

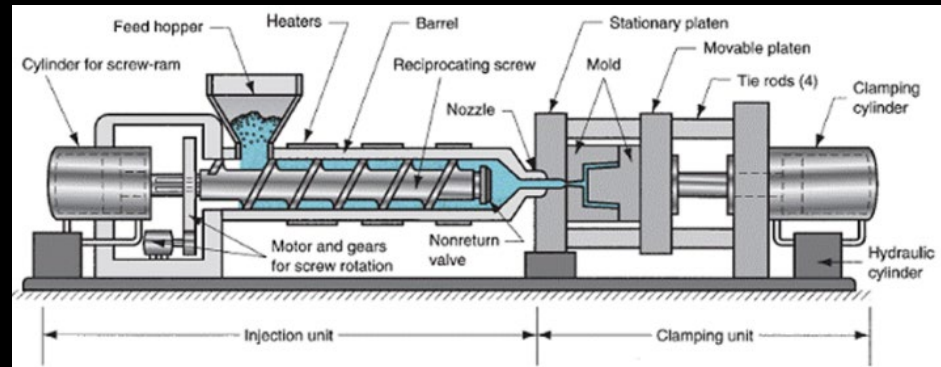
# INJECTION MOLD HEAT TRANSFER STUDY WITH THE CARABINER MOLD

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Pittsburg State University Research Colloquium  
April 14, 2021

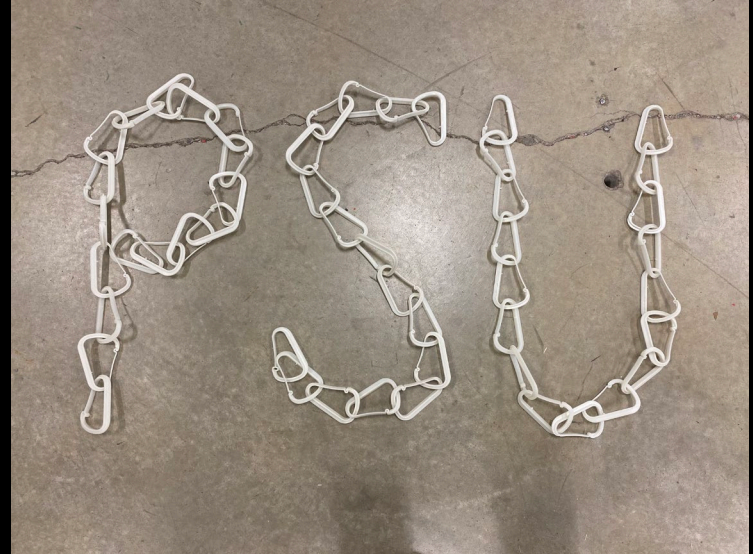
# INTRODUCTION

- In industry, ensuring that processes are running at optimal settings is extremely important to ensure that the company is making quality parts for their consumers.
- Injection molding processing parameters are critical to part outcome.
  - Pressures
  - Injection speed
  - Cooling time
  - **Temperature**



# PROJECT GOALS

- To gain an understanding of heat transfer during processing
- To apply that knowledge when faced with poor part quality situations.
- Project Goal:
  - Understanding heat transfer → overall process at optimal settings
  - Determine best material for the application
  - Understand how heat transferred throughout the mold during processing



# TECHNOLOGY USED

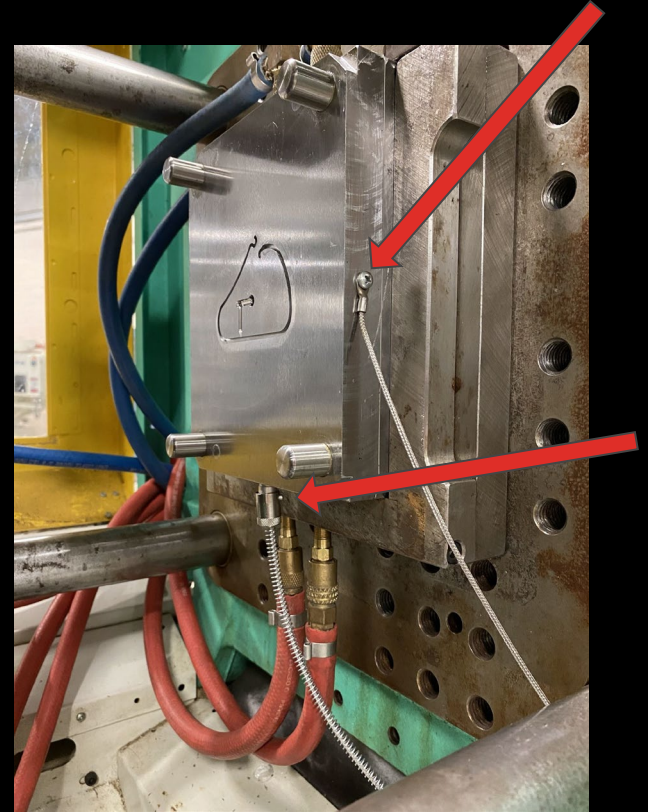
- Arburg Allrounder 320s 500-150 Injection Molding Machine
  - 55 Ton Clamping Capacity
  - Hydraulic Machine Design
- Extech 4-Channel Data Logging Thermometer
  - Surface Mount Thermocouples
  - Probe Thermocouples



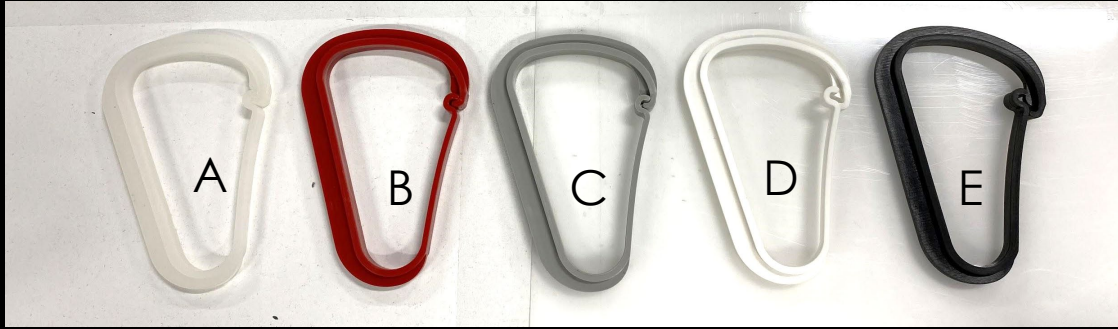


# MOLD SPECIFICATIONS

- Master Unit Die Insert Mold
- Single Cavity Carabiner
  - Cavity Material: P20 Steel
  - Thermal Conductivity: 21 Btu/ft/hr, deg F
- Thermocouple Inserts
- Mold Maker
  - R&D Leverage – Lee Summit, MO



# MATERIAL TESTING



- (A) Capron 8200 NL – Mineral Filled Nylon
- (B & C) Magnum 357 - Red & Grey ABS
- (D) Hylon 6610-18 - 18% Glass Filled Nylon
- (E) GE Valox 310 SEO - PBT

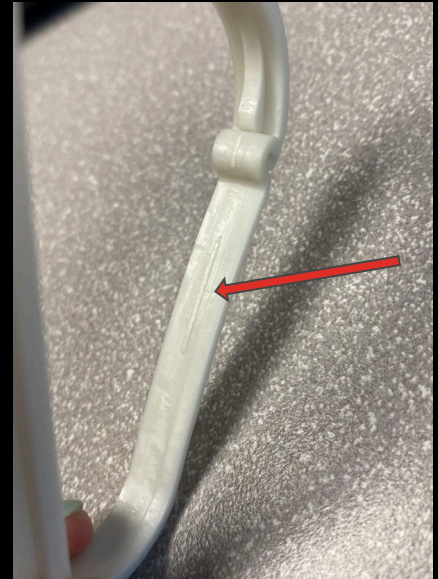
# RESULTS



- Capron 8200 NL – Mineral Filled Nylon
  - Good mechanical properties
  - No stress line when folded
  - Stuck in mold
- Magnum 357 – Red & Grey ABS
  - Good mechanical properties
  - Stress line when folded
  - Stuck in mold
- GE Valox 310 SEO – PBT
  - Good mechanical properties
  - Stress line when folded
  - Stuck in mold
  - Severely warped
- Hylon 6610-18 – 18% Glass Filled Nylon
  - Acceptable mechanical properties
  - Stress line when folded
  - Stuck in mold
  - Severely warped

# MOLD MODIFICATIONS

- During preliminary tests, our parts were sticking in the mold.
- A groove was machined into the ejector side to ensure the part stayed in the “B” half of the mold.
- After mold modification, the mold ran satisfactorily and the process window could be expanded.

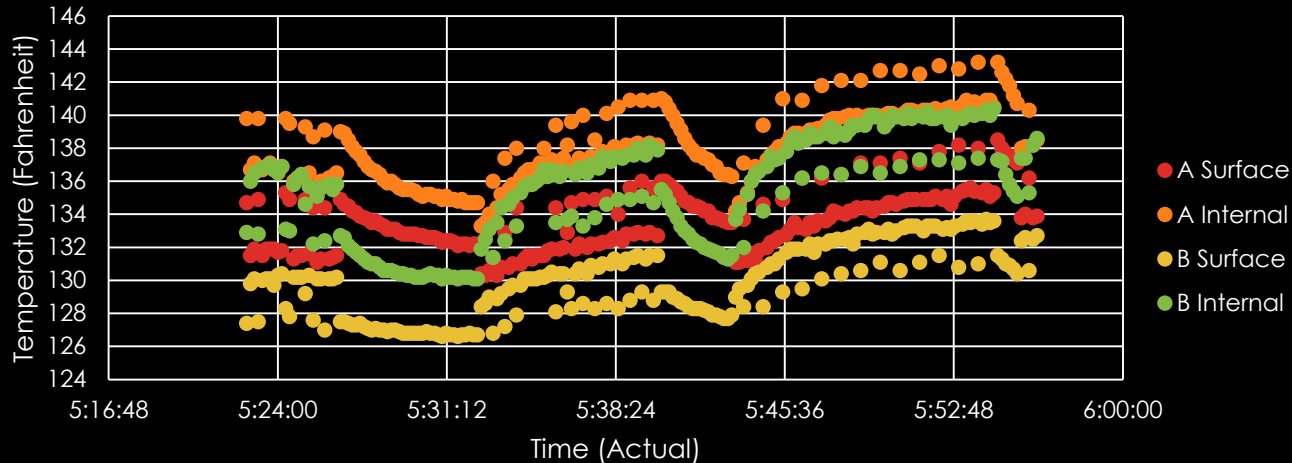




# MOLDING TRIALS

## Molding Trial 1: Interruptions During Molding Process

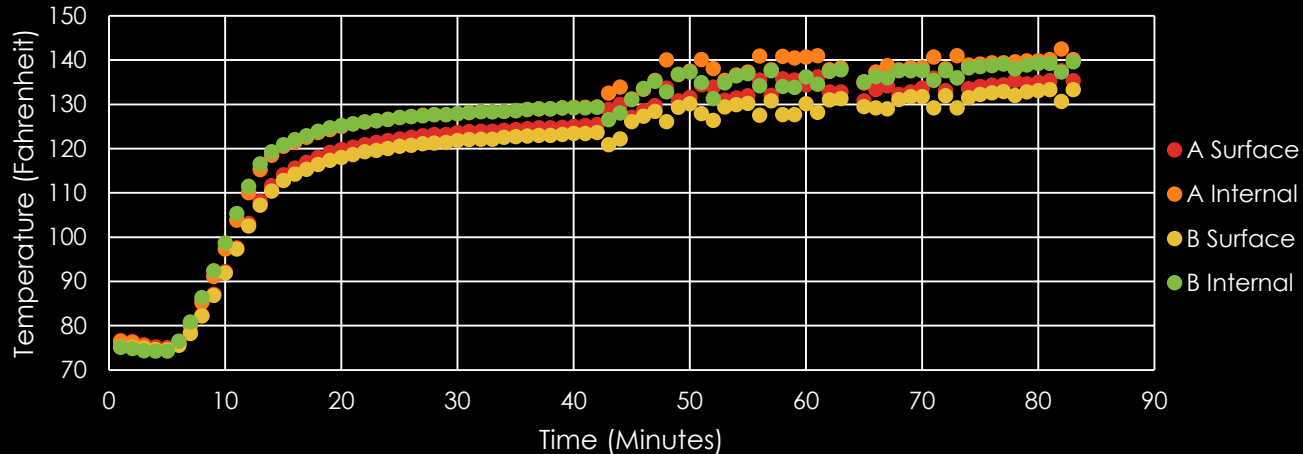
- Study how process interruptions affect the temperature of the mold.
- Allows the processor to know how long it will take to start producing good parts after a process interruption.



# MOLDING TRIALS CONTINUED

## Molding Trial 2: Start Up

- Study how long it takes for the mold to reach molding temperature.
- Allows the processor to know how long it will take the mold to heat up to processing temperature.



# FINDINGS FROM MOLDING TRIALS

- We noticed that as the mold opened during each cycle, the temperature would increase a few degrees.
- We think this may be due to some strain on the thermocouples in the mold.

## **Molding Trial 1**

- When an interruption occurred, it took a few cycles before the mold temperature regulated to its processing temperature.
- The internal heat of the mold was greater than the heat on the surface.

## **Molding Trial 2**

- When the machine was not running, it took around 20 minutes for the mold to reach processing temperature.
- During processing, the temperature throughout the mold stayed constant, but only the A half (internal) reached the set mold temperature (140 °F).

# ACCOMPLISHMENTS & FUTURE WORK

## **Accomplishments**

- Conducted 5 different material tests.
- Established material that was used for continued trials.
- Learned how to use and extract data from data logging thermometer.
- Molded 500 carabiner clips and found how heat transferred throughout the mold.

## **Future Work**

- Procure mold cavities made of aluminum, 3D printed material, and stainless steel to evaluate the heat transfer in these different materials.
- Conduct studies on mold wear for each mold.
- Conduct additional heat flow studies.



# ACKNOWLEDGEMENTS

- Department of Plastics Engineering Technology
- Paul Herring
- Progressive Mold Components
- R & D Leverage – Lee Summit, MO

