WPM1

Group One

Design Decision & Justification

Decision: Dual scotch yoke piston with both an outflow/inflow nozzle per piston

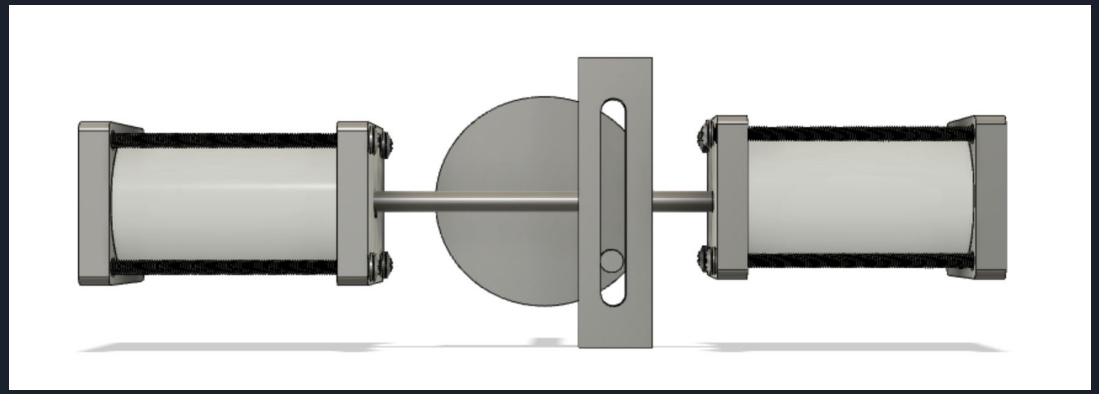
Justification:

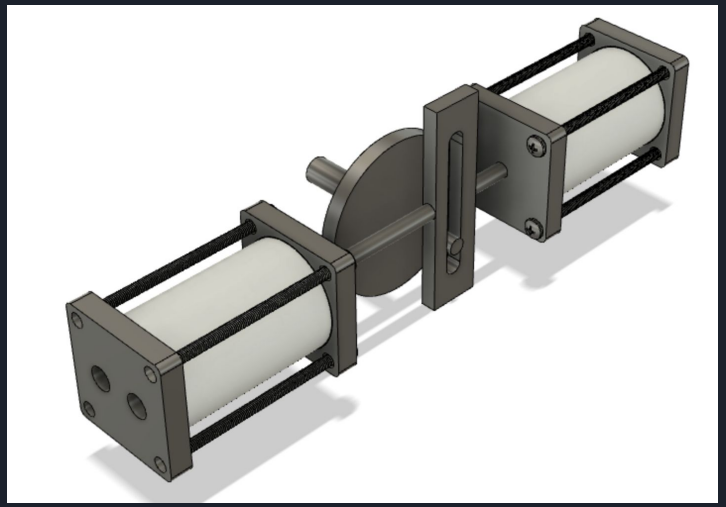
Two scotch yoke pistons
- Constant flow
- Sinusoidal reciprocating motion

Pistons facing each other
- Single slotted yoke arm and center plate
- Contrasting motion

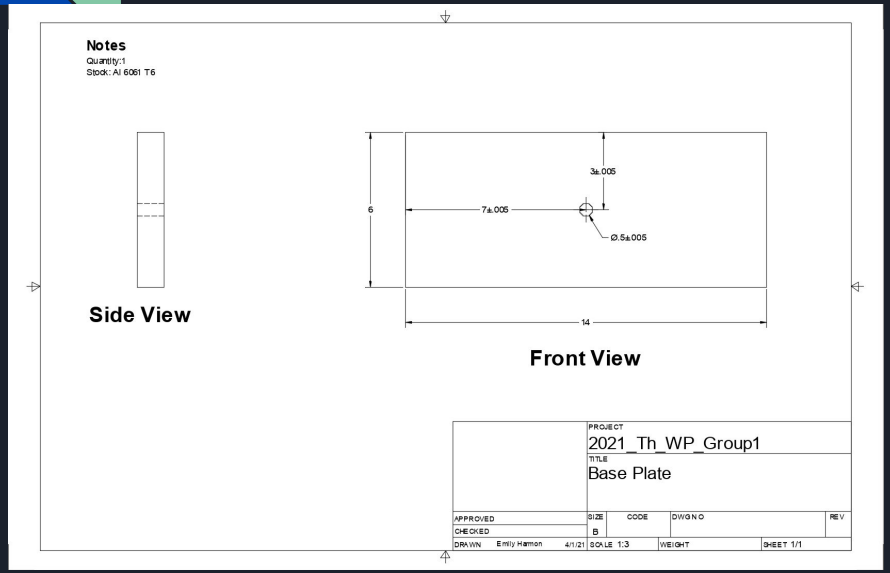
Two inflow/outflow nozzles per piston
- More efficient

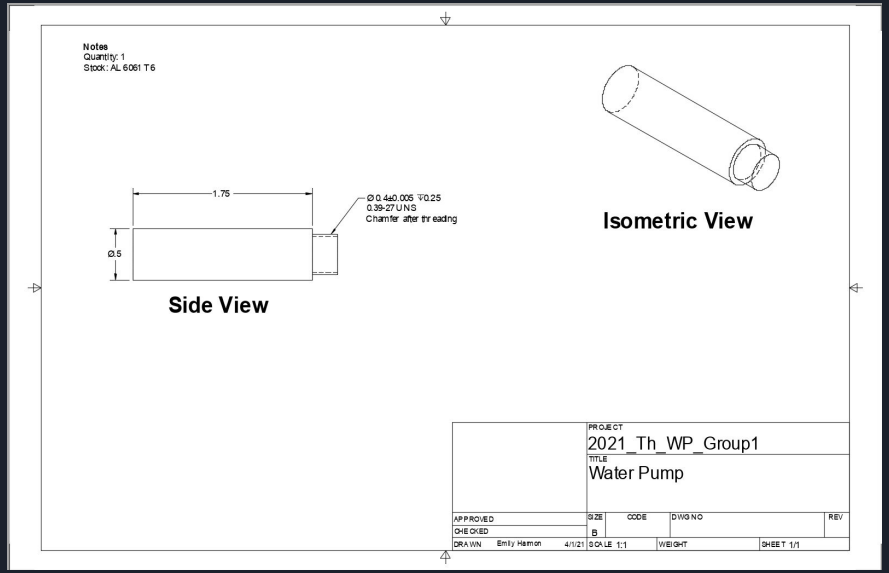
Initial CAD Model



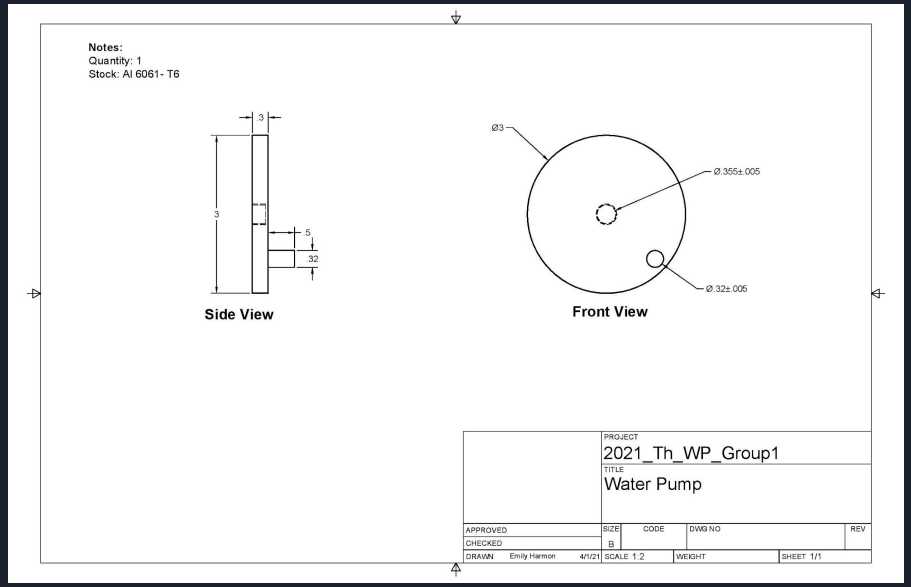


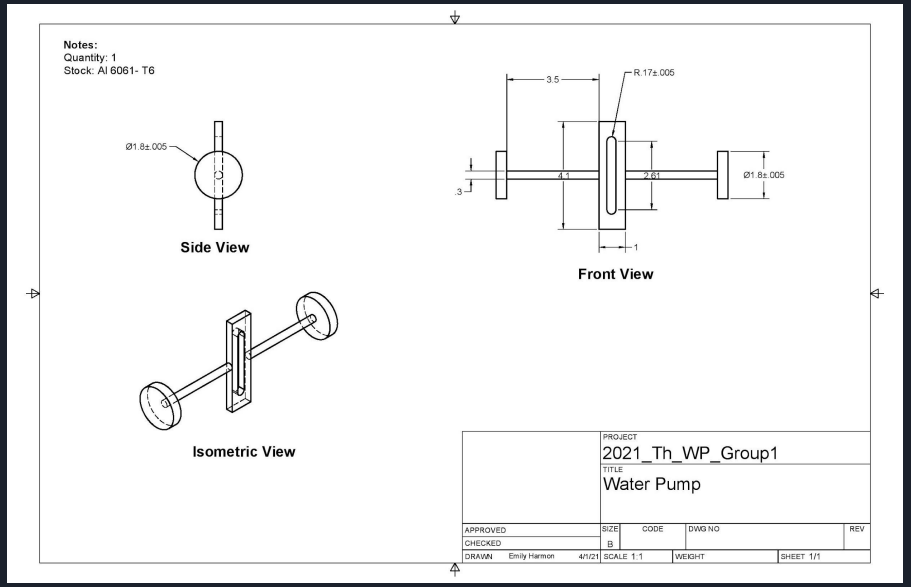
Part Drawings



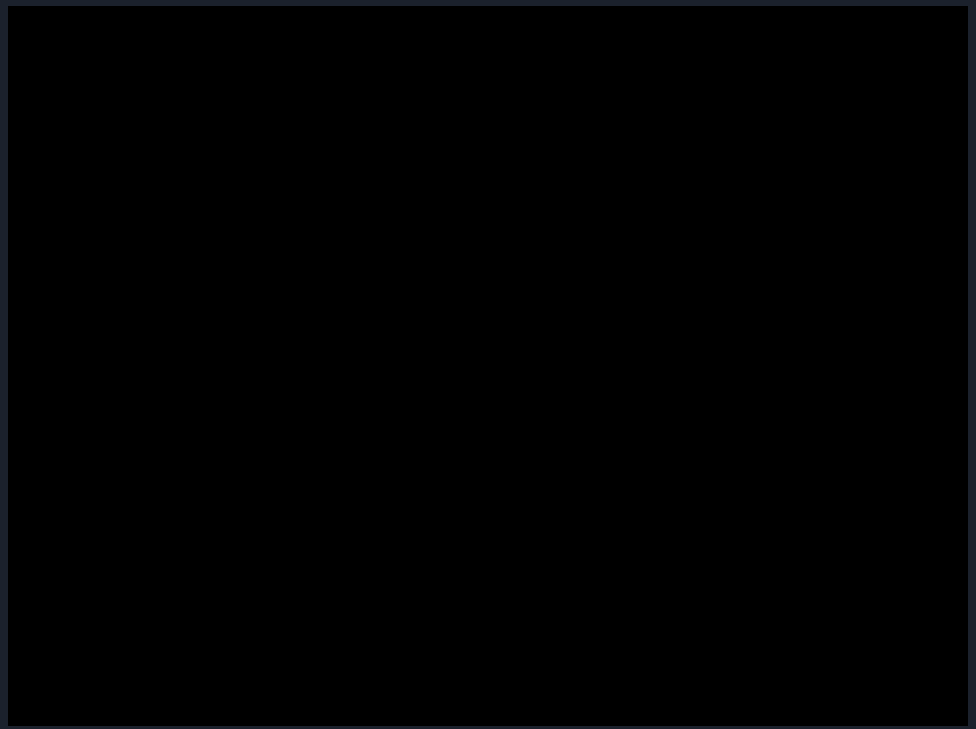


Part Drawings cont.



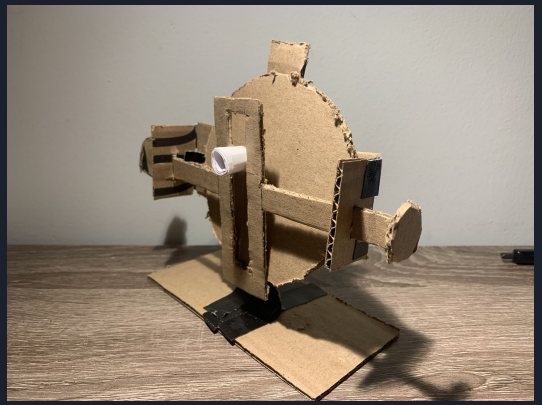


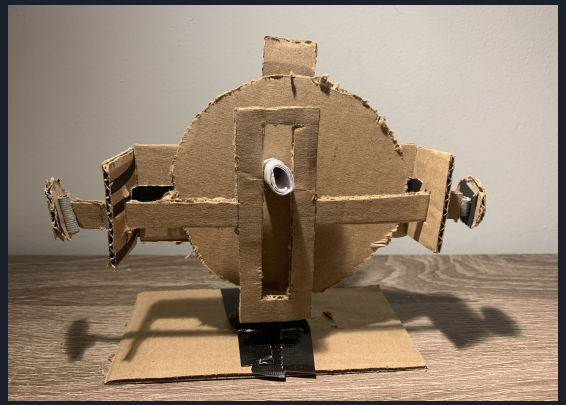
Animation

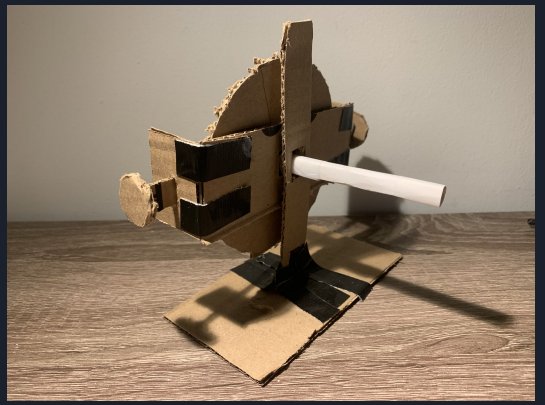


Cardboard/Paper Prototype

- Component shown: Scotch yoke mechanism with circular pistons added on sides (dimensions are not representative of final design)

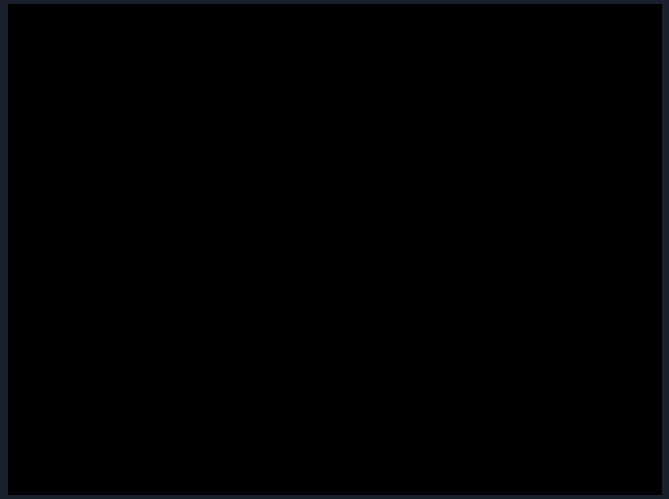






Cardboard/Paper Prototype

- Video showing Scotch Yoke motion



Fabrication Plan

- Parts to manufacture
  - Scotch yoke
    - Need specific shape and size and correct threads for end cap
  - Back plate, stand for piston
    - Simple to machine, can place holes in desired location for specification of piston setup
  - Guide for Scotch yoke
    - Need specific motion to fit yoke
- Parts to order
  - Cylinder, end caps
    - Pre-made and very reasonably priced at Emerson
    - Practicality, standardization, saves time
  - O rings
    - Not able to machine, only available at McMaster
  - Barbed pipe fittings
    - Reasonably priced at Emerson, NPT fits end cap threats, barbs fit provided tubing
  - Output shaft
    - Can purchase at the right size for the test setup

Final Cost Analysis and Parts List

Total Prototype cost:

15 hours * $40/hr + 40 hours * $120/hr + $46.34= $5446.34

Product cost (single production):

$5446.34+ (25+5+4+30)*$1.20 = $5523.14

Product cost per pump:

$5446.34/1000 + (25+5+4+30)*$1.20 = $82.25

Part	Material	#	Cost per item	Total cost	
Bored Cylinder, 3"	6061 T6	2	$1	$2	
Machined End Caps	6061 T6	4	$1	$4	
1/4" diameter rod	1012 steel	10 inches	$0.10	$1.00	
1/2" diameter rod	1012 steel	7 inches	$0.23	$1.61	
1/4 - 20 threaded rods	steel	6 ft	$1.02	$6.12	
1/2" x 4" Aluminum Bar	6061 T6	4 inches	$1.18	$2.36	
1/2" x 2 1/4" Aluminum Bar	6061 T6	9 inches	$0.73	$6.57	
Water resistant neoprene O-ring	Neoprene Rubber	pack of 50	$0.32	$15.95	
1/4 - 20 Hex Nuts	Steel	32	$0.06	$1.92	
3/8" barbed x 1/4" NPT pipe fittings	Nylon	4	$0.55	$2.20	
				$27.78	Emerson Total
				$15.95	McMaster Total

Fabrication Timeline

- April 2nd: submit finalized Emerson & McMaster Orders (Mathias Kohler)
- April 5th (mill): machine backplate and piston stand (Sebastian Torres)
- April 6th (lathe): machine output shaft and guide pin for Scotch yoke (Emily Harmon)
- April 9th (mill): machine center portion of Scotch yoke (Camille Slattery)
- April 9th (lathe): machine grooves in piston for O rings, arms of yoke and thread center and arms to fit (Gabriella Passarelli)
- April 12th: assemble all parts, test run in lab without water (Kean Chastain-Howley)
- Fix/modify parts if needed
- Final water pump test (Kean Chastain-Howley)

Summary of Team Charter

- Our team meets every Tuesday from 6-8 PM via Zoom
- Our primary method of communication is GroupMe and our documents are stored in a shared Google Drive folder
- Mathias Kohler is the Schedule Coordinator and one of the Co-Design Coordinators
    - Responsibilities include: tracking progress, creating deadlines, checking team members work, resolving conflict, reviewing CAD models, and working alongside Kean Chastain-Howley
- Kean Chastain-Howley is one of the Co-Design Coordinators
    - Responsibilities include: checking that parts fit together, ensuring master assembly functions, and working alongside Mathias Kohler
- Emily Harmon, Gabriella Passarelli, Camille Slattery, and Sebastian Torres are the Design/Manufacturing team members
    - Responsibilities include: designing parts, creating part drawings, machining parts, and delivering said parts to Kean Chastain-Howley
- The whole team will contribute to the written report, with each member focusing on the portion of the pump they designed and manufactured

Static Stress Analysis