# M2.05 – Synchronic Drive

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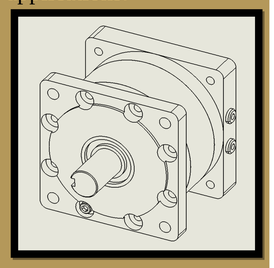
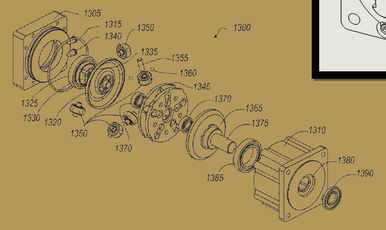
## INTRODUCTION

Our senior design project collaborates with Argent Automation, a pioneer in automation technology known for the patented **Synchronic Drive**. This innovative gear reducer provides unique advantages, such as zero-backlash, high stiffness, and energy efficiency, offering cutting-edge solutions for OEM and servo motor applications.

**U.S. 11,761,517**





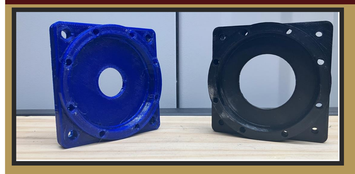

## MANUFACTURING PLAN

- Received 3D model and functionality details from sponsors; reviewed design, and material selections
- Create a cost-effective 3D-printed prototype and assemble it for initial evaluation
- Use 3-axis and 5-axis CNC machining, with waterjet and band saw support;
- Test CNC code on REM shapes and wood to ensure precision.
- Assemble parts and conduct functional tests to validate the expected results.

## Material Selection

**Prototyping Materials**:
•**PETG** for FDM (Fused Deposition Modeling) parts due to its durability and ease of use.
•**Chitu Conjure Tough ABS-like Resin** for SLA (Stereolithography) parts, providing high precision and toughness.
•**REN Shape and Wood** used to test CNC code, reducing costs, preventing tool damage.
**Final Material Selection**:
•**4140 Steel** for input and output disks due to its high fatigue strength and abrasion resistance, ideal for load-bearing parts.
•**1018 Steel** for housing and index plates, chosen for its machinability and durability, ensuring long-term structural reliability.

## 3D PRINTING AND PROTOTYPING




*We created 3D printed prototype of all the parts that we are required to machine.*

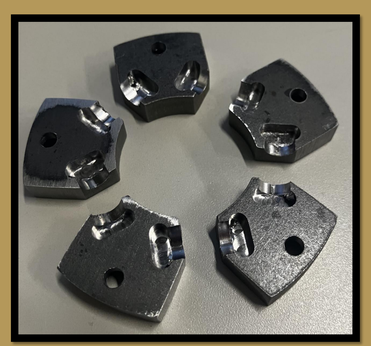
- We used the Craft Bot XL's in the makerspace to make the Index Plates, and housing with PETG filament
- Due to the intricacy of the input and output discs, we opted to use an "Elagoo Mars 2" resin printer with "Chitu Systems Conjure Tough ABS like Resin" .

### Items Manufactured

**AFT Block, FWD Housing**
Mounting points connecting the input motor to the output shaft.
Created using CNC 3 axis after testing CNC code with wood
**Input and Output Discs**
These components work in tandem to reduce the speed of the driving motor and convert it to torque. Created using 5 axis CNC machining.
**Index Plates**
Midpoints that holds the needle nose bearings that connects the input and output discs and allows them to work in tandem.

## Assembly and Working principles

Max Gear Ratio **16:1**
Max Contact force **1111 lbf**
Max Contact Stress **55506.9 psi**
Max Output **1100.67 in-lb/124.36 Nm**

## Challenges & Solutions

- Original design for Index_Plate_F had extremely thin outer walls which lead to near impossible machining operations. To compile with design for manufacturing standards and reduce replacement cost
- Custom vise required for Index_Plate_F to meet tolerance specifications
- Input disk required a specialized tool holder due to steep angle of 5-axis cuts on internal surface
- Design change on internal width on input disk to account for power disks
- Fine tuning feeds and speeds especially for operations with 1/8" endmills.

## Conclusion and Final Recommendations

- Lead time for shipping parts and tools is extremely important and effects machining timelines far more than design choices
- Proper file management can save hours of labor from being repeated
- Testing code on wood and ren shape was a good cost-effective decision
- Verifying toolpaths with simulations and peers can save lots of time and tools.

## Acknowledgements

- Ingram Hall Makerspace and its staff
- Brain Earl for all his assistance in 5-axis operations
- Mark Summers and Dr. Mohammad for guided the team as our instructors this last year
- Harrison Thramann, for providing an ear and keen mind throughout all our engineering struggles

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