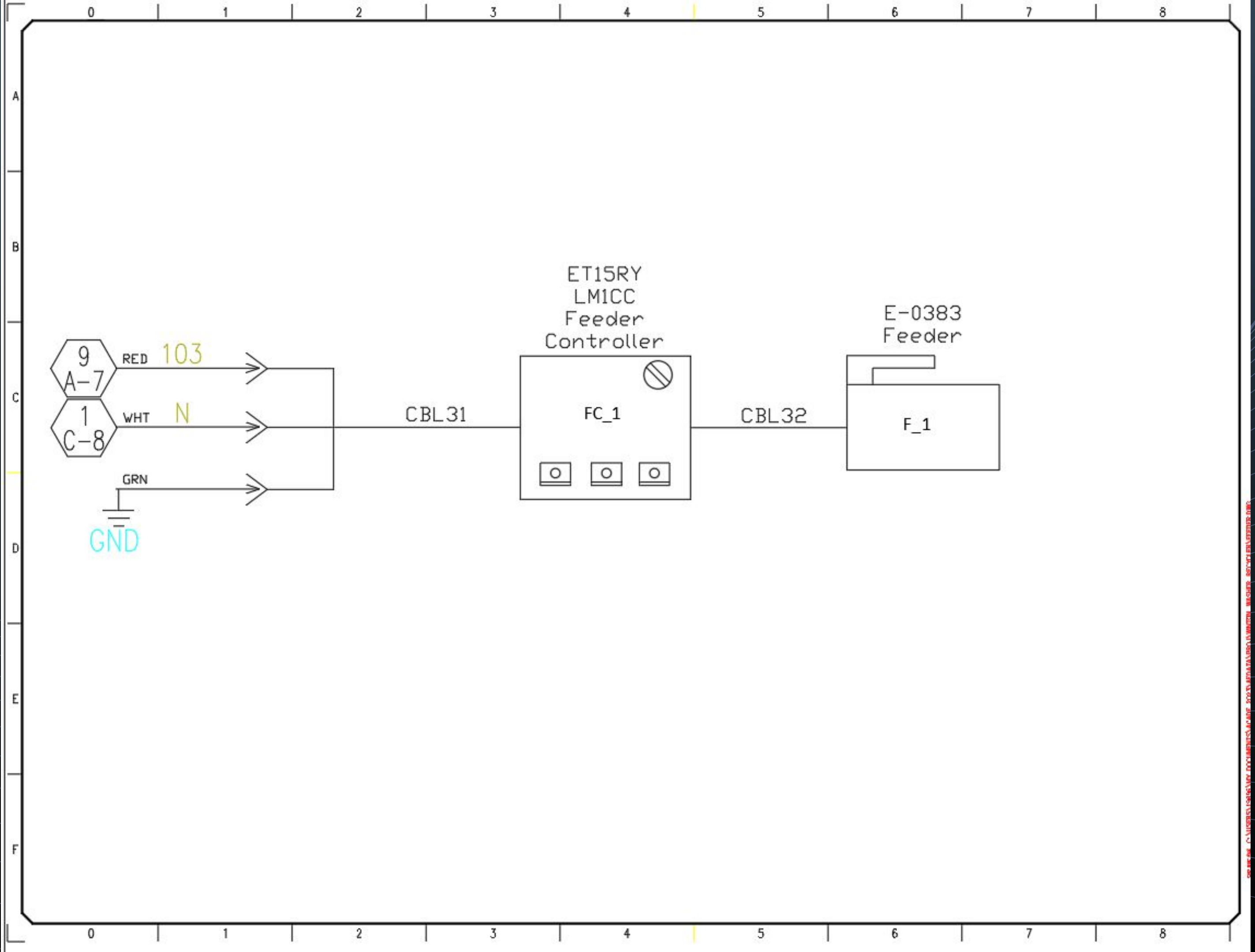


Orienting Part



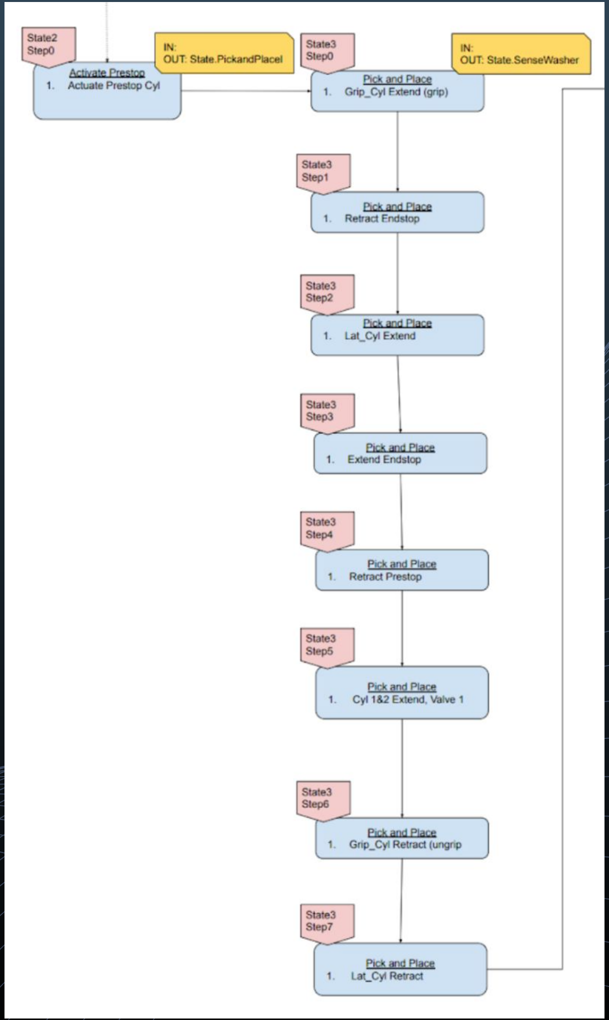


201
8
F-0
BLU
24V
2
E-6
BLU
DC Safe
Power
S24
Slot 2 Siemens SM322
24VDC 16-pt Sourcing
Output Module
DC1+
0
1
2
3
4
5
6
7
COM1
PLC_O_1
DC2+
24 DC LAMP
0
1
2
3
4
5
6
7
COM2
205
A2
A1
SSR1
AC
18
OUT
15
IN
RED
103
10
C-0
RED
102
1
E-8
200
8
F-8
DC COM
206
LT0
RGB
FAN
207
11
A-0
201
11
A-8
200
9
Autodesk
9 OF 12

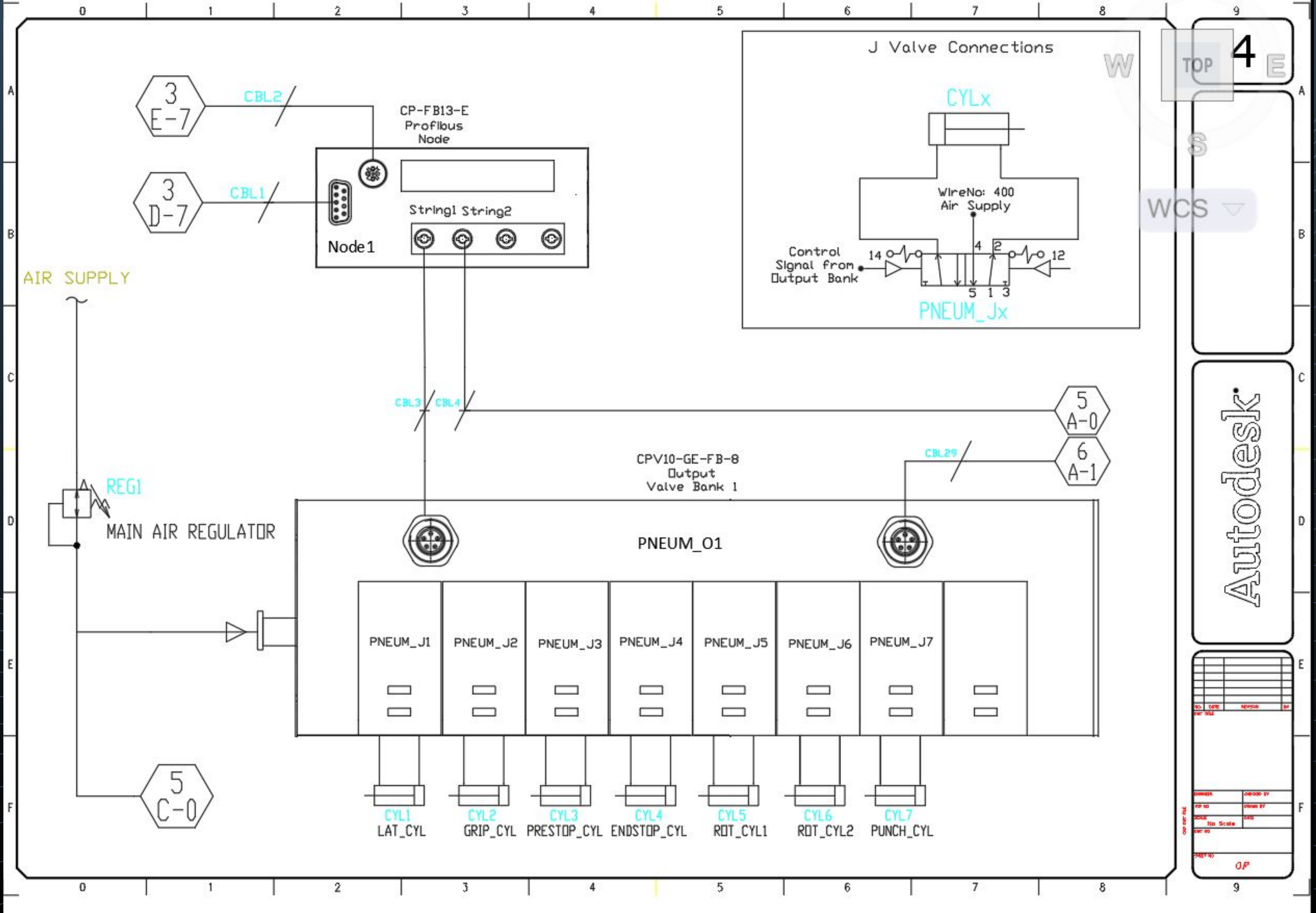


9
A-7
RED
103
1
C-8
WHT
N
GRN
GND
CBL31
ET15RY
LM1CC
Feeder
Controller
FC_1
CBL32
E-0383
Feeder
F_1

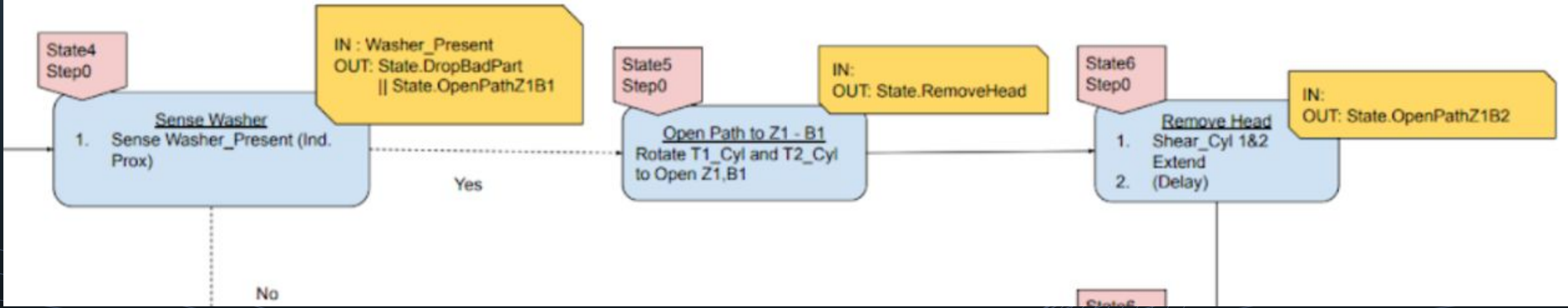
Part Movement



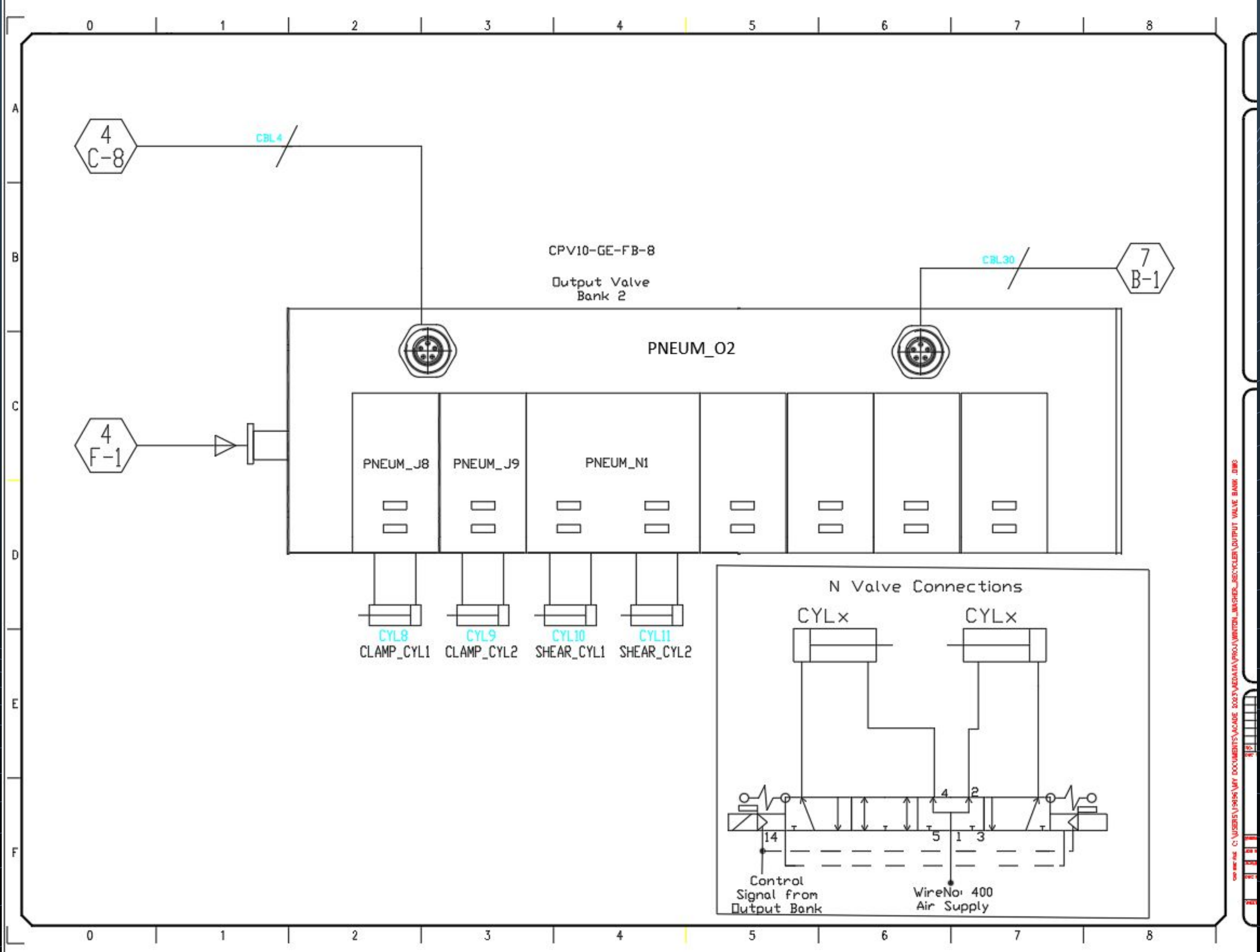
Part Movement



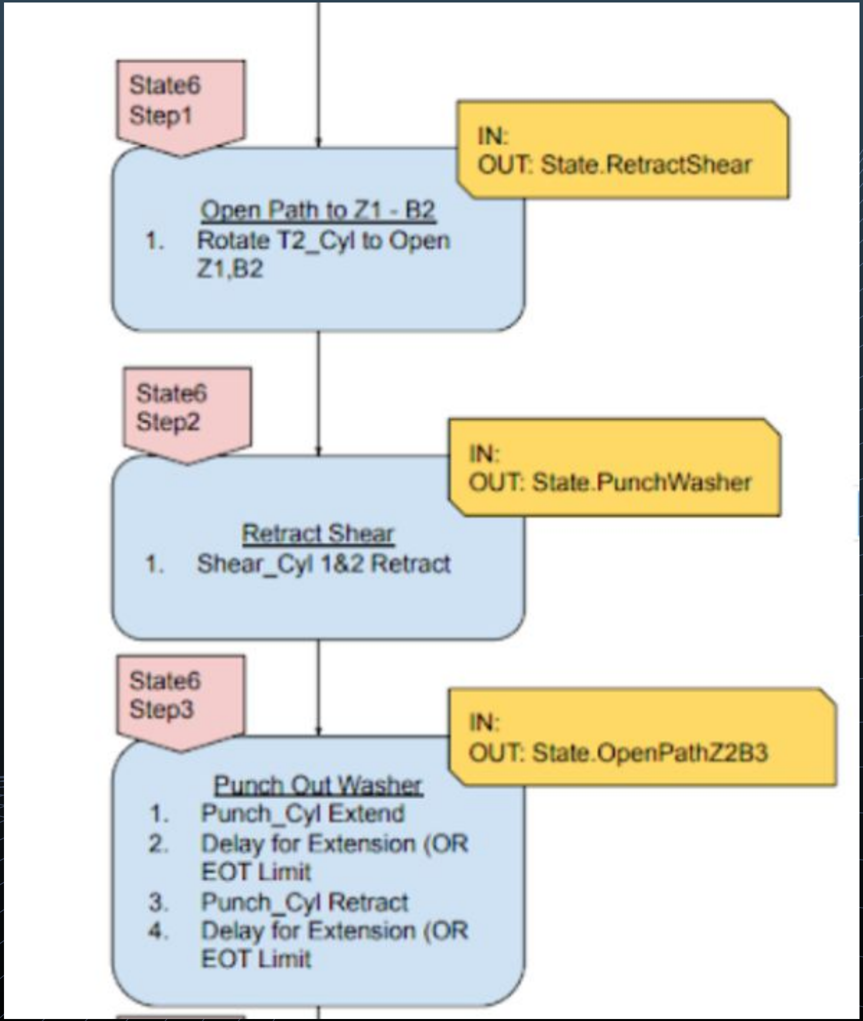
Head Removal



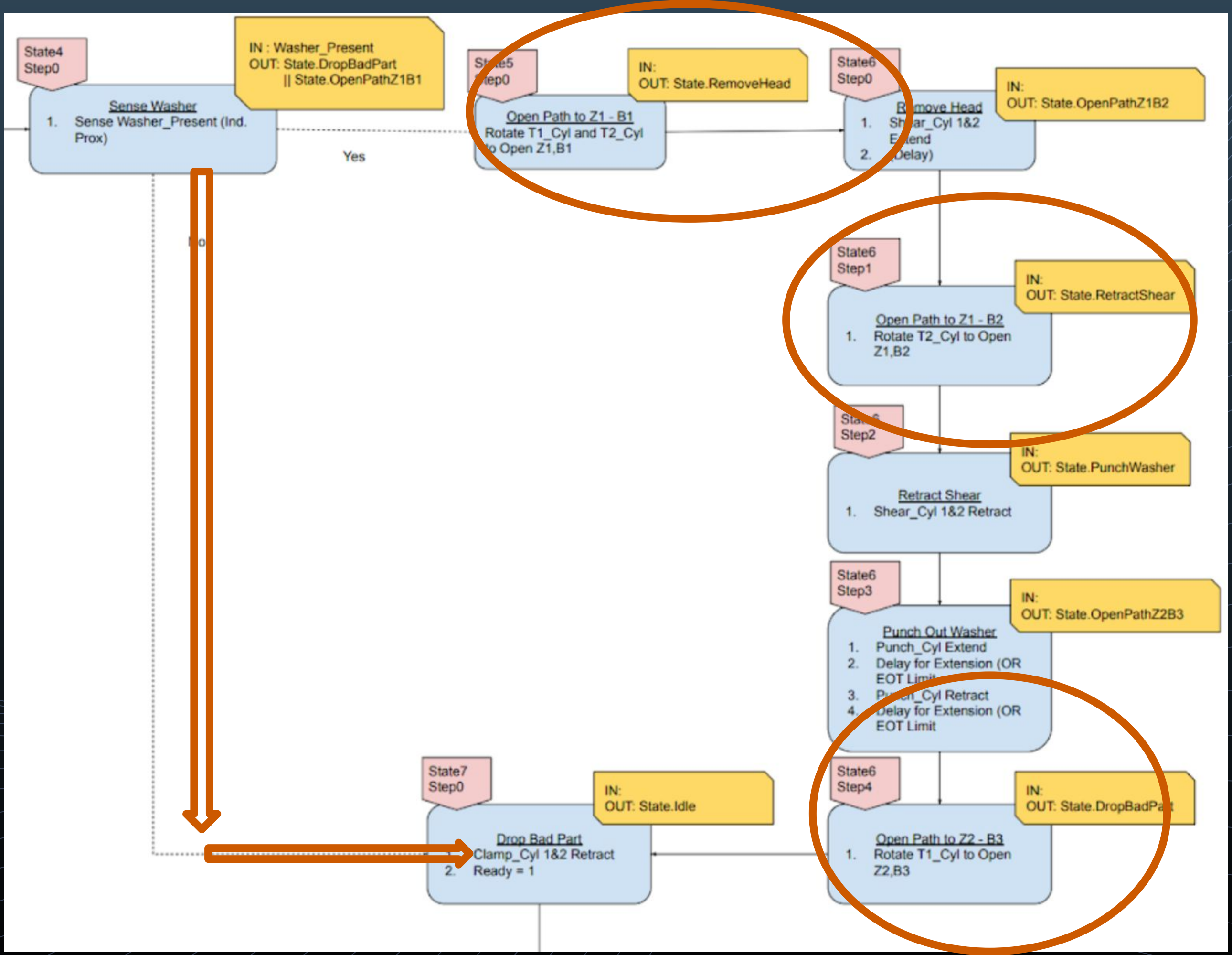
Head Removal



Washer Removal



Sorting



State4 Step0
IN : Washer_Present
OUT: State.DropBadPart || State.OpenPathZ1B1
Sense Washer
1. Sense Washer_Present (Ind. Prox)
Yes
State5 Step0
IN:
OUT: State.RemoveHead
Open Path to Z1 - B1
Rotate T1_Cyl and T2_Cyl to Open Z1,B1
State6 Step0
IN:
OUT: State.OpenPathZ1B2
Remove Head
1. Shear_Cyl 1&2 Extend
2. (Delay)
State6 Step1
IN:
OUT: State.RetractShear
Open Path to Z1 - B2
1. Rotate T2_Cyl to Open Z1,B2
State6 Step2
IN:
OUT: State.PunchWasher
Retract Shear
1. Shear_Cyl 1&2 Retract
State6 Step3
IN:
OUT: State.OpenPathZ2B3
Punch Out Washer
1. Punch_Cyl Extend
2. Delay for Extension (OR EOT Limit
3. Punch_Cyl Retract
4. Delay for Extension (OR EOT Limit
State7 Step0
IN:
OUT: State.Idle
Drop Bad Part
Clamp_Cyl 1&2 Retract
2. Ready = 1
State6 Step4
IN:
OUT: State.DropBadPart
Open Path to Z2 - B3
1. Rotate T1_Cyl to Open Z2,B3

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

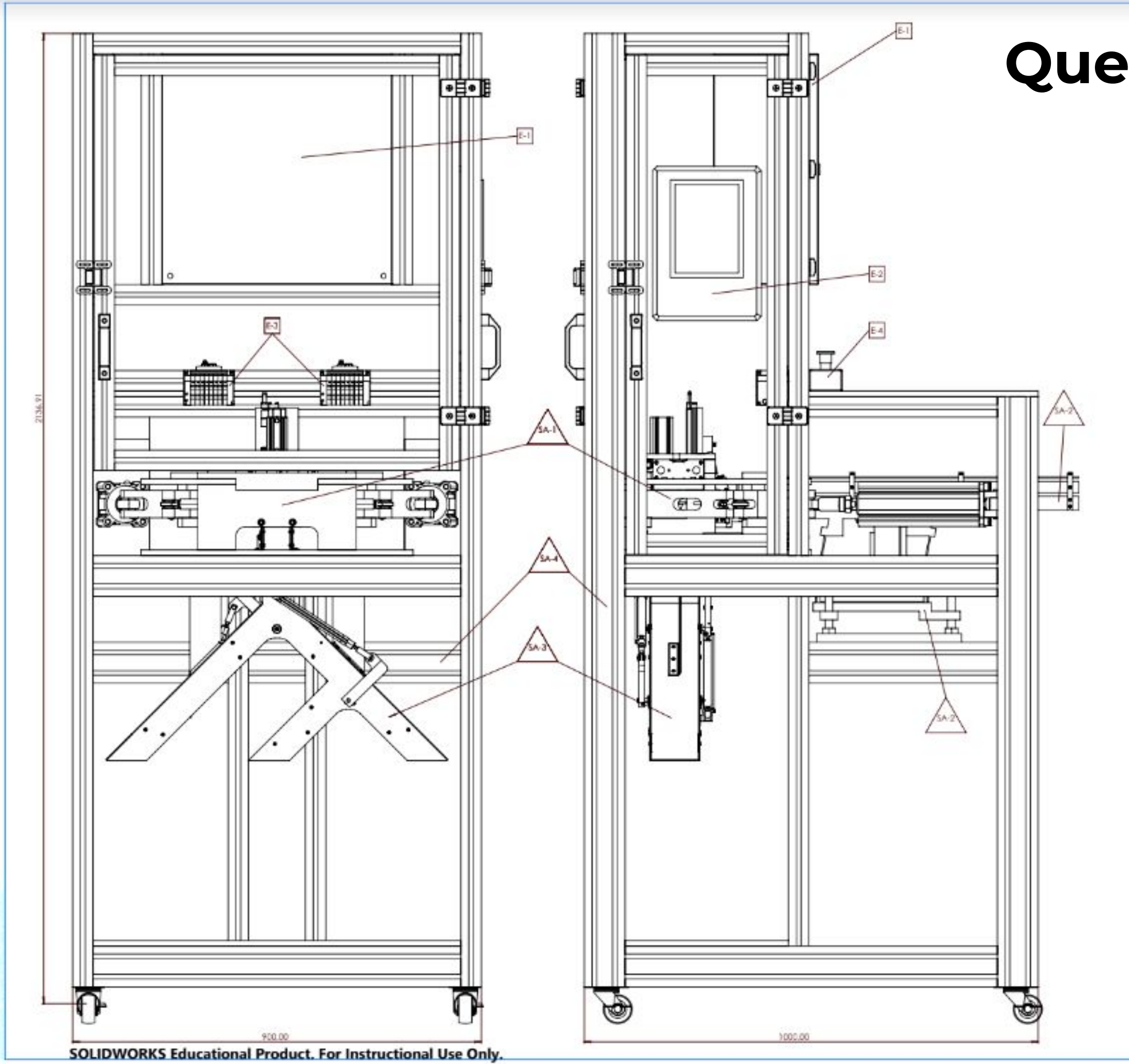
Specifications Summary

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	millimeter s	Sphere test

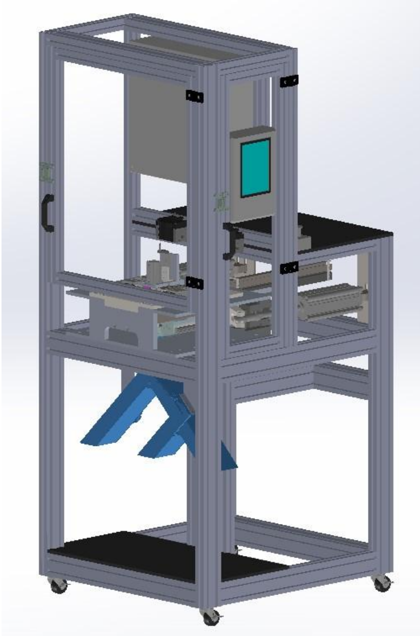
Specifications Summary

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/0 and HMI via ProfiBUS	Required	-	-	Yes/No
Yes	I/0 achieved with Festo CPI valve banks and input blocks	Required	-	-	Yes/No
Yes	PLC Control	Required	-	-	Yes/No

Questions?



BALLON #	PART NUMBER	DESCRIPTION
SA-1	A40-1400-11-010	Sub Ass. Mechanical
SA-2	A40-1400-11-019	Sub Ass. Vibrator and Rail
SA-3	A40-1400-11-030	Sub Ass. Sorting
SA-4	A40-1400-11-020	Sub Ass. Chassis
E-1	N/A	300 x 400 x 200 Enclosure
E-2	N/A	HMI
E-3	N/A	Valve Bank
E-4	N/A	E-Stop



Appendix K - Instruction / Maintenance Manual

Attached next.

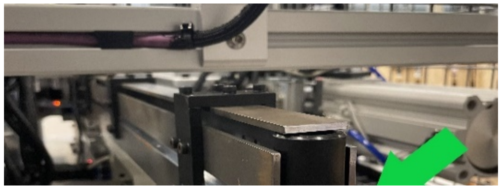
swoboda technologies	Swoboda Operating System	XXXX	
	Instruction List for Winton Washer Recycler	Issue Date: 7/24/22	Rev. Date: 7/24/22
Owner: Lance Deemter		Releaser: Lance Deemter	

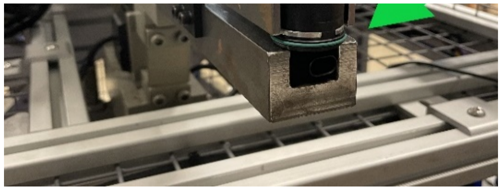
1. Important Documentation
    1.1 For all procedures, forms, and work instructions referenced within this document

2. Safety Notes
    2.1 The user is obliged at all times to operate the equipment/system only with the safety precautions
    2.2 The personell responsible for the equipment/system shall be obliged to ensure all safety measures
    2.3 The equipment may only be maintained, set-up, repaired, etc. by personel

3. Operability
    3.1 When first operating machine
        3.1.1 Machine is connected to eletricity and air supply
            3.1.1.1 Air supply needs to be 8 bar
        3.1.2 All doors are closed
    3.2 Run machine
        3.2.1 Insert part(s) into vibrating rail*

*orientation of part does not matter as long as head is in slotted rail





3.2.2 Follow steps 4 for operator maintainence

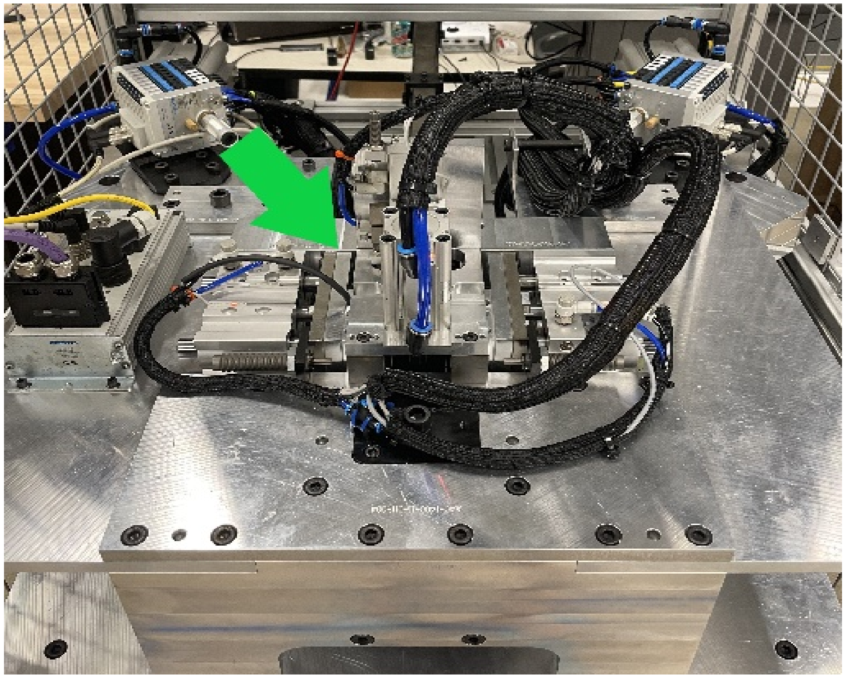
3.3 Empty bins when full

4. Complete Disassembly

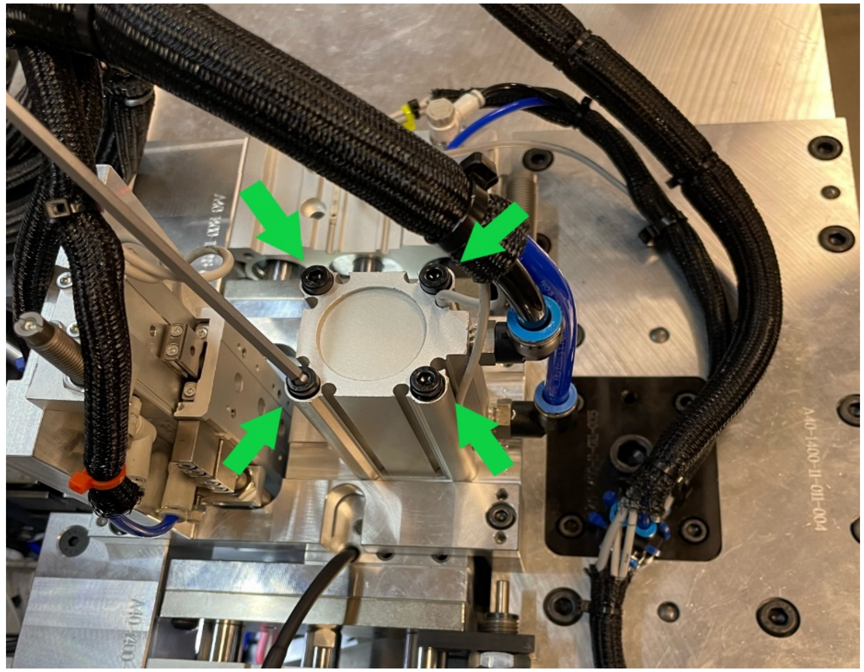
E-STOP IS PRESSED, AIR IS OFF

4.1 Remove washer removal base

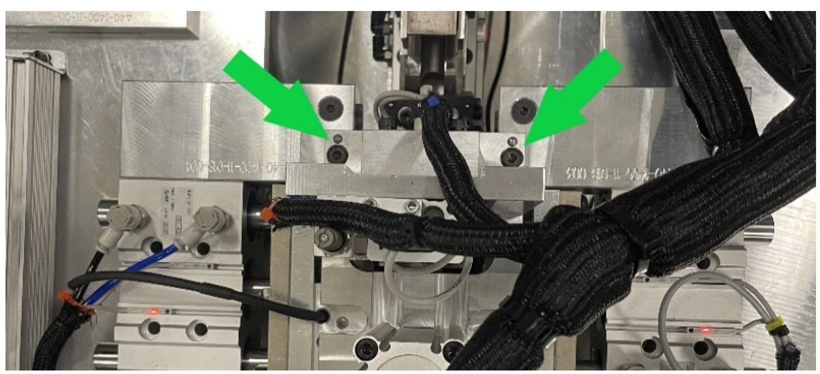
4.1.1 Open rear door for access to top / hole punch mechanism

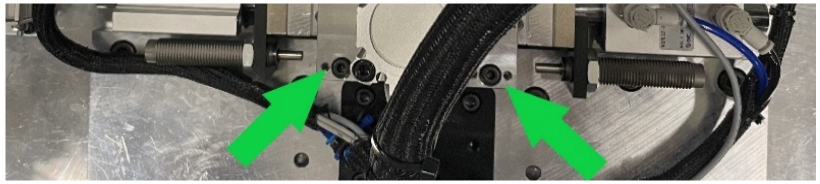


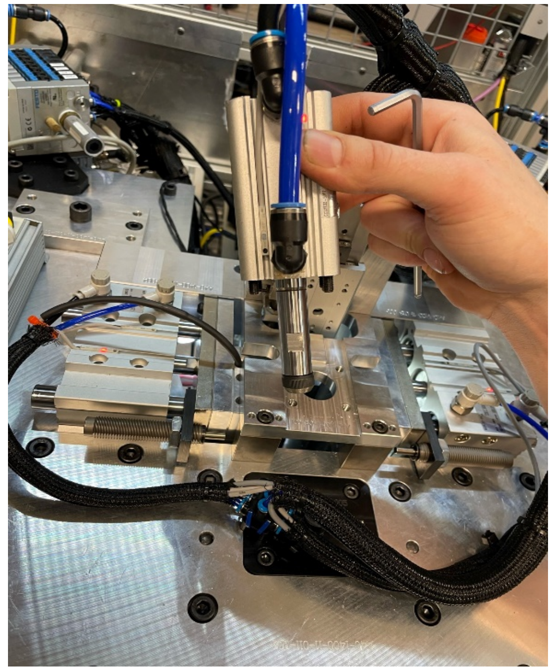
4.1.2 Remove 4, 4mm M5 bolt screws on top of cylinder



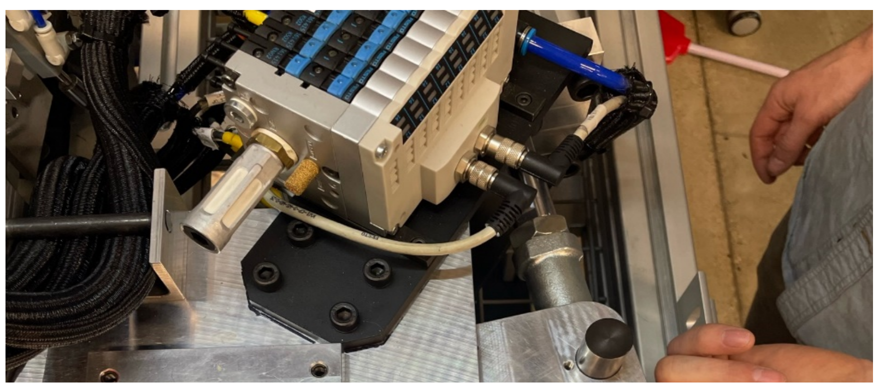
4.1.3 Remove 4 5mm bolts using an M4 alan key

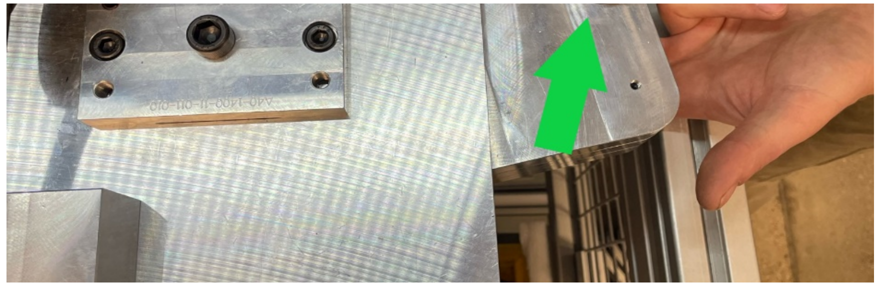




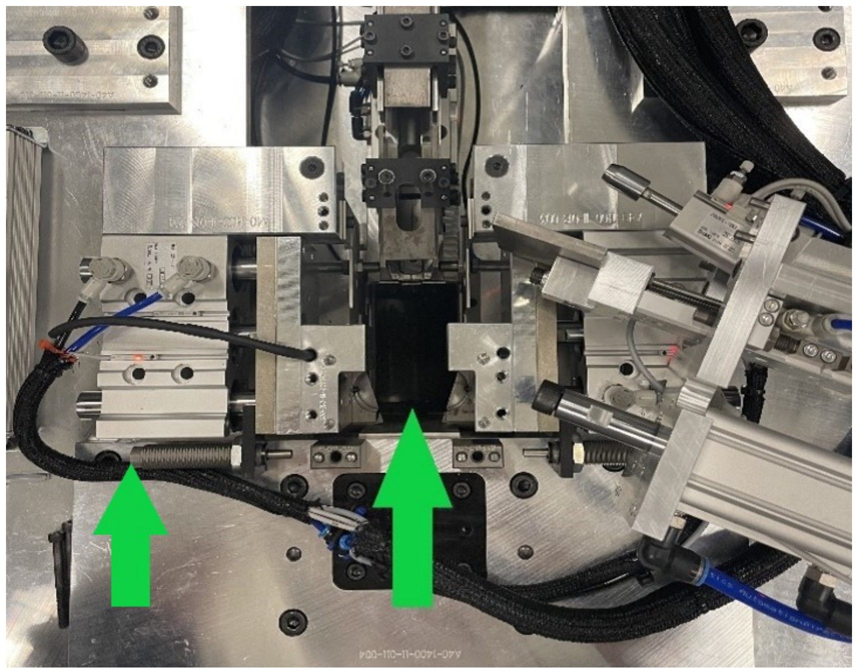


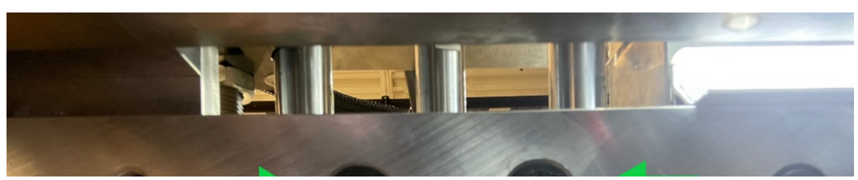
4.2 Remove shear arm pin

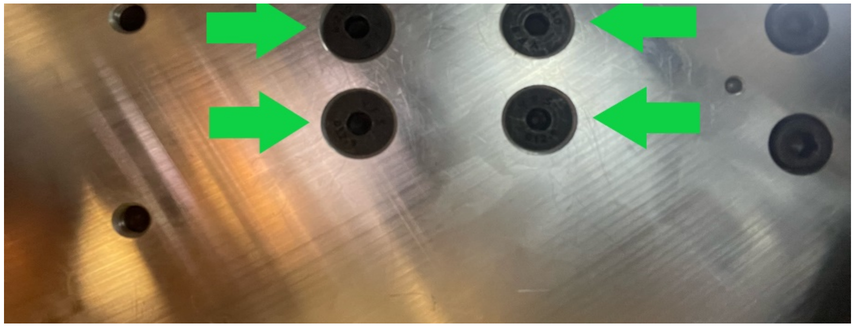




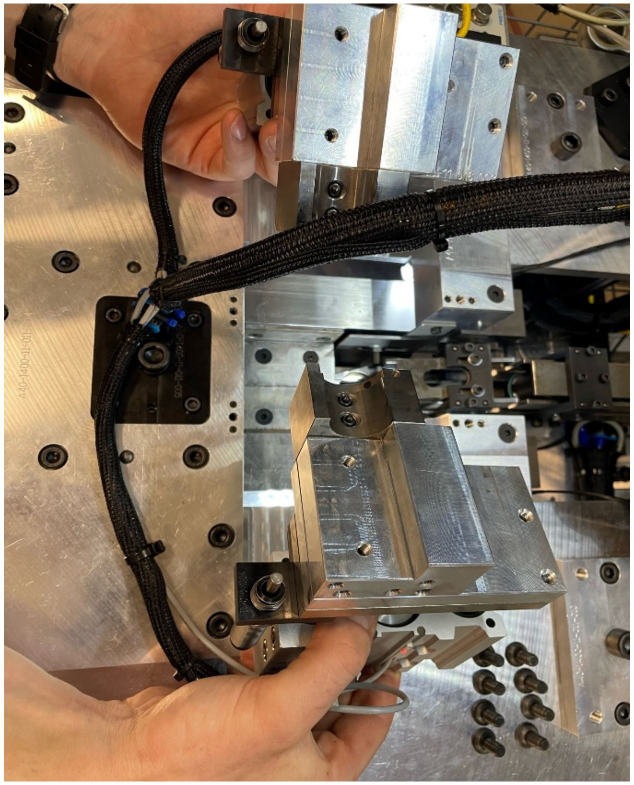
4.3 Remove 4 5mm, M8 screws undermeath shear cylinders to remove clamps



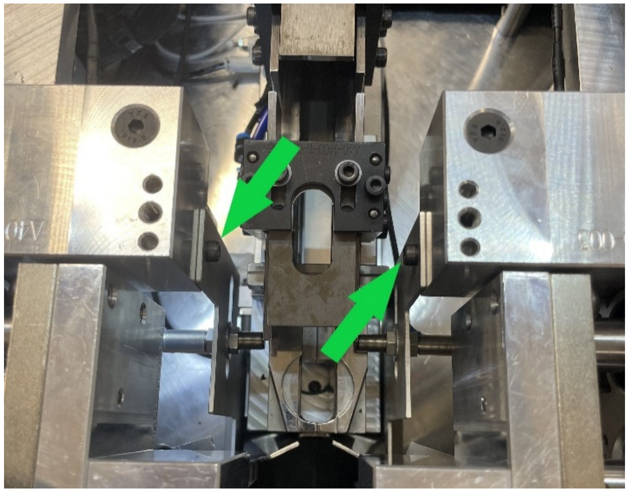




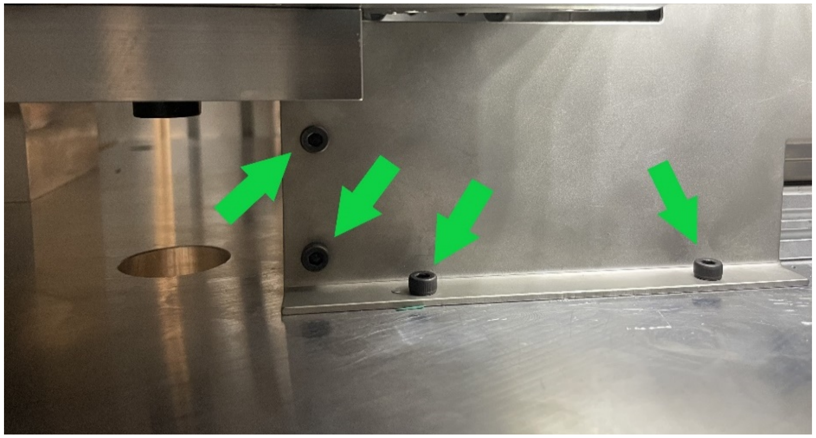
4.3.1 Remove Clamps



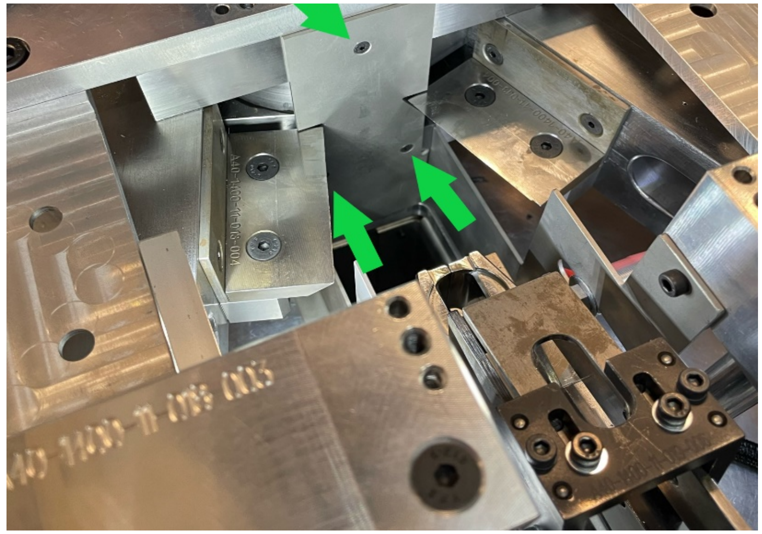
4.4 Remove 2 3mm screws on shrapnel shroud from inside



4.4.1 Remove 4 3mm bolts on shrapnel shroud from outside

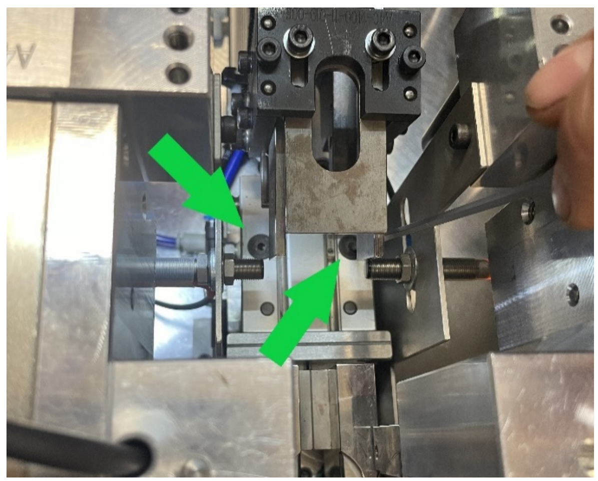


4.4.2 Remove Middle shroud 3 2mm, M2 bolts

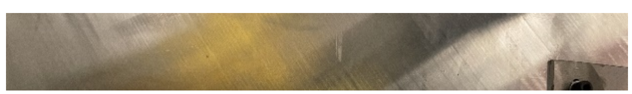


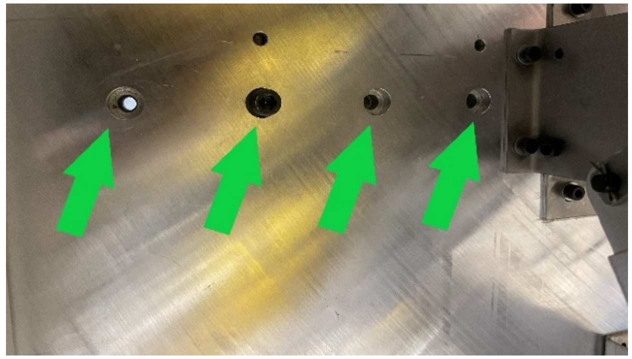
4.4.3 Remove lateral transfer

Remove 2 3mm bolts on top of cylinder



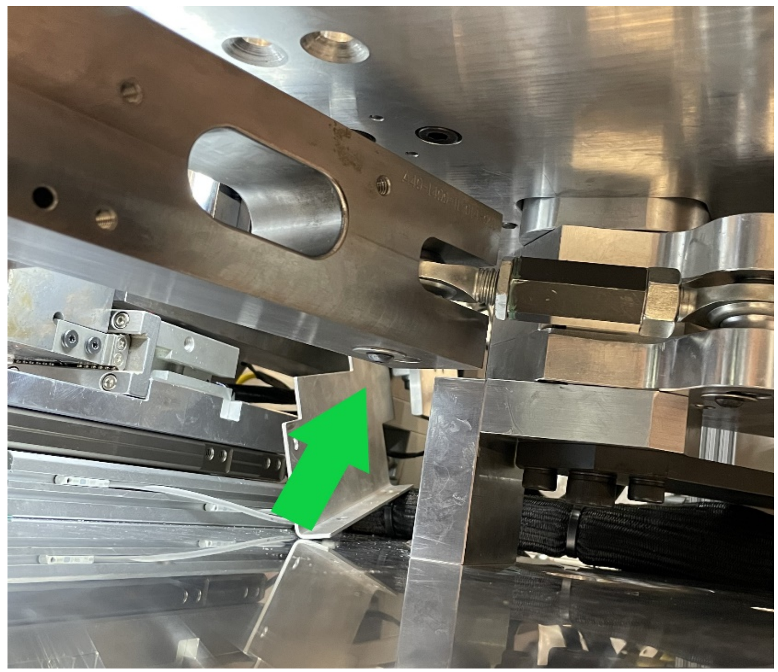
4.4.4 Remove 4 bottom 5mm bolts on bottom



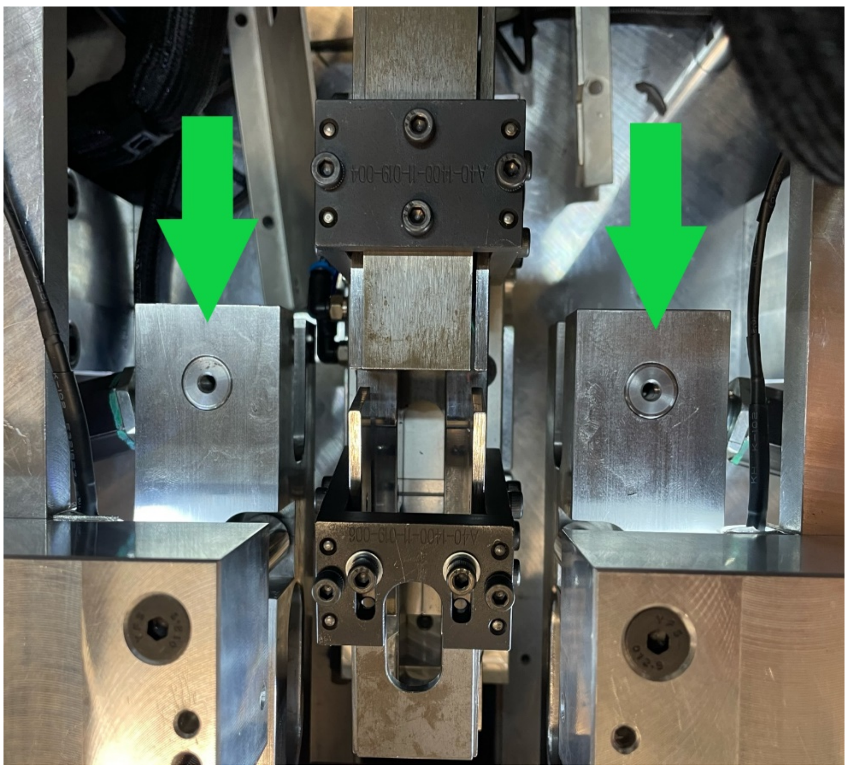


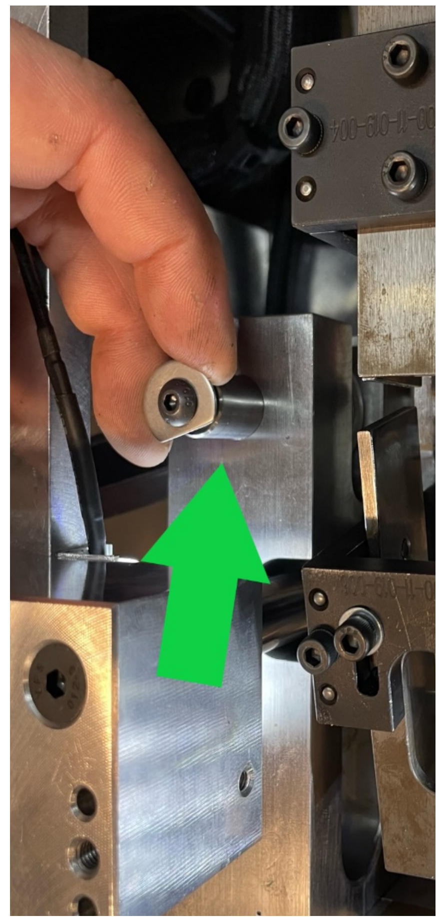
4.5 Remove shear arm pins

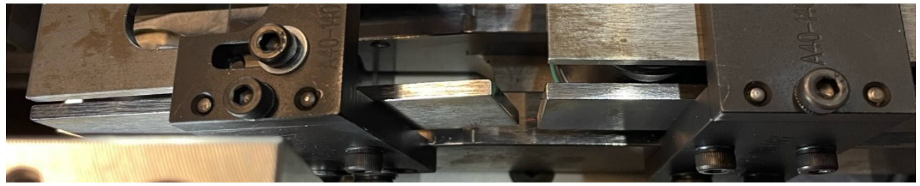
4.5.1 Remove M5 button head cap screw under shear arm



4.5.2 Attach screw from step 4.5.1 and pull out pins

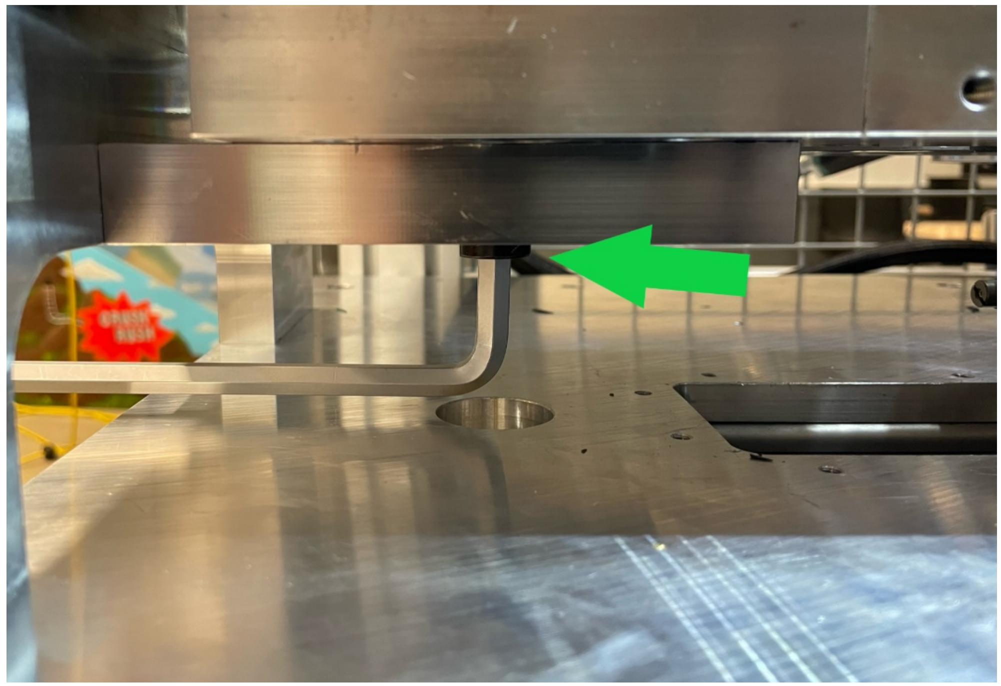




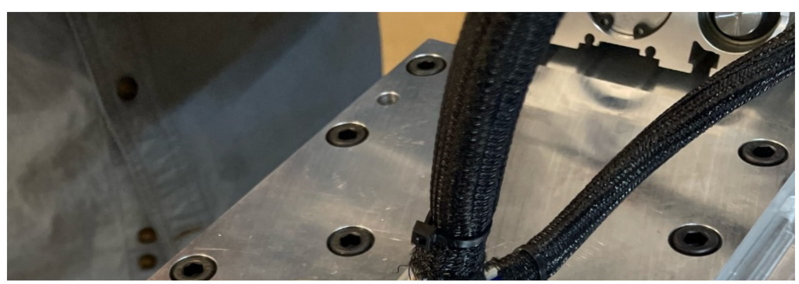


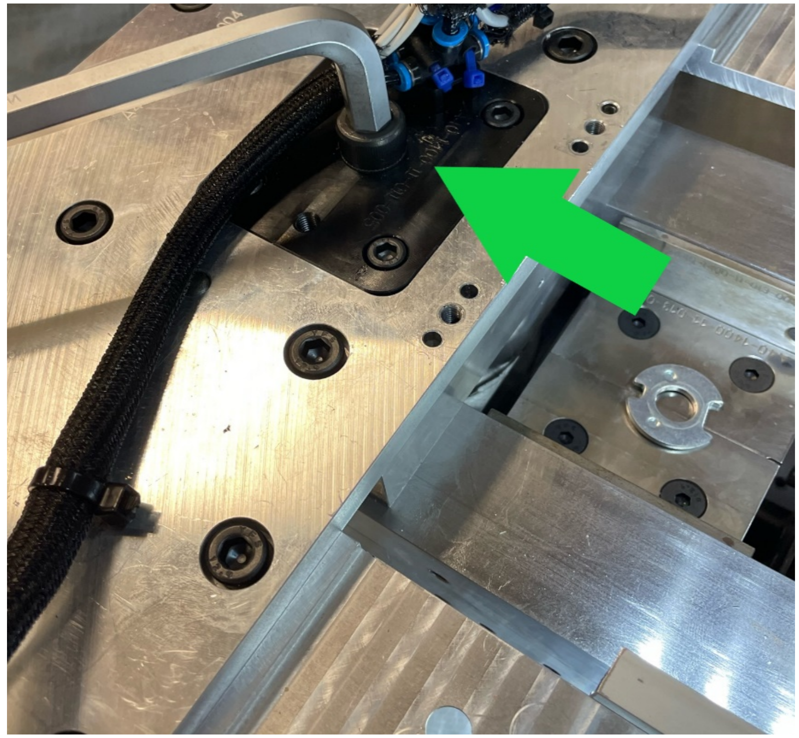
4.6 Remove Shear Arms

4.6.1 Remove lower shear arm shaft bolt by just loosening lower M8 8mm bolt

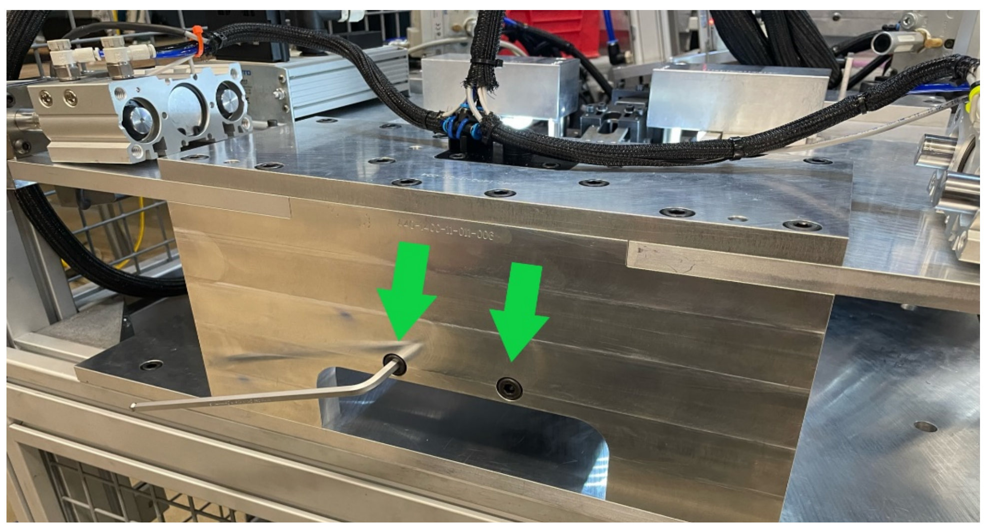


4.6.2 Remove upper shear arm shaft bolt by just loosening upper M10 8mm bolt

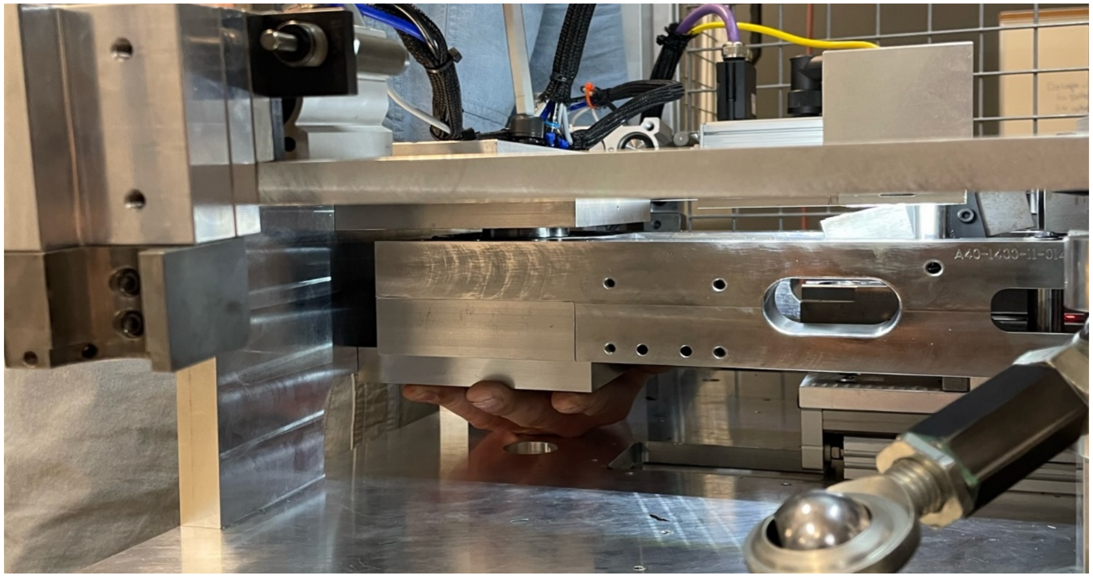


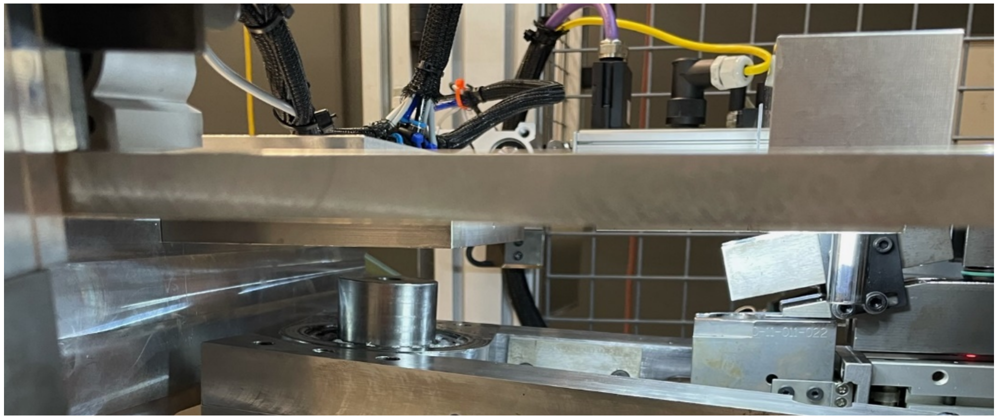


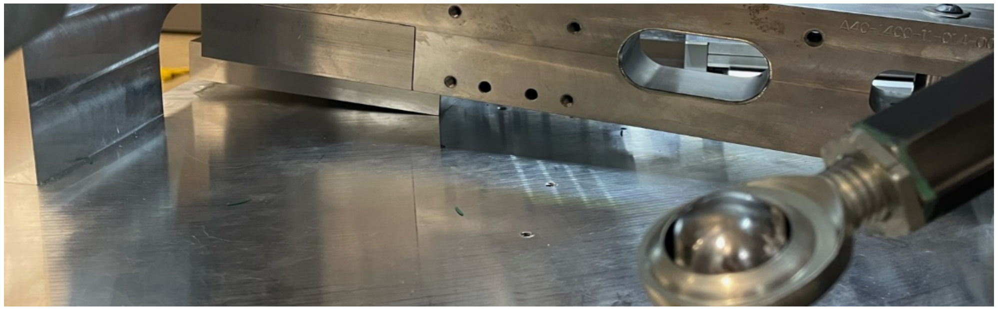
4.6.3 Remove



4.6.4 By loosening and removing the upper shear arm bolt from step 4.6.2, the shear arms and main bearing can be lowered

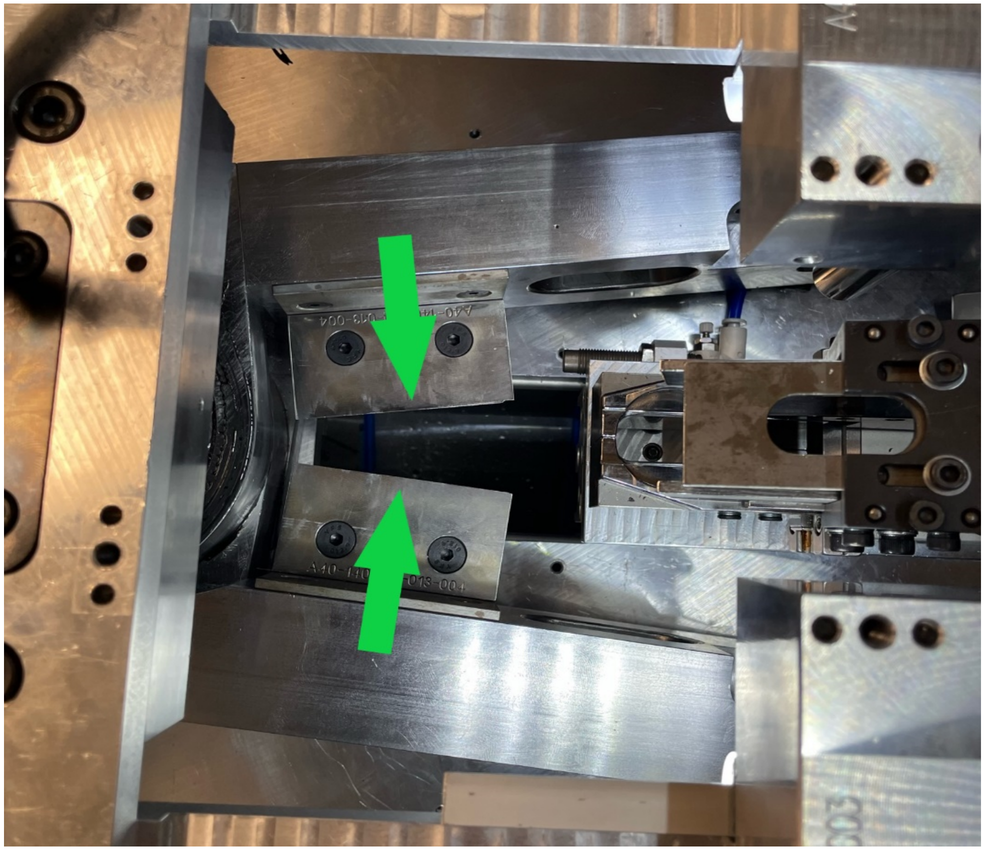


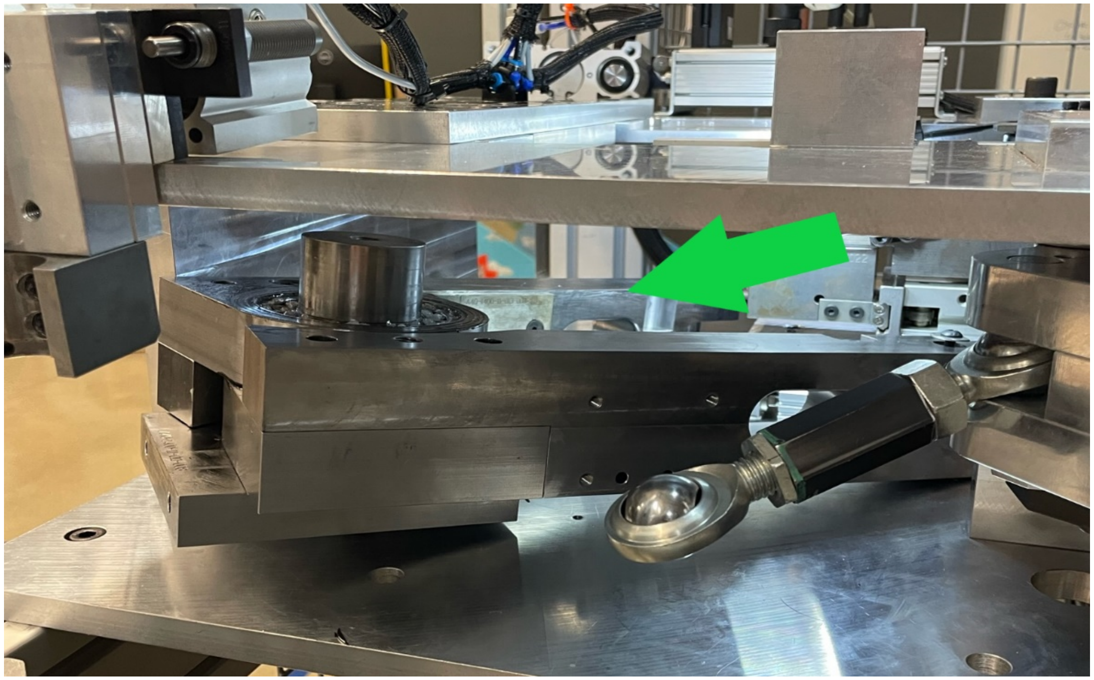




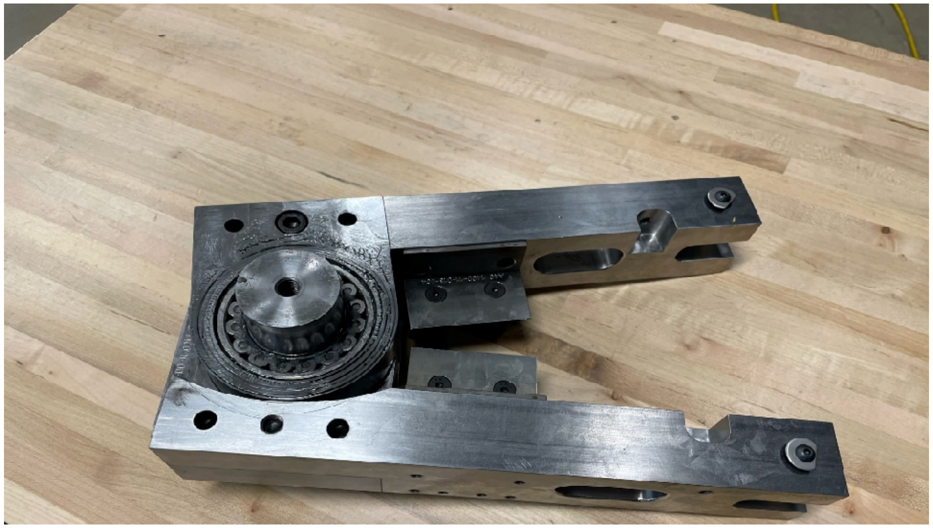
4.6.5 Removing shear arms and main bearing

Blades must be oriented as such and can be removed towards the side of the machine



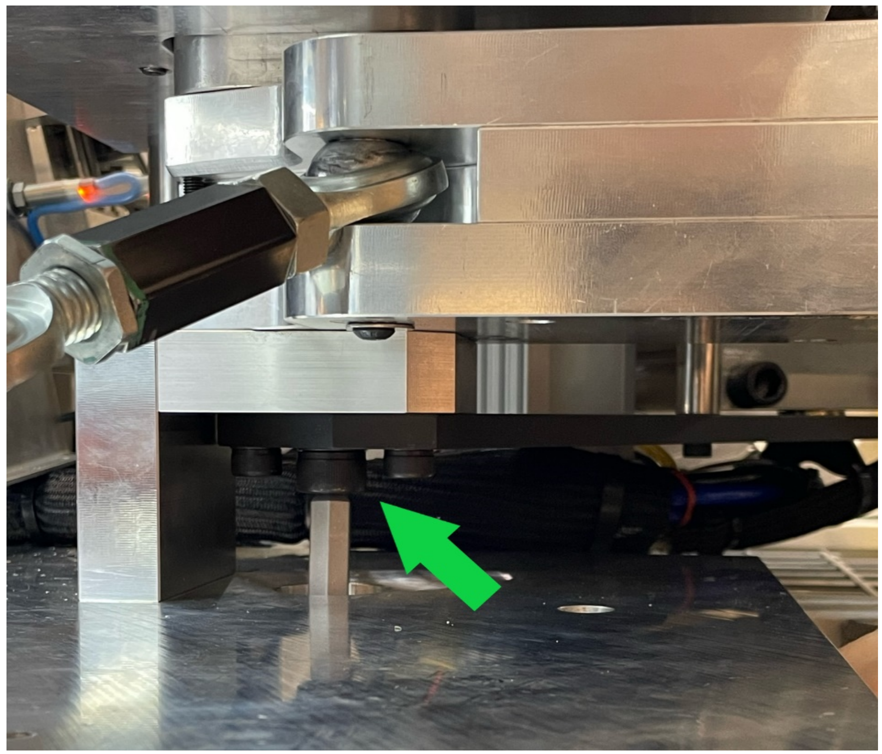


4.6.6 Complete access to shear arms and bearing

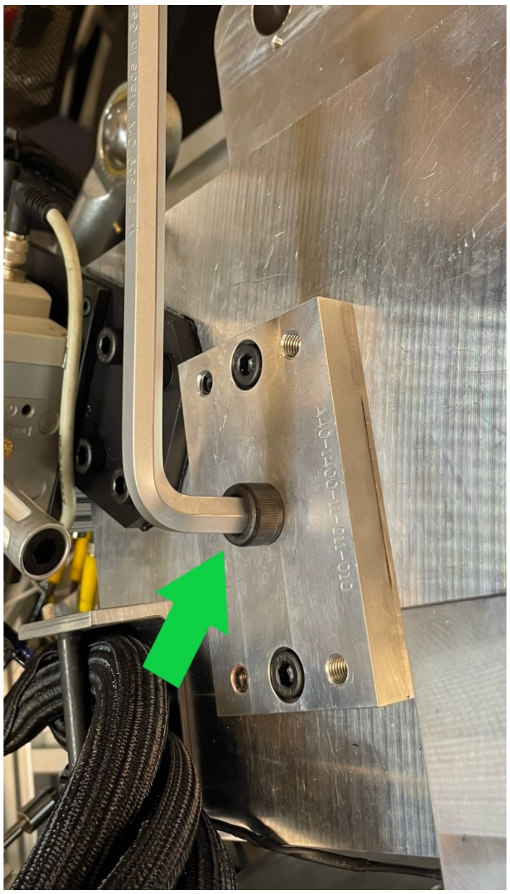


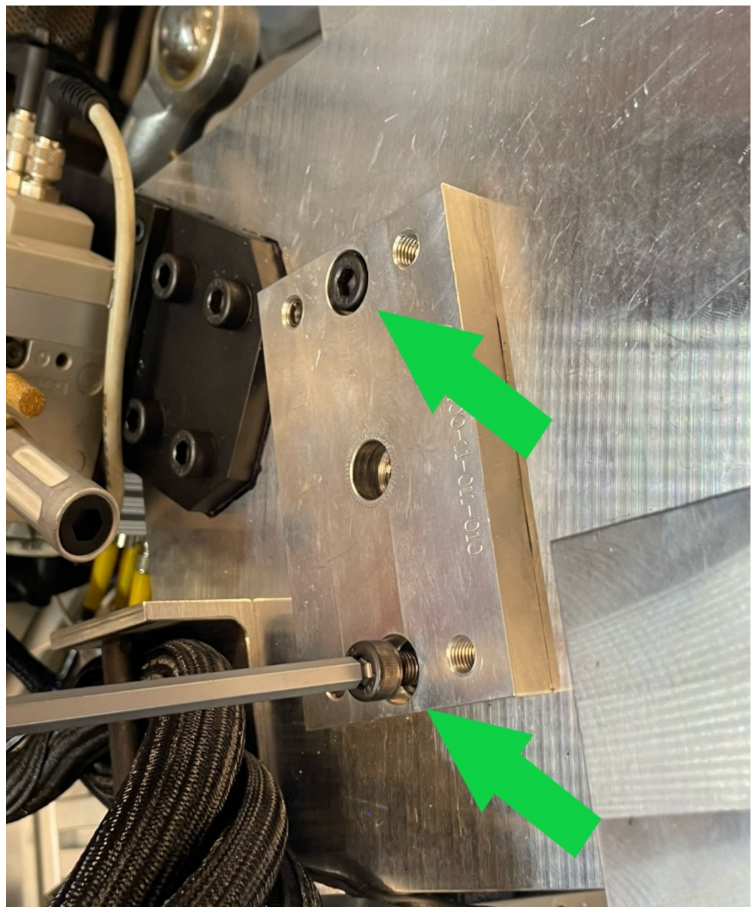
4.7 Remove shear tert link

4.7.1 Loosen snd remove bottom M12 bolt to remove tertitary link

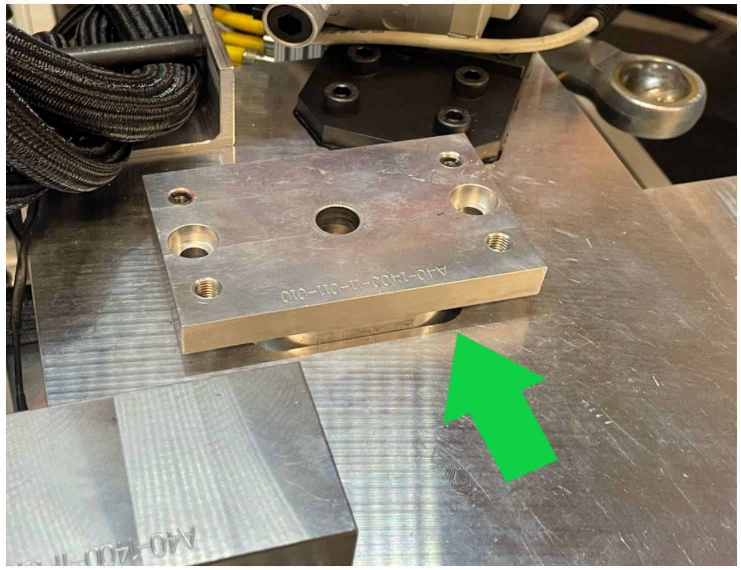


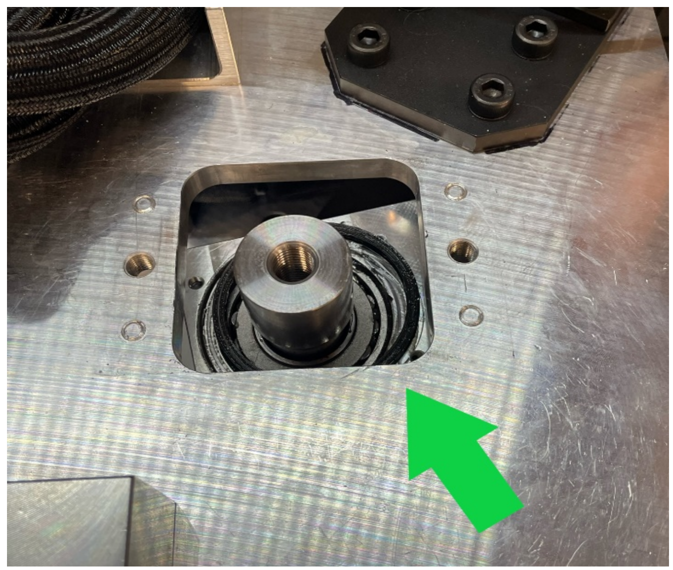
4.7.2 Loosen and remove top M12 bolt and M8 screws



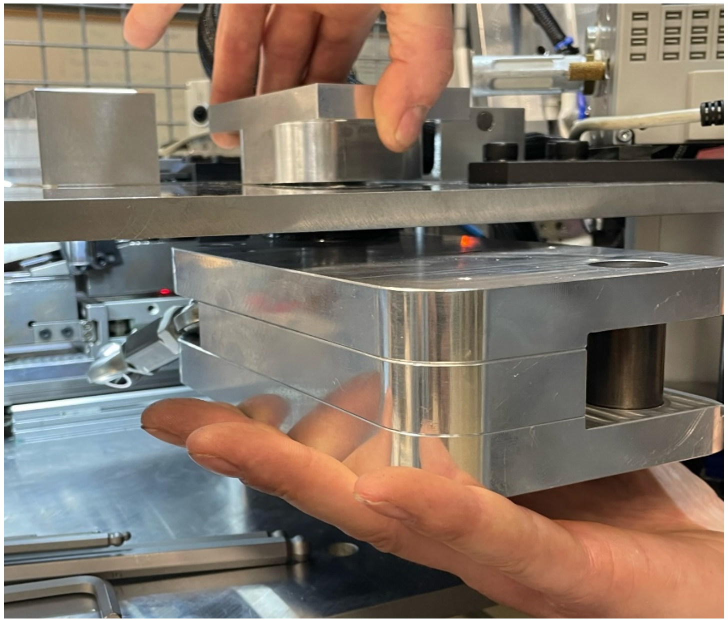


4.7.3 Remove inside tertitary link pin



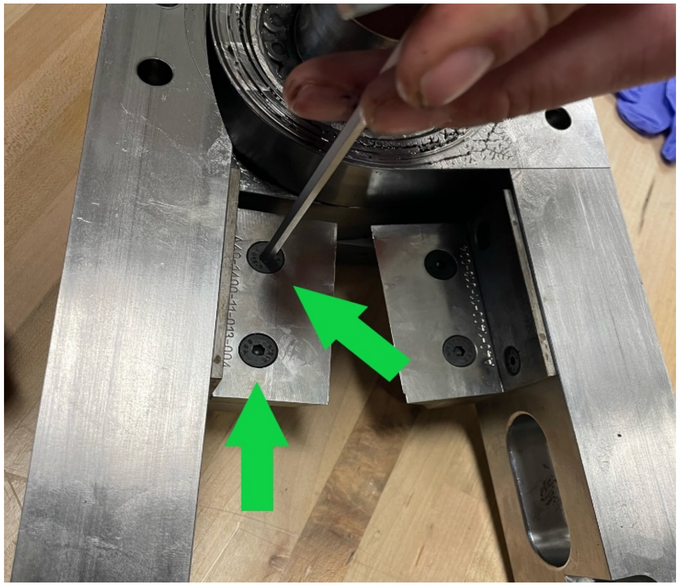


4.7.4 Remove tertiary arms



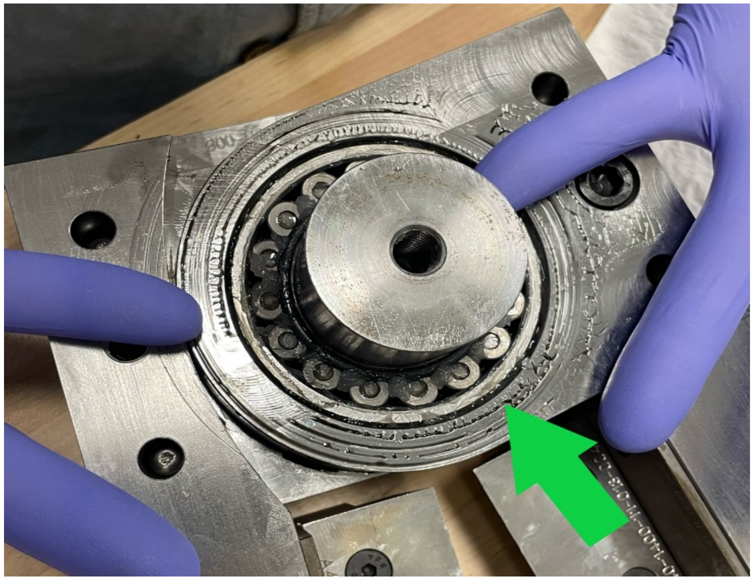
4.8 Remove Blades

4.8.1 Remove M4 flat head bolts to remove shear blades

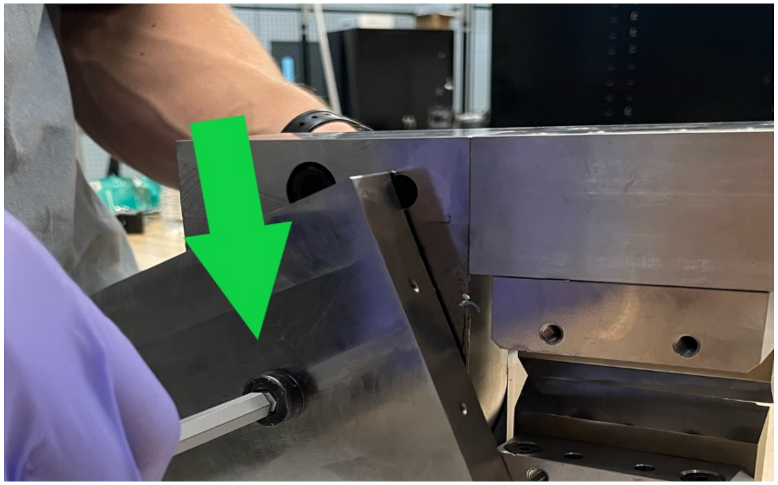


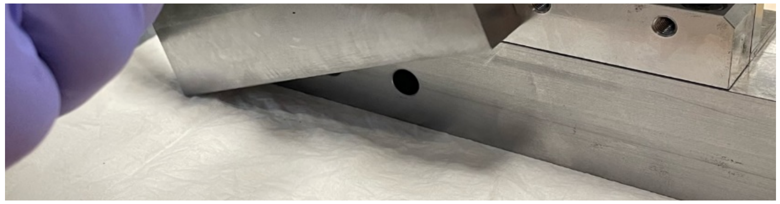
4.9 Remove bearings

4.9.1 Wear gloves and expose side of bearing

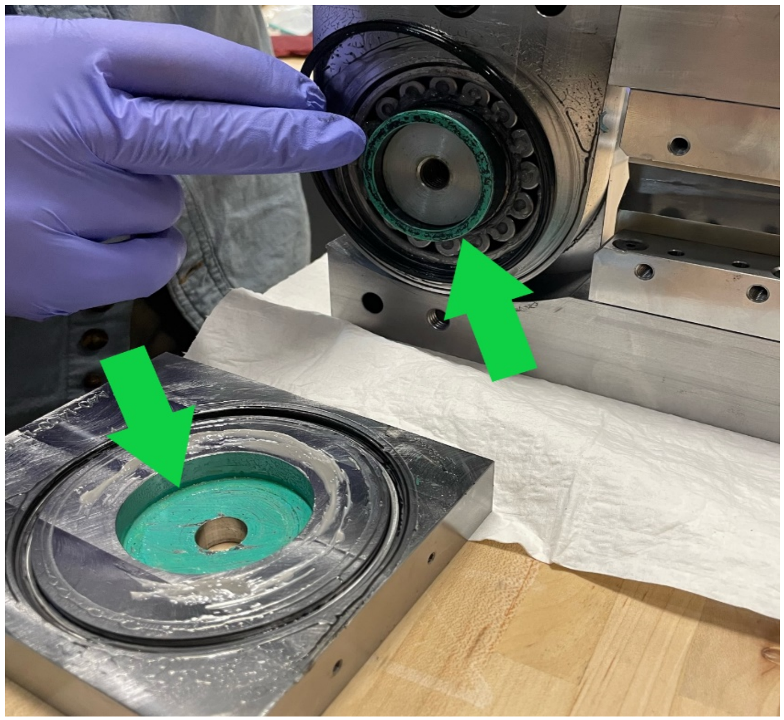


4.9.2 Remove main M12 bolt using M8 alan key and remove the shear arm cover





4.9.3 Remove O-rings and spacer, ensuring that the green sides stay together



4.9.4 Remove shear arms from eachother

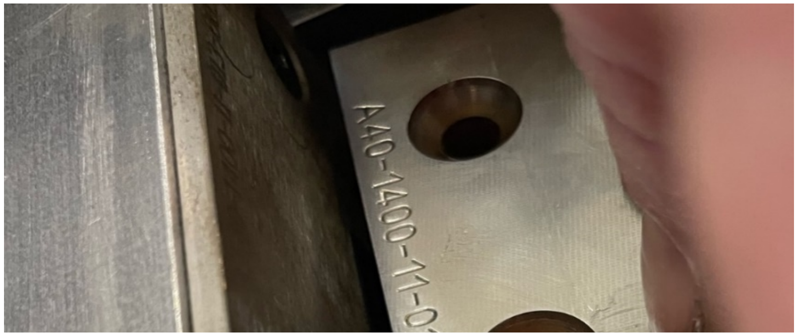
5 Maintenance

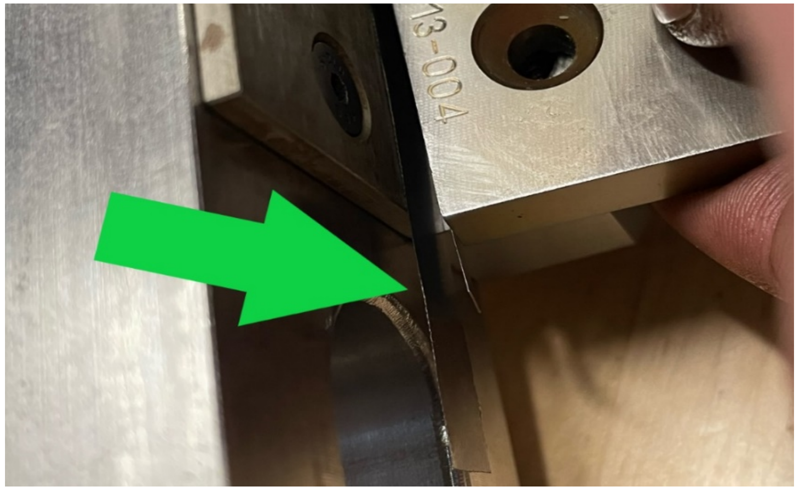
E-STOP IS PRESSED AND AIR IS OFF

5.1 Part dislodged in main cutting area
Refer to steps 4.1.1 - 4.1.3

5.2 Part dislodged in lateral transfer
Refer to steps 4.1.1 - 4.4.4

5.3 Changing shear blades
Refer to steps 4.1 - 4.8
Make sure to use shims and depicted below





5.4 Changing or maintaining bearing
Refer to steps 4.1 - 4.9

5.5 Node removal
5.5.1 Remove 2 3mm M4 screws