



University
of Idaho

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Client:

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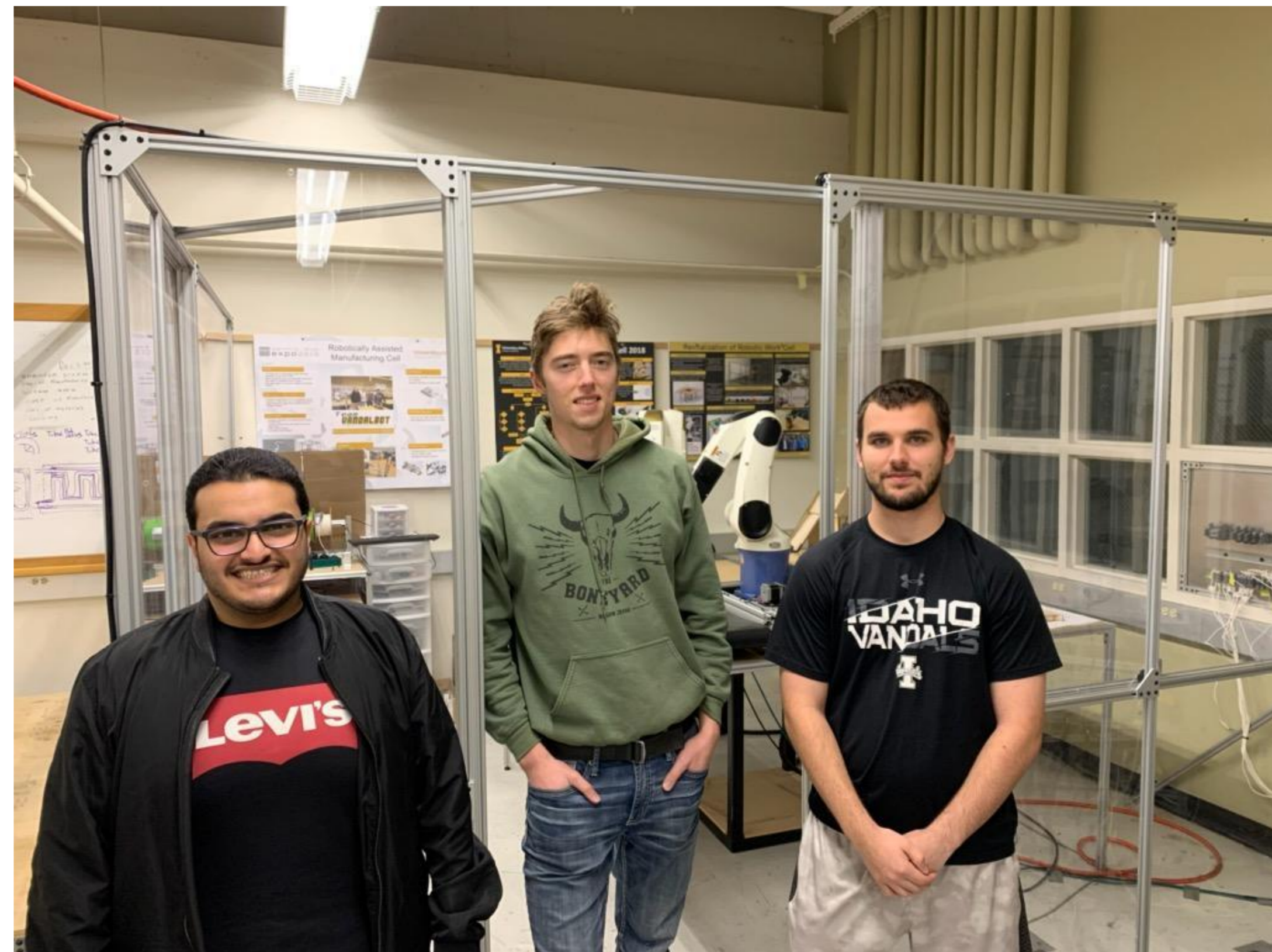
Advisor:

Steve Beyerlein

Mentor:

Jacob Miller

ROBO SHOP





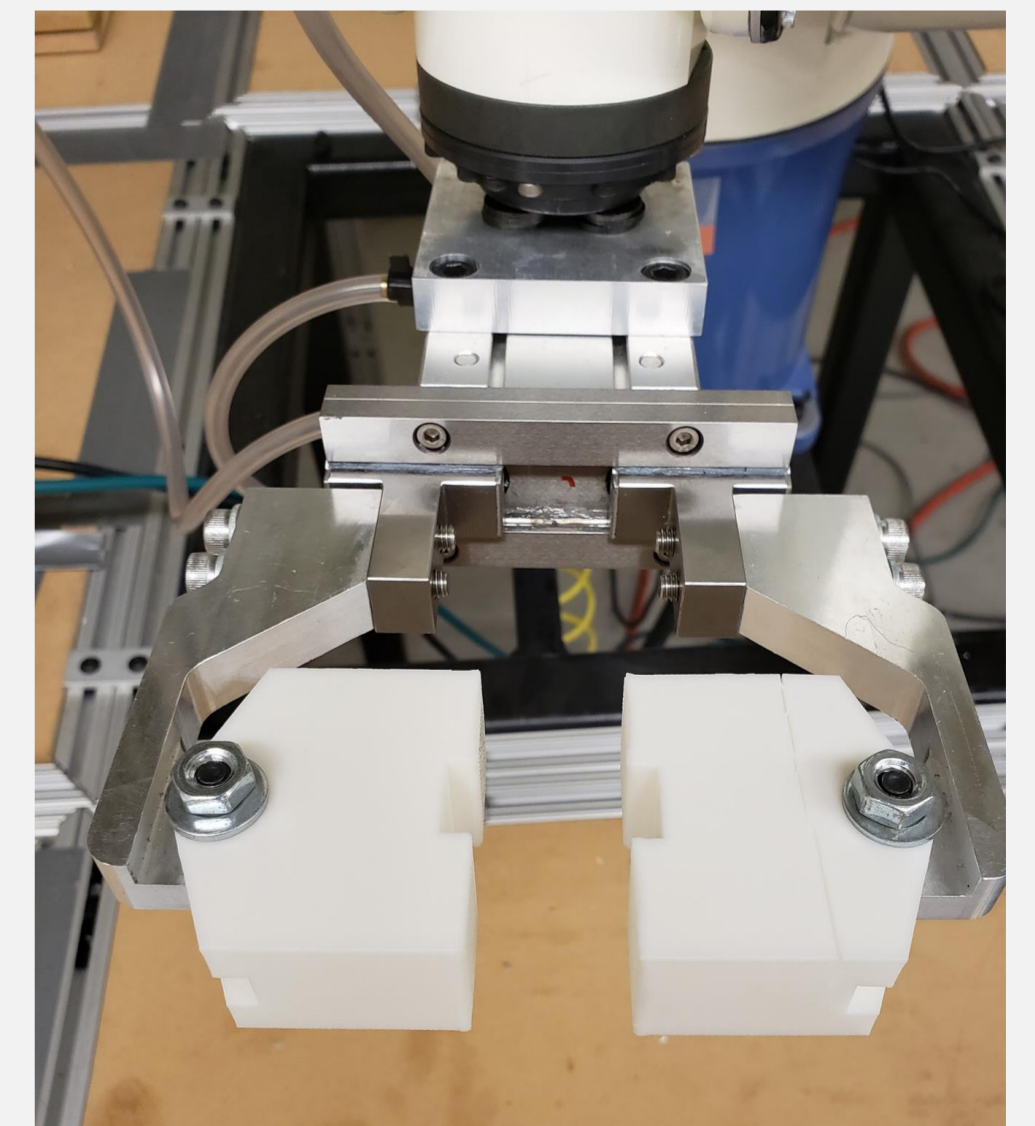
Value Proposition

Our team seeks to expand the assembly capabilities in the robotic manufacturing cell in the senior design suite. Our mission is to add fastener handling and installation to the existing part handling, part scanning, and part assembly features. The upgraded cell will have a wider range of simulated manufacturing operations that can be shown to prospective students and will have expanded infrastructure that can be used to enhance technical electives in industrial automation.

Objectives

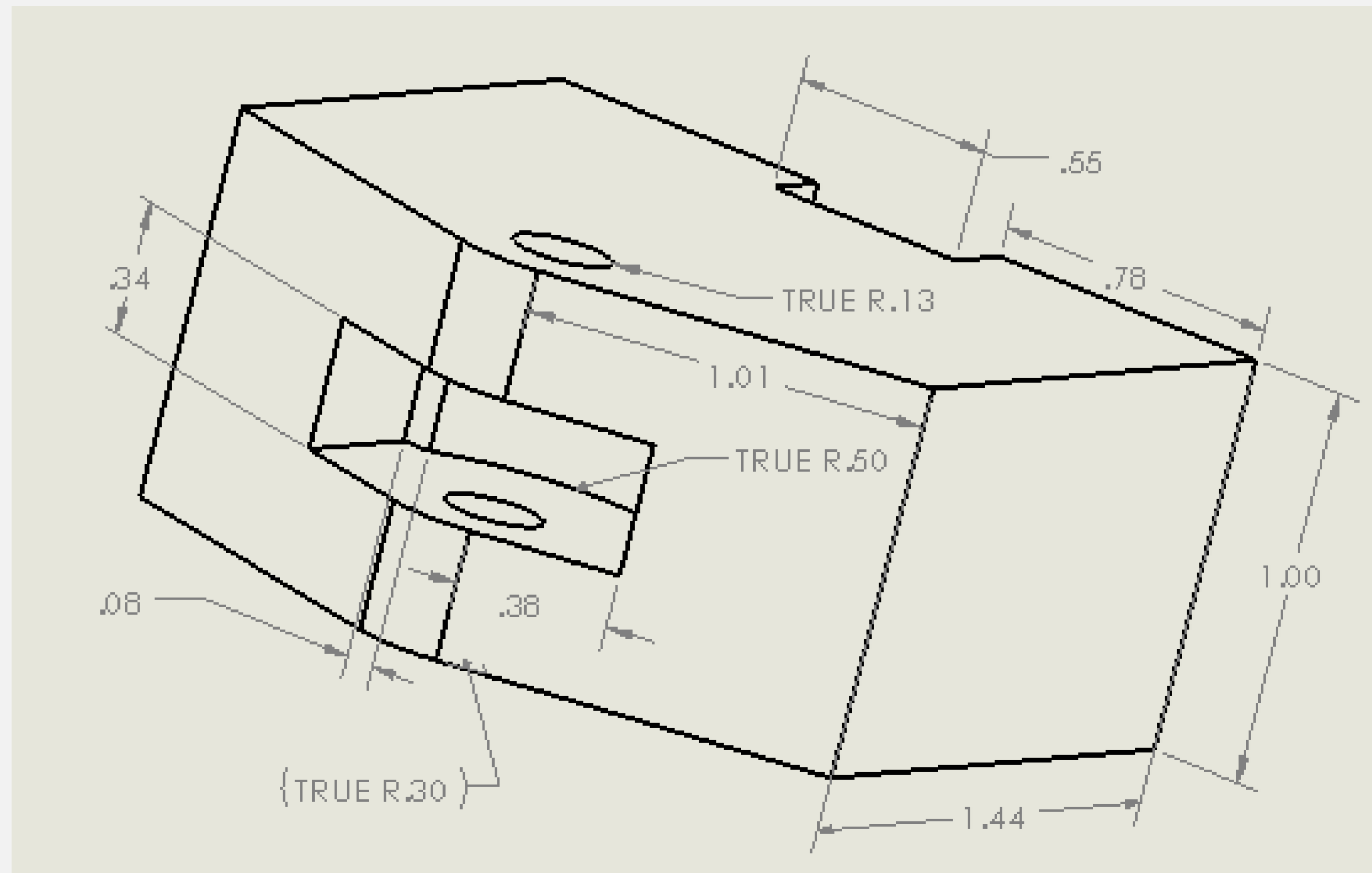
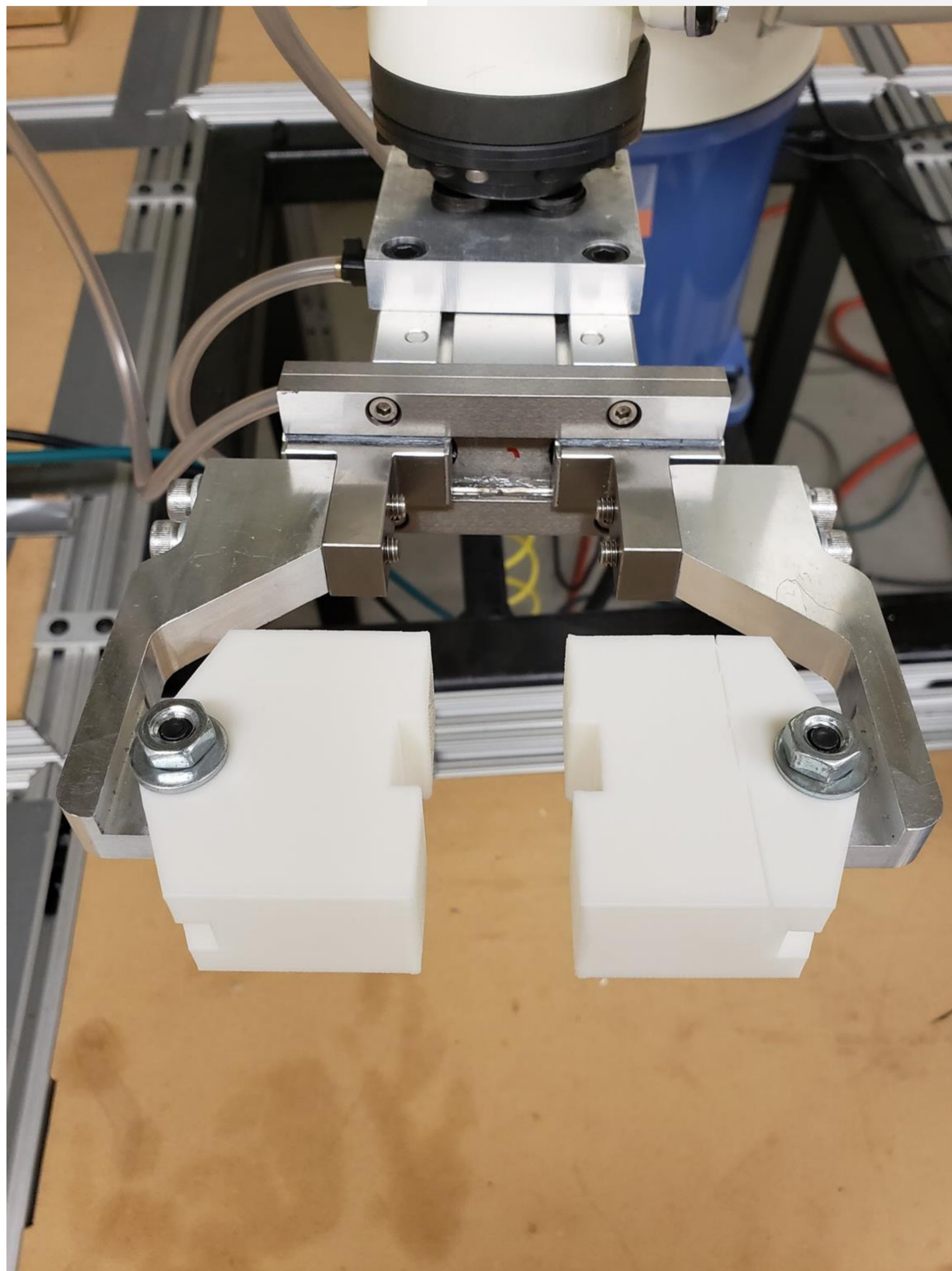


- Pick up screw
- Fasten screw
- Identify parts
- Manipulate parts

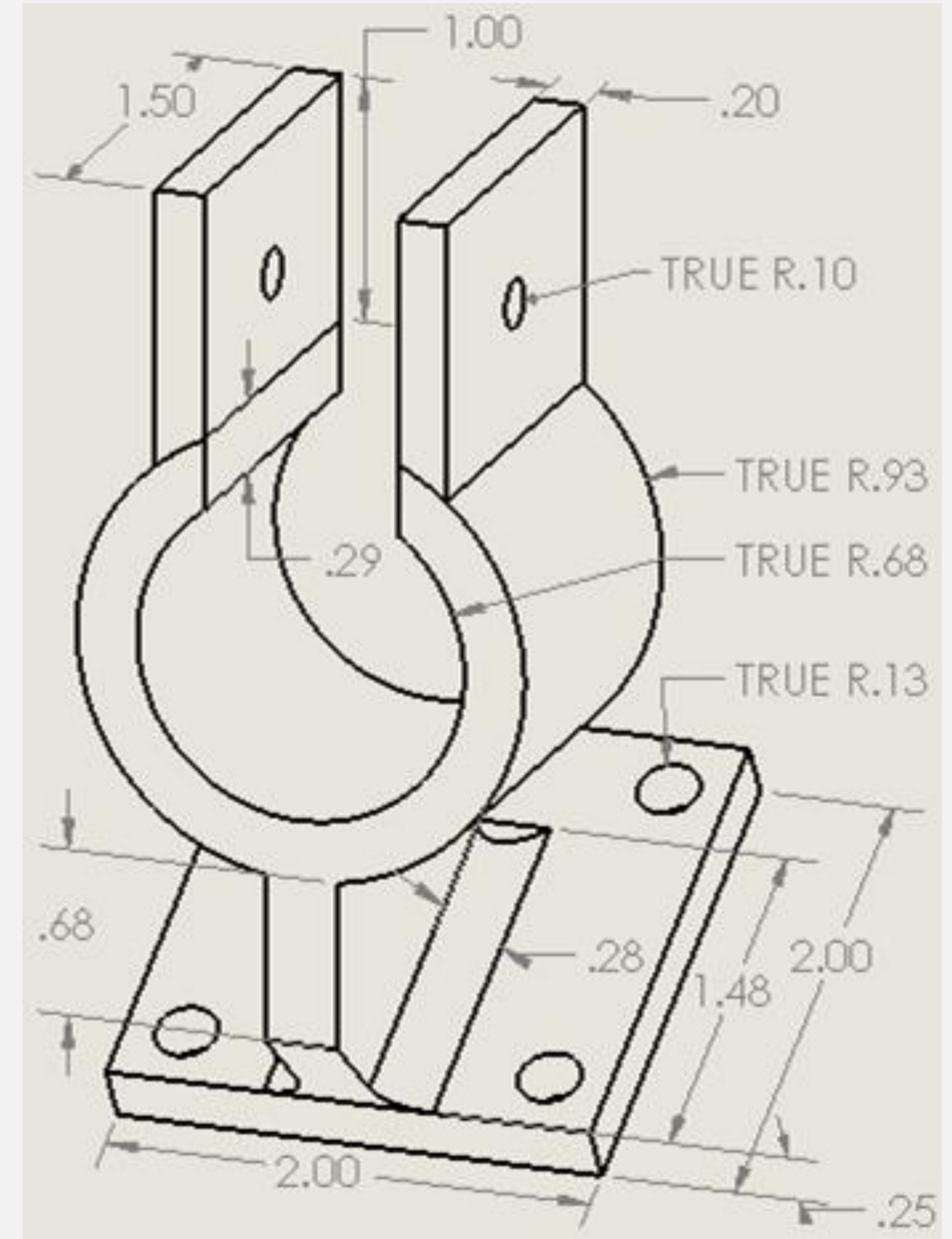




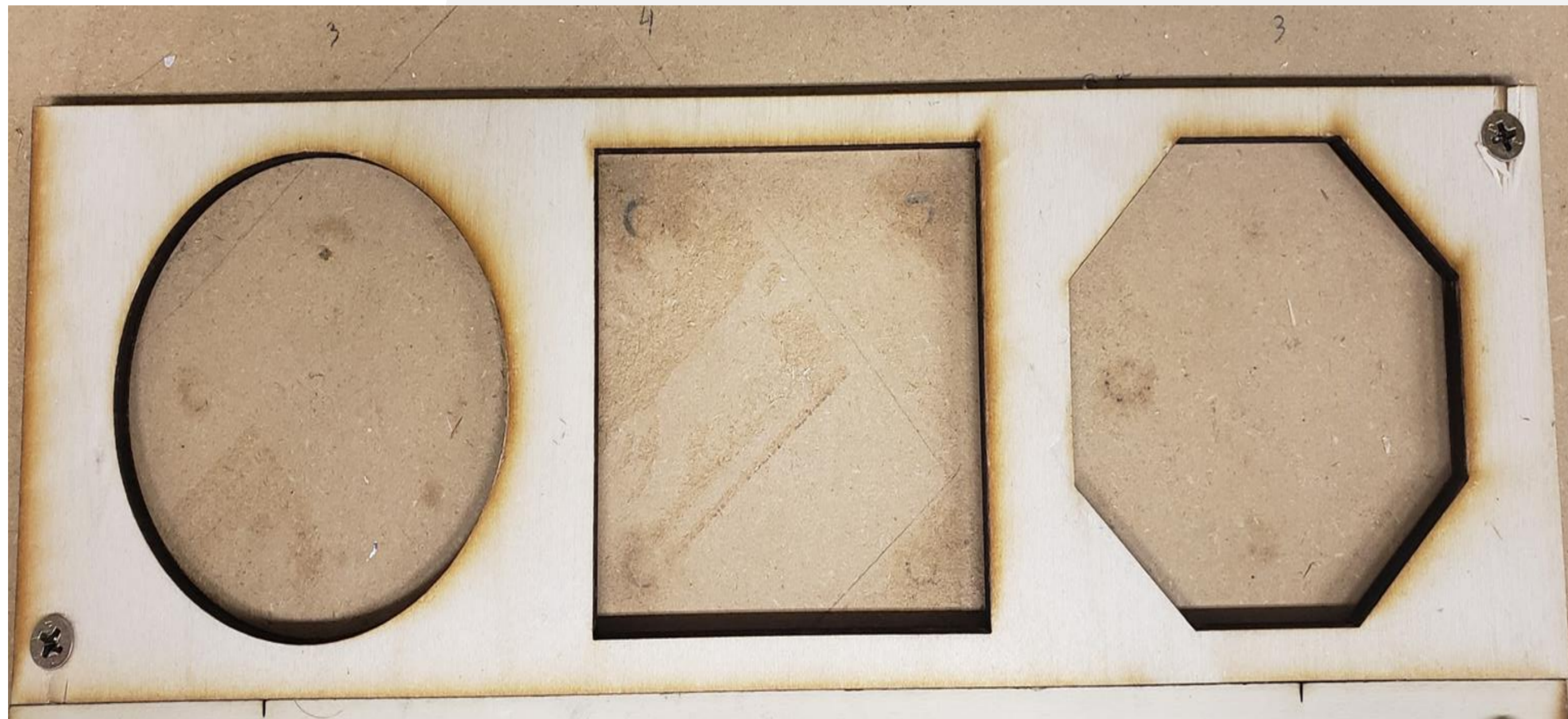
GRIPPER LIPS



ROBOT #2 END EFFECTOR



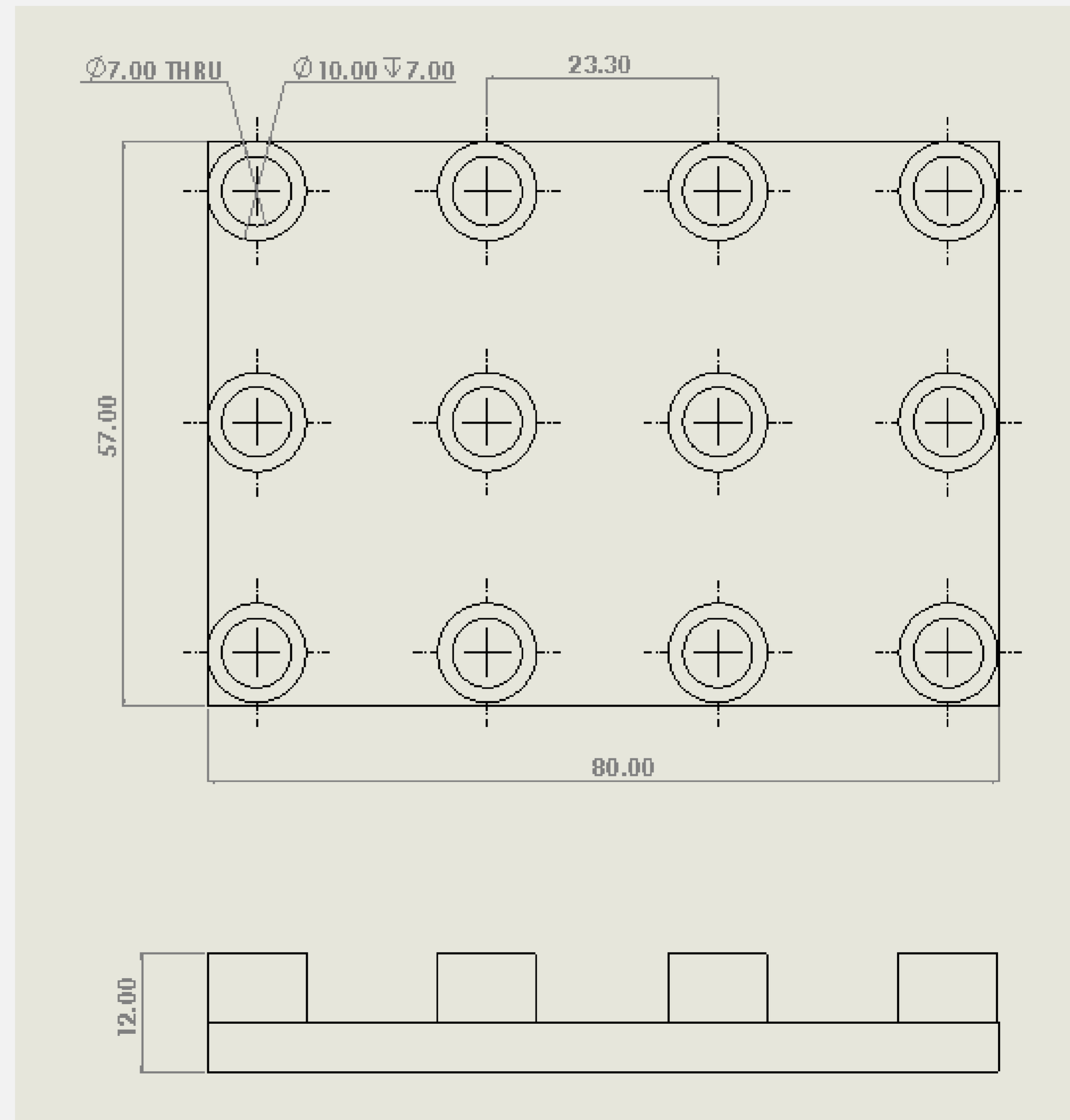
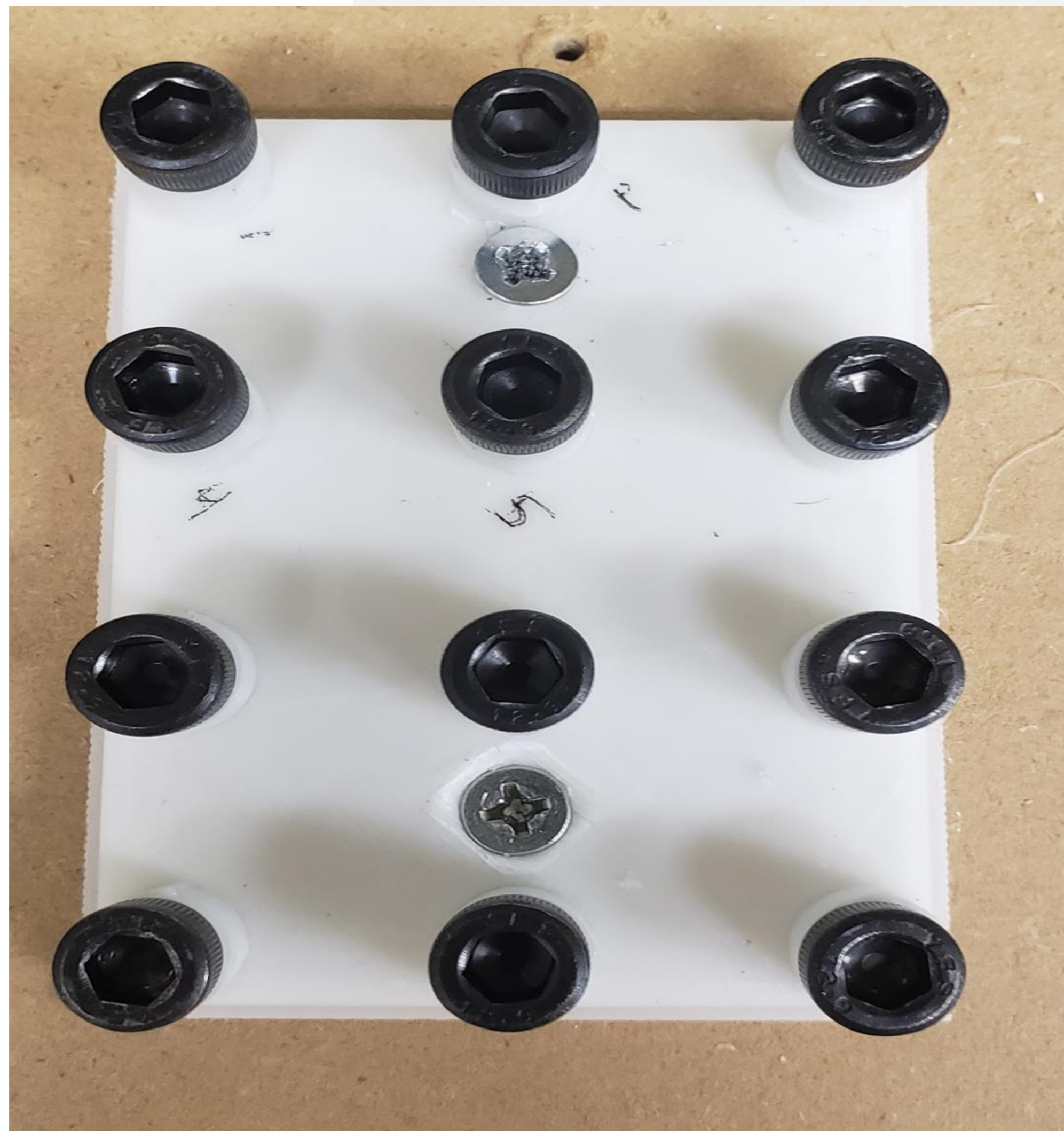
PART HOLDER



Dimensions:

3 1/16 in. for all main dimensions

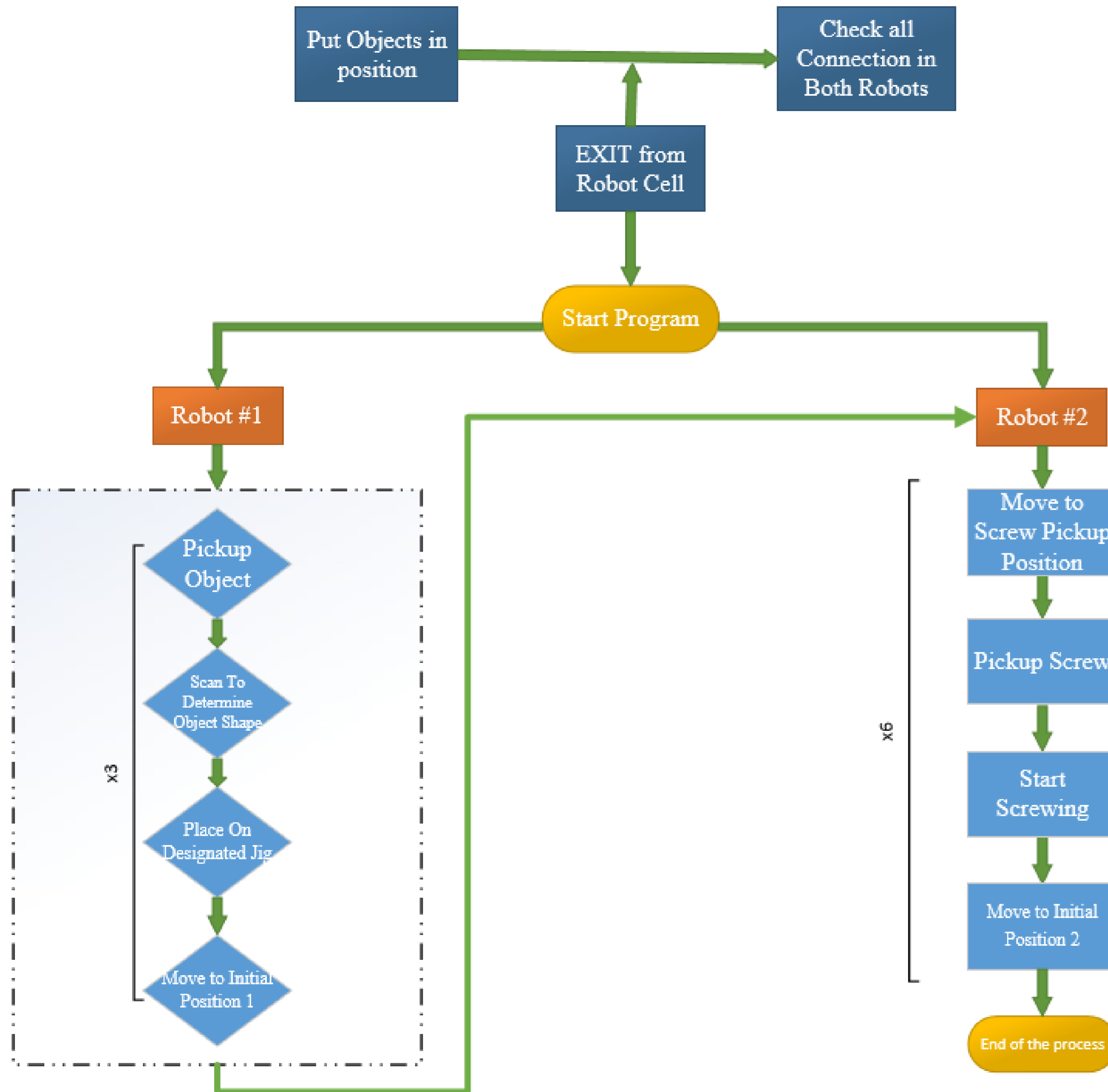
SCREW HOLDER





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PROCESS DESCRIPTION

Wincaps Code

```
'ESTABLISHES CONNECTION WITH SCANNER, GATHERS BARCODE INPUT INTO S1
COM_ENCOM #8
  INPUT #8, S1
  COM_DISCOM #8

  'Square
  IF S1 = "SQ" THEN
    APPROACH L, j05, @E 130
    MOVE L, @E j05
    DELAY 500

'OPEN GRIPPER & DEPART
SET I065
RESET I064
DELAY 500
DEPART L, @E 100
```

Explanation:

- Send Signal to Scanner
- scanner read and send back a signal to know which part is there.
- move part to the specific position
- open the gripper and leave the part

Wincaps Code

```
'REST POS
MOVE P, @E j01
'Receives Signal from Robot 1
  COM_ENCOM #10

  INPUT #10, I3

'Start Screwing
  IF I3 = 3 THEN

    'Fastener 1 pickup
    MOVE P, @E j02
    SPEED 6.6667 'change speed to 2%
    MOVE P, @E j03
    DELAY 1000
    SPEED 75
    MOVE P, @E j02

    'Back to REST POS
    MOVE P, @E j01

    'Circle hole 4
    MOVE P, @E j37
    SPEED 6.6667 'change speed to 2%
    MOVE P, @E j38
    DELAY 1000
    SPEED 75
    MOVE P, @E j37

    SPEED 50
    'BACK TO REST
    MOVE P, @E j01
```

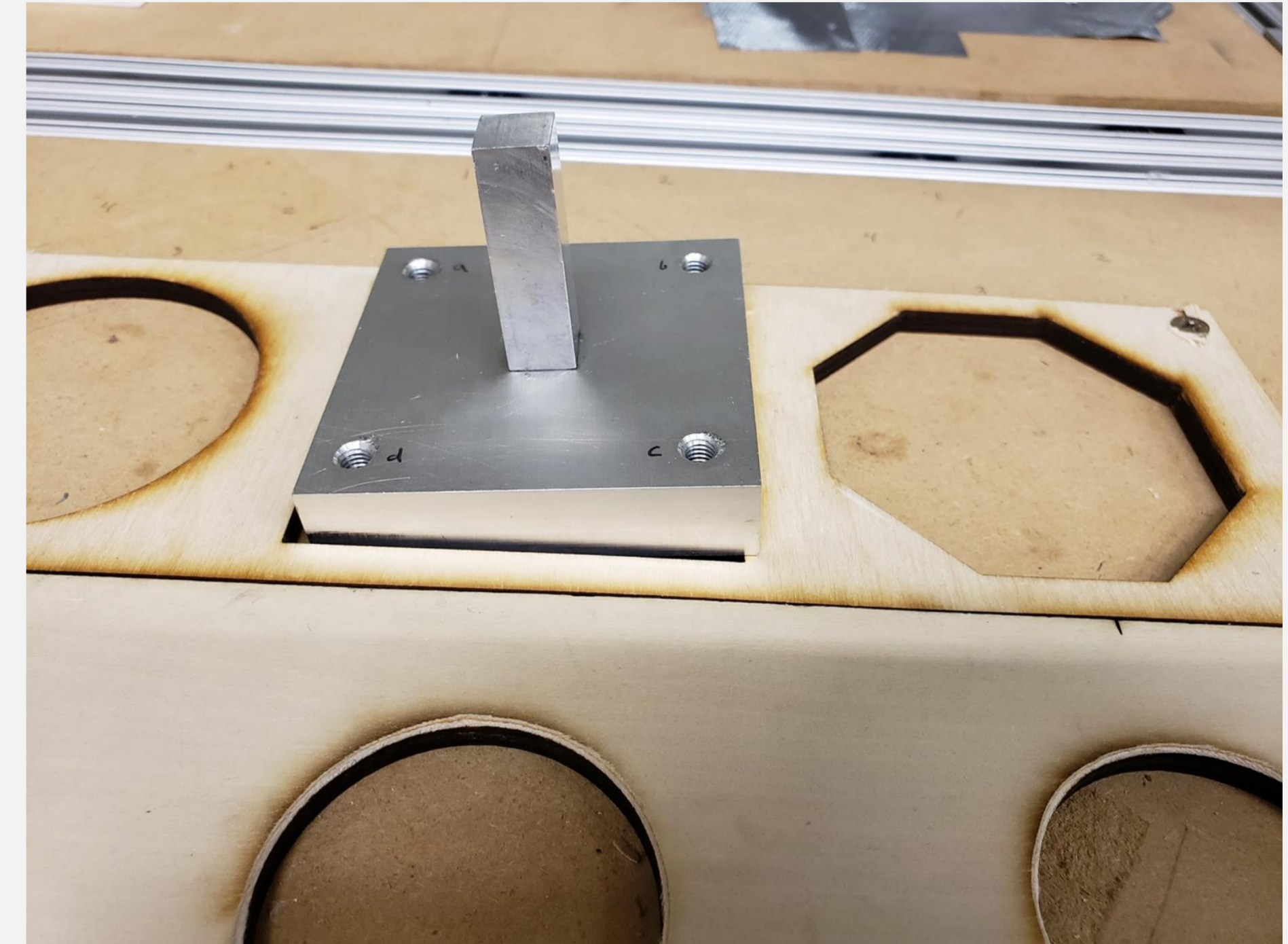
Explanation:

- Wait for the first Robot signal.
- Start working if the second robot received the signal.
- move to fastener jig position.
- pick up a fastener.
- move to the hole in the one of the parts.
- go down slowly and start screwing.
- Leave the object with faster speed.
- go back to safe position.

Drop off Test



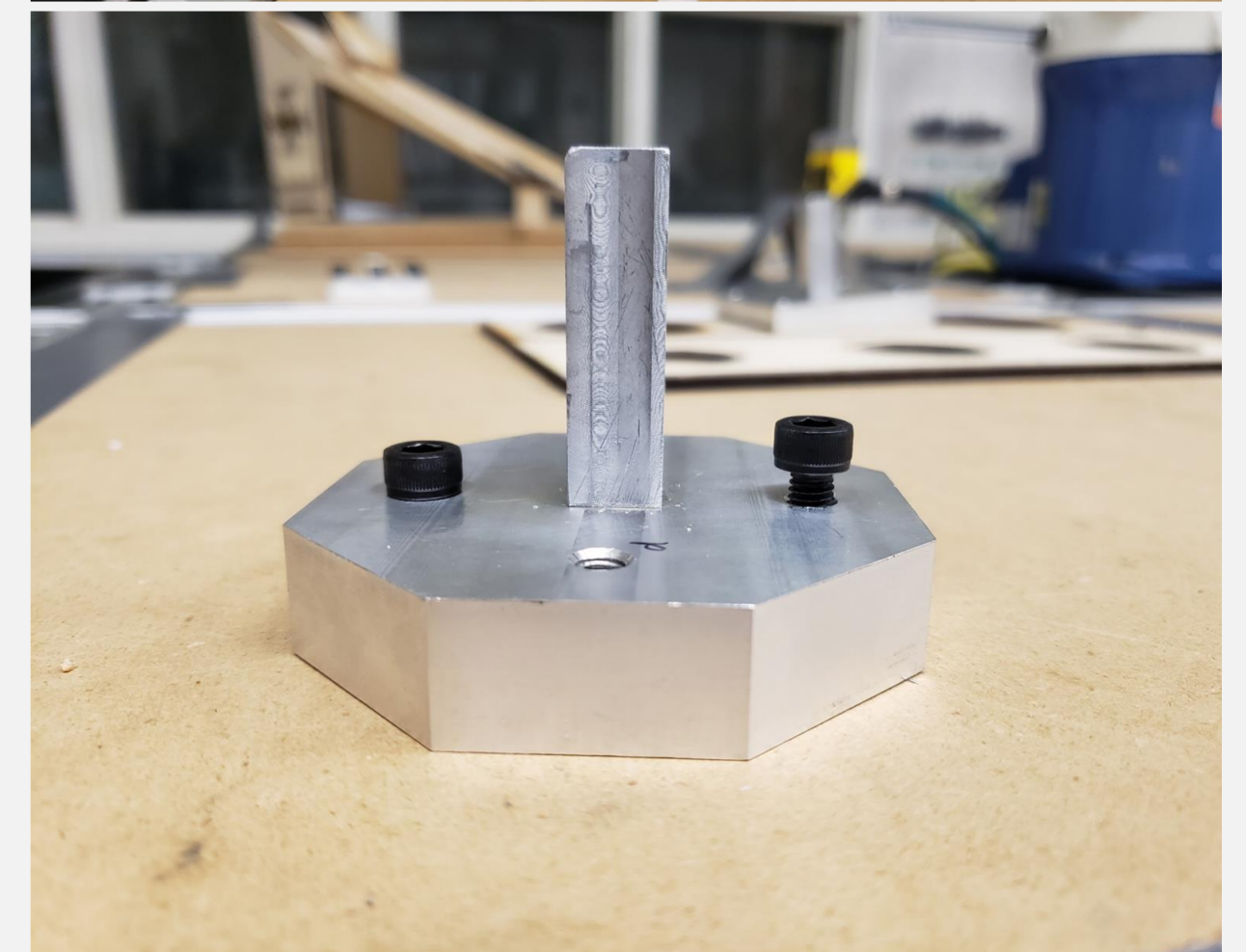
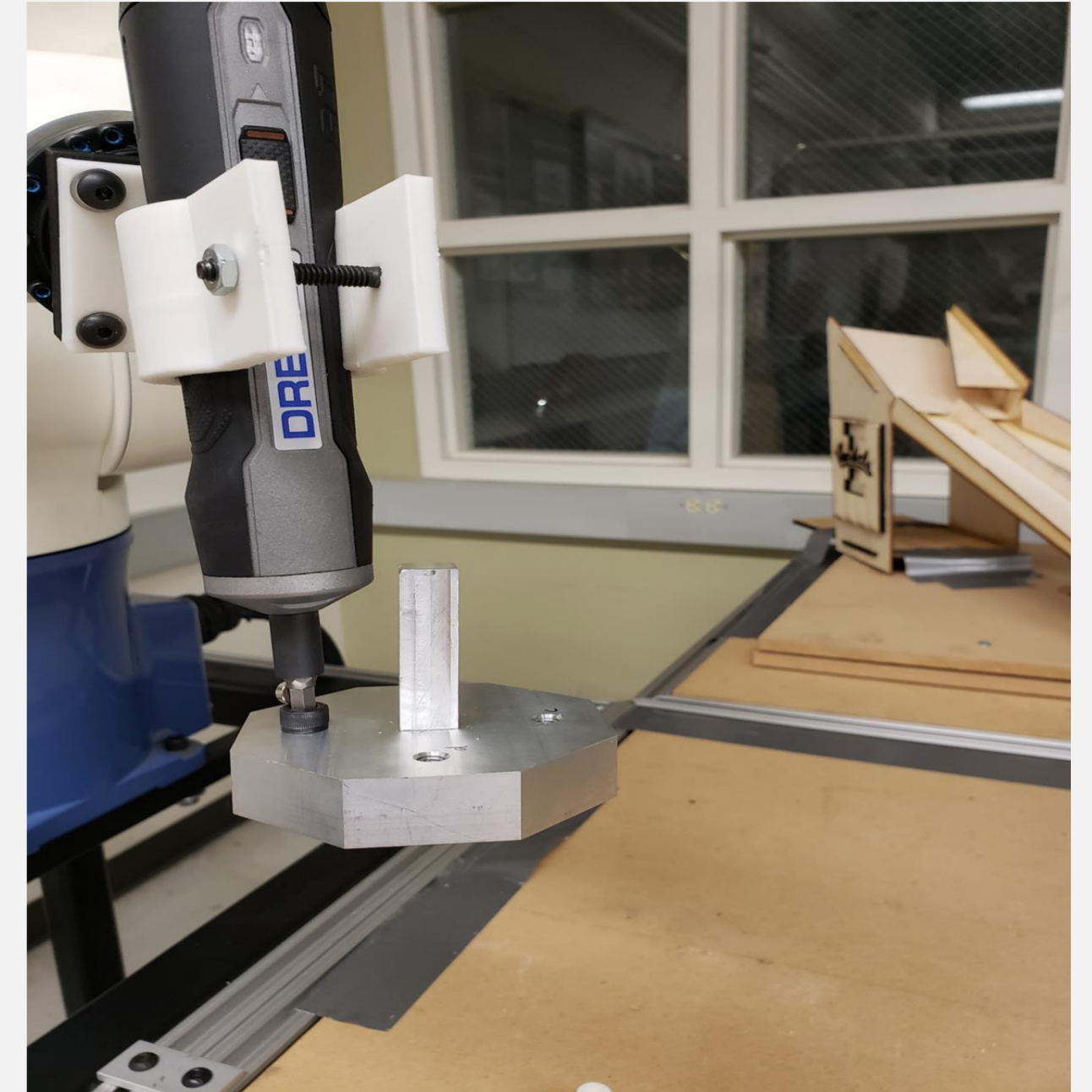
Test #	Square location	Square drop-off	Notes	Circle Location	Circle drop-off	Notes	Octagon Location	Octagon drop-off	Notes
1	2	yes	perfect	3	yes	hit front bounced in	1	no	left and back
2	3	no	front	1	yes	perfect	2	no	left and back
3	2	yes	perfect	1	yes	perfect	3	no	left and front
4	1	yes	perfect	3	yes	hit front bounced in	2	no	left and front
5	3	no	front	2	yes	perfect	1	no	left and back
6	1	yes	perfect	2	yes	perfect	3	no	left and front
7	2	yes	perfect	1	yes	perfect	3	no	left and front
8	1	yes	perfect	3	yes	hit front bounced in	2	no	left and back
22	3	yes	perfect	2	yes	perfect	1	yes	perfect
23	1	yes	perfect	3	yes	perfect	2	yes	perfect
24	2	no	front awkward pick-up	1	yes	perfect	3	yes	perfect
25	2	no	front awkward pick-up	3	yes	perfect	1	yes	perfect
26	2	yes	perfect	1	yes	perfect	3	yes	perfect
27	2	yes	perfect	3	yes	perfect	1	yes	perfect
28	3	yes	perfect	1	yes	scraped lower right corner	2	yes	perfect
29	1	yes	perfect	2	yes	perfect	3	yes	perfect
30	2	yes	perfect	3	yes	perfect	1	yes	perfect
31	3	yes	perfect	2	yes	perfect	1	yes	perfect
32	3	yes	perfect	2	yes	perfect	1	yes	perfect
33	2	yes	perfect	3	yes	perfect	1	yes	perfect
34	3	yes	perfect	1	yes	perfect	2	yes	perfect



Screwing in Test



Test #	Part Location	# of Magnents	Speed (%)	Slipped/Spun /Straight	Lifted Part?	Screwed in Fully?	Notes
1	Pushed into bottom left corner	2	1	Slipped	yes	yes	Original Code
2	Pushed into bottom right corner	2	1	Straight	yes	yes	
3	Pushed into bottom right corner	2	1	Spun	no	no	
4	Pushed into bottom right corner	2	1	Spun	yes	yes	
5	Pushed into bottom right corner	2	1	Barley Slipped	no	yes	
6	Pushed into bottom right corner	2	1	Barley Slipped	no	yes	
7	Pushed into bottom right corner	2	1	Slipped	yes	yes	
8	Pushed into bottom right corner	2	1	Slipped	yes*	yes	
9	Pushed into bottom right corner	2	1	Slipped	yes	no	
10	Pushed into bottom right corner	2	1	Straight	no	yes	
11	Pushed into bottom right corner	2	1	Slipped	yes	yes	
12	Pushed into bottom left corner	2	1	Slipped	yes	yes	
13	Pushed into bottom left corner	2	1	Slipped	no	no	
14	Pushed into bottom left corner	2	1	Slipped	yes	yes	
15	Pushed into bottom left corner	2	1	Spun	yes	yes	
46	Pushed into bottom left corner	1 Big	7	Straight	yes	yes	Made countersink slightly bigger
47	Pushed into bottom left corner	1 Big	7	Straight	no	yes	
48	Pushed into bottom left corner	1 Big	7	straight	no	yes	
49	Pushed into bottom left corner	1 Big	7	straight	no	yes	
50	Pushed into bottom left corner	1 Big	7	Straight	yes	yes	
51	Pushed into top right corner	1 Big	7	straight	yes	yes	
52	Pushed into top right corner	1 Big	7	Straight in	no	yes	
53	Pushed into top right corner	1 Big	7	slipped	no	yes	
54	Pushed into top right corner	1 Big	7	spun	no	yes	
55	Pushed into top right corner	1 Big	7	slipped	yes	yes	
56	Pushed into bottom right corner	1 Big	7	straight	no	yes	
57	Pushed into bottom right corner	1 Big	7	straight	no	yes	
58	Pushed into bottom right corner	1 Big	7	straight	no	yes	
59	Pushed into bottom right corner	1 Big	7	straight	no	yes	
60	Pushed into top left corner	1 Big	7	straight	no	yes	



- LESSONS LEARNED

- Coordinate systems/robot movement

- XY, Joint, Tool

- Fastener insertion/manipulation

- Magnets

- Gripper lips FEA

- Failure mode

- Robot handoff protocol

- Automated screw delivery system

- Slide, Spring

- RECOMMENDATION FOR FUTURE PROJECT

- FASTENER DELIVERY SYSTEM

