CWC Generator

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NAU NORTHERN ARIZONA UNIVERSITY

And Dynamometer

NAU NORTHERN ARIZONA UNIVERSITY

Project Description

- Goal: Create a small-scale generator for the NAU CWC team
  - Helps save time and resources
  - Improves performance of the turbine
- Client and Advisor: Professor Willy
  - 20+ years experience in industry
- Wind Energy is growing nationwide
  - Wind Energy in US [1]: 2014 - 4% VS 2023 - 10%

Design Efforts

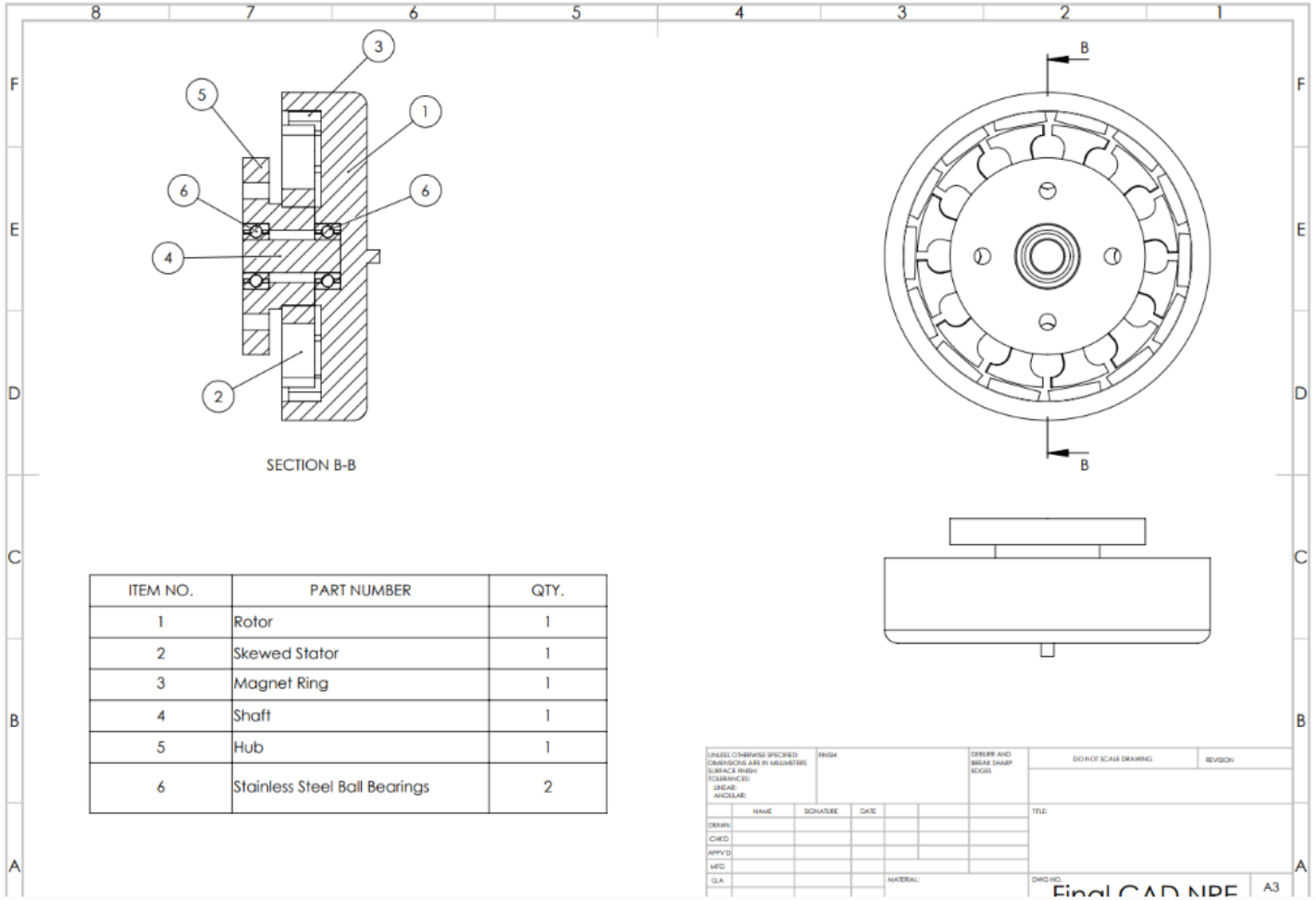
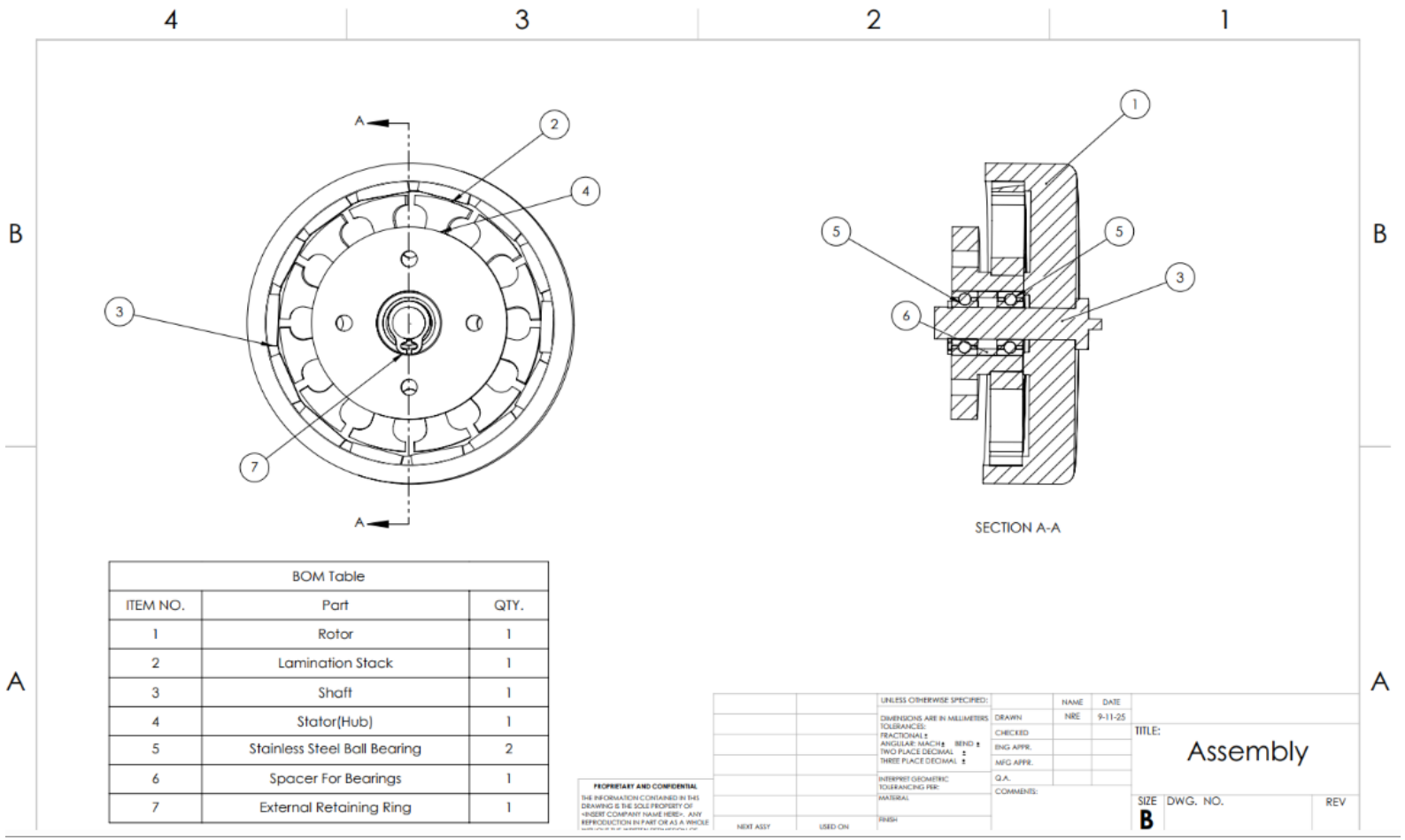


Figure 1: Final Assembly CAD (Rev B)

Design Efforts



BOM Table		
ITEM NO.	Part	QTY.
1	Rotor	1
2	Lamination Stack	1
3	Shaft	1
4	Stator(Hub)	1
5	Stainless Steel Ball Bearing	2
6	Spacer For Bearings	1
7	External Retaining Ring	1

Figure 2: Final Assembly CAD (Rev C)

Purchasing Plan

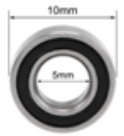
ITEM NO.	PART	DESCRIPTION	PURCHASE QUAN	Price $	Total Price $	PART STATUS	PRIMARY VENDER	LINK	NOTES	IMAGE
1	Magnet Wire	1pc Magnet Wire, 23 AW	1	$ 31.36	$ 31.36	Ordered	Remington Industries	https://www	More wiring	
2	Aluminum Rod	1pc - 2 1/2 inch diameter	1	$ 116.00	$ 116.00	Ordered	McMaster-Carr	Tight-Toleran	Manufacturing Casing and Hub	
3	Retaining Ring	100pc - External Retaini	100	$ 6.71	$ 6.71	Ordered	McMaster-Carr	External Ret	Only need 1	
4	Steel Rod	1pc - 2 1/2 inch diameter	1	$ 53.96	$ 53.96	Ordered	McMaster-Carr	Low-Carbon	For making the shaft of the generator	
5	Epoxy Glue	EFT Epoxy Glue	1	9.14	$ 9.14	Received	Harbor Feight	Quick-Settin	Appling to magnets to casing	
6	Ball Bearings	4pc Ball Bearings Bore 4	4	7.64	$ 7.64	Received	Amazon	uxcell MR10	Only need 2	
7	Magnet Wire	1pc Magnet Wire, 23 AW	1	19.09	$ 19.09	Received	Remington Industries	https://www	First wire purchase with donation	
8	Magnets	14pc Magnets	14	0	$ -	Received	Elemental Motor	-	Donation	
9	Silicon Steel	1pc Silicon Steel Sheet	1	0	$ -	Received	Elemental Motor	-	Donation	
10	Power/Battery Conn	240pc - Smeace 15/30/4	1	30.12	$ 30.12	Received	Amazon	Amazon.com	Power kit for dyno	
			Total Parts Nee	24	Total Parts Recei	20				
			Total Spent	$ 274.02	Parts Required (%	80%				
					Assembled (%)	33%				

Figure 3: Bill of materials

CAD of Lamination Stack

- .007" thick silicon steel sheets
- Lasered out each sheet
- Epoxied the lamination stack using 832-C
- Total hours to manufacture ~ 25

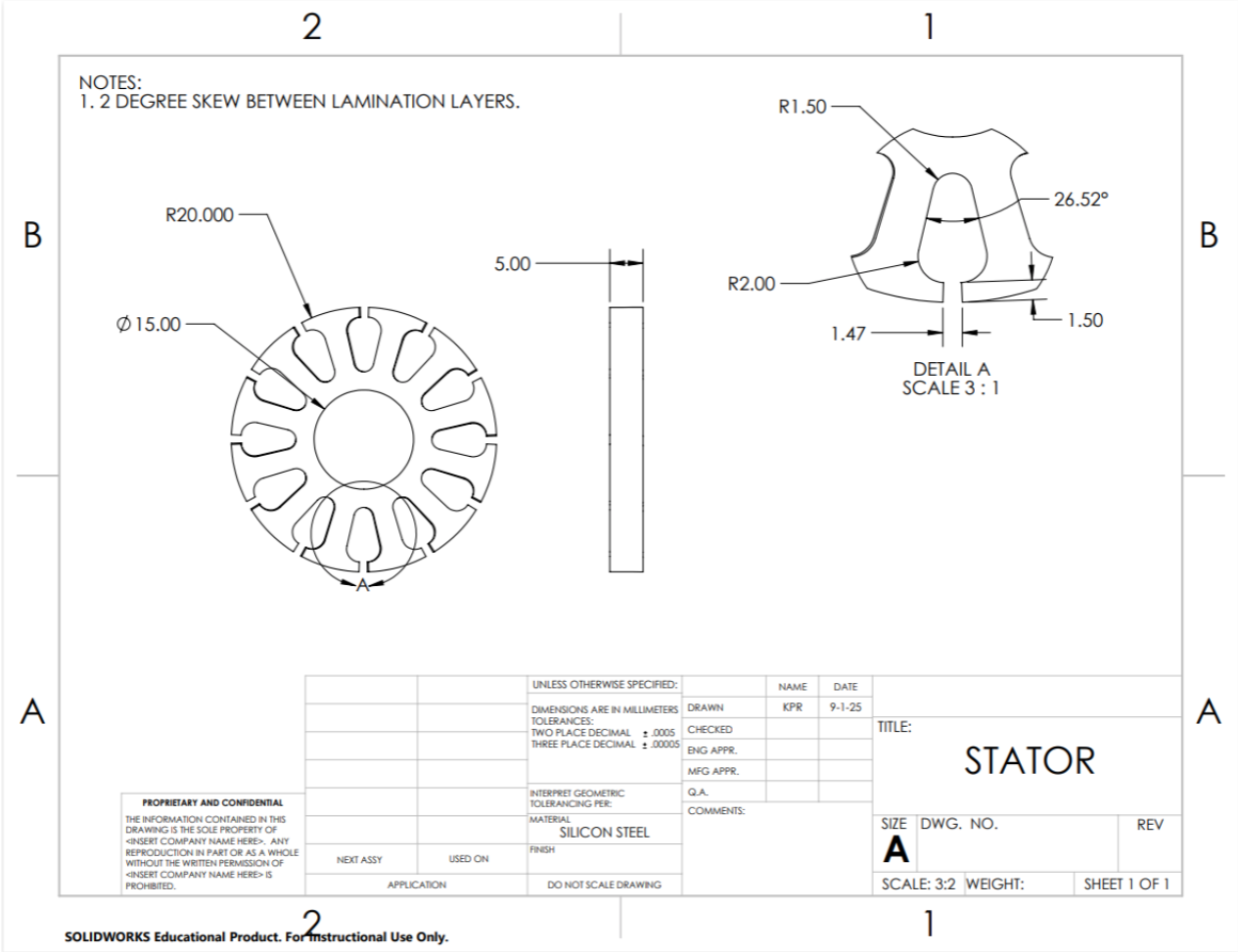


Figure 4: Stator Lamination Stack CAD

Lamination Stack

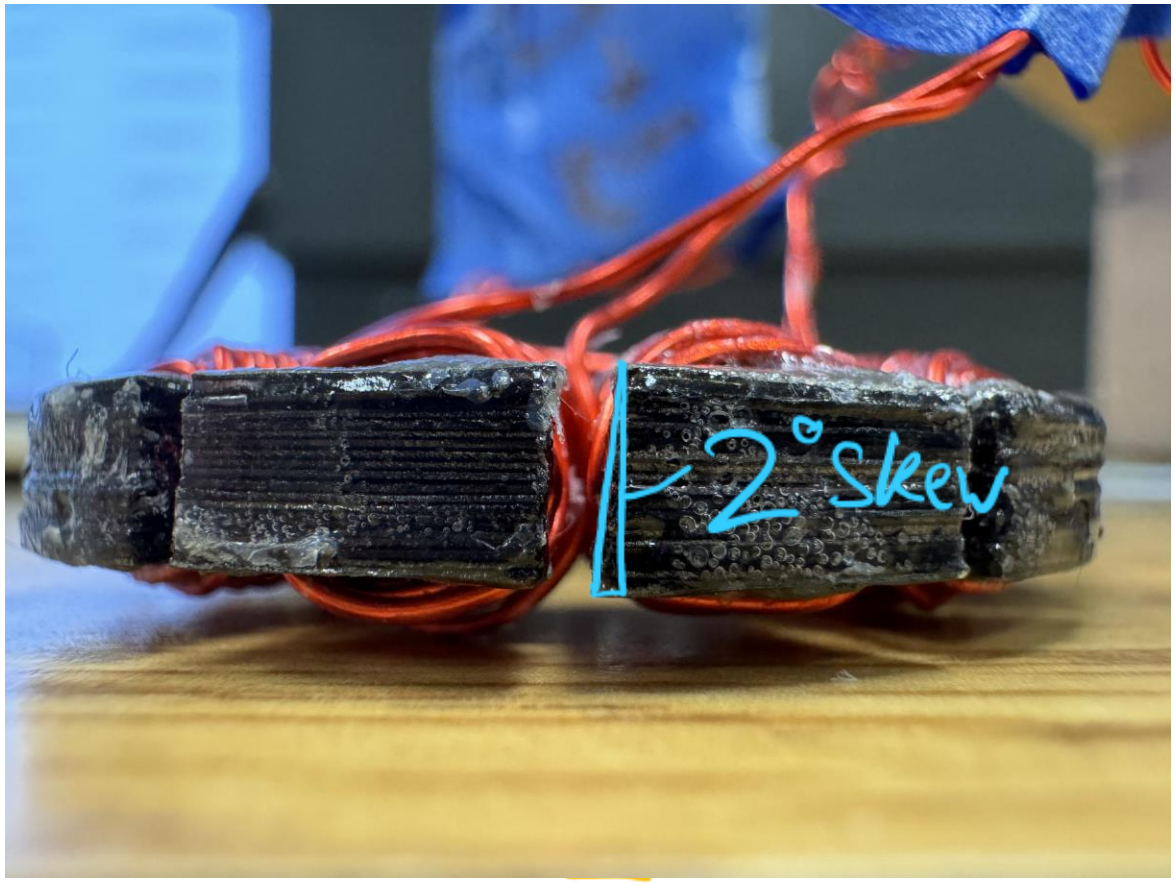


Figure 5: 2 Degree Skew

Figure 6: Top View of Lamination Stack

33% Build Demonstration- Coils

- Practiced Winding
- Wound one coil first to be tested
- Wound one phase at a time
  - Fill Factor: 58.77%
- Each phase was tested
- Total hours: ~12 hours

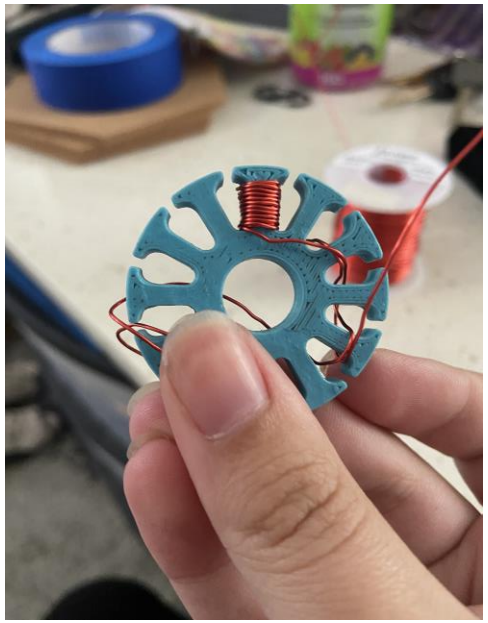


Figure 7: Practice Winding

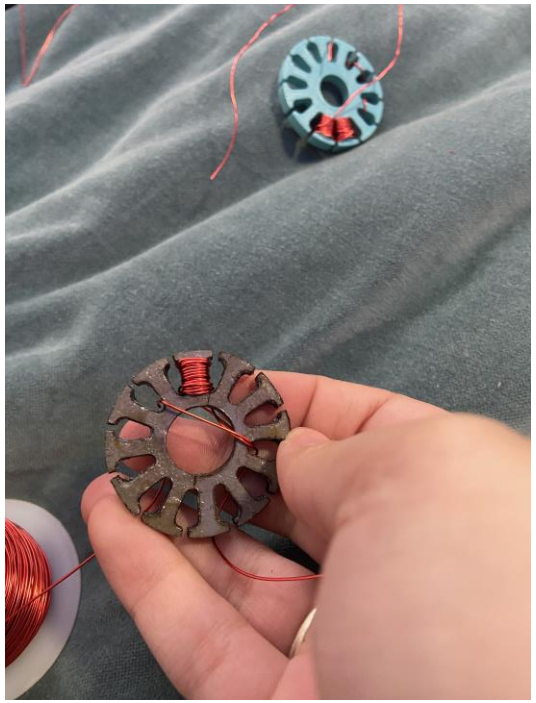


Figure 8: First Official Winding

33% Build Demonstration - Coils

- Hipot tested to 500 Volts per IEC 60950 regulations
- Slaughter AC Hipot Tester

Figure 9: First Coil Testing

Figure 10: Testing with sides taped

33% Build Demonstration- Coils

- Practiced Winding
- Wound one coil first to be tested
- Wound one phase at a time
  - Fill Factor: 58.77%
- Each phase was tested
- Total hours: ~12 hours

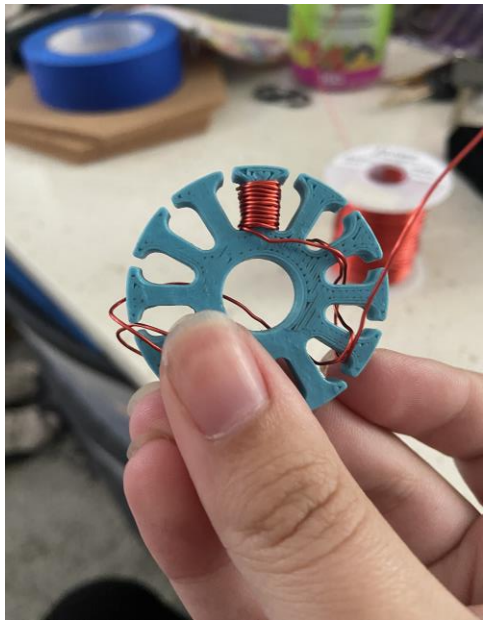


Figure 11: Practice Winding

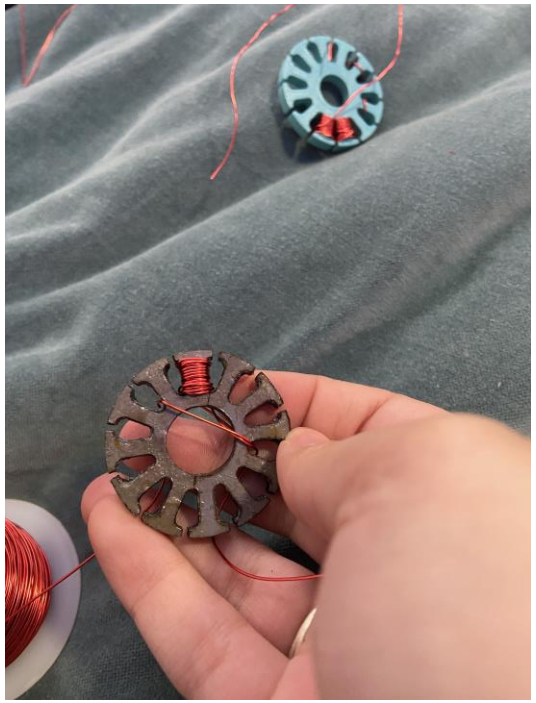


Figure 12: First Official Winding

Hipot Testing

Video 1: Phase 1 Hipot Testing

Video 2: Hipot Testing All Phases at Contact Point

33% Build Demonstration- Coils

Figure 13: Completed Winding Front

Figure 14: Completed Winding Back

Simulation with new turn number

- New simulation results are as follows:
  - Magnetic Flux: 0 - 1.7 Tesla
  - Torque: .006 - .04 Nm
  - Kv Rating: 120 RPM/V
  - Peak Voltage: 170V
  - Power: 1.7 kW

*All of these values are within our benchmark

Total Hours: ~ 2 hours

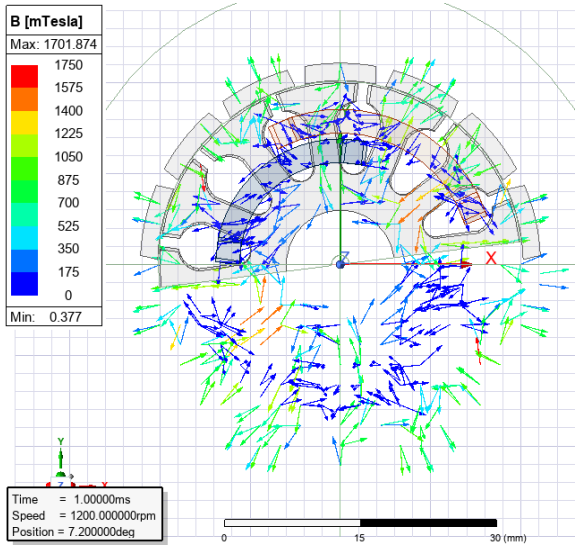


Figure 15: Magnetic Flux Vectors

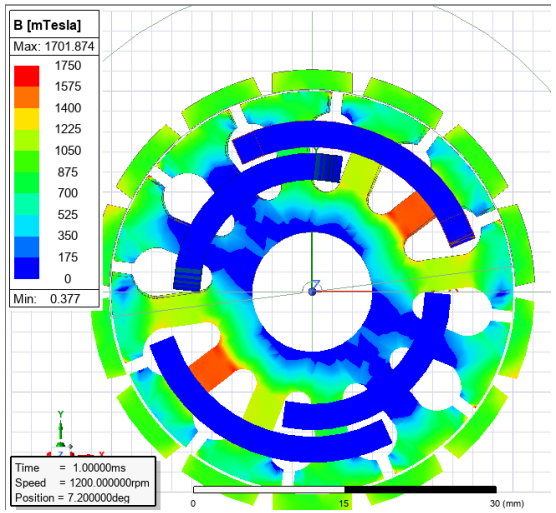


Figure 16: Magnetic Flux

Looking Ahead

- Next in the Manufacturing Process:
  - Rotor
  - Hub
  - Shaft

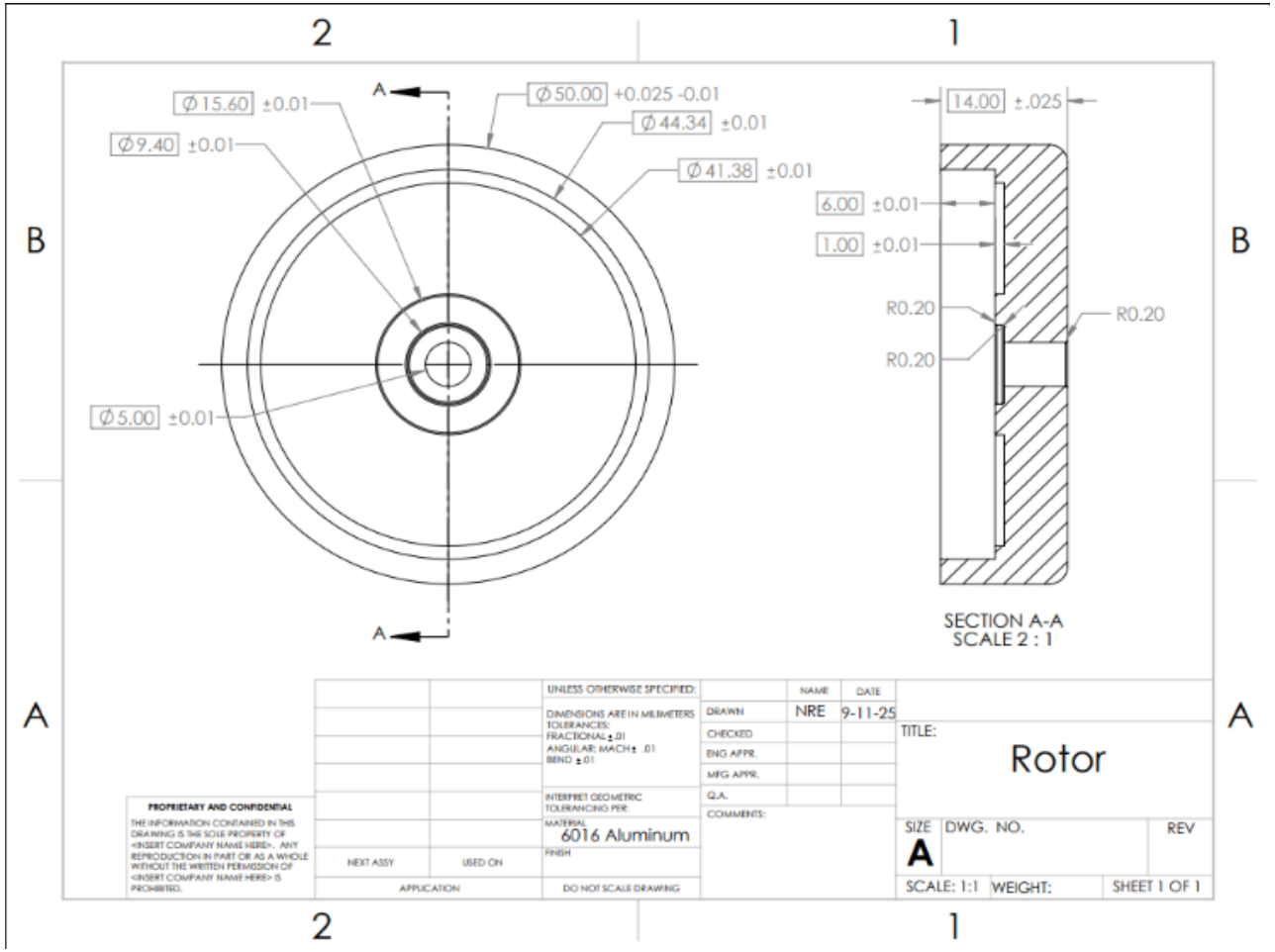


Figure 17: Rotor Drawing

Looking Ahead cont.

- Dynamometer
  - Torque, voltage, and current calibration
  - Generator Kv curves
    - MAD Jenny
    - Melon Motor

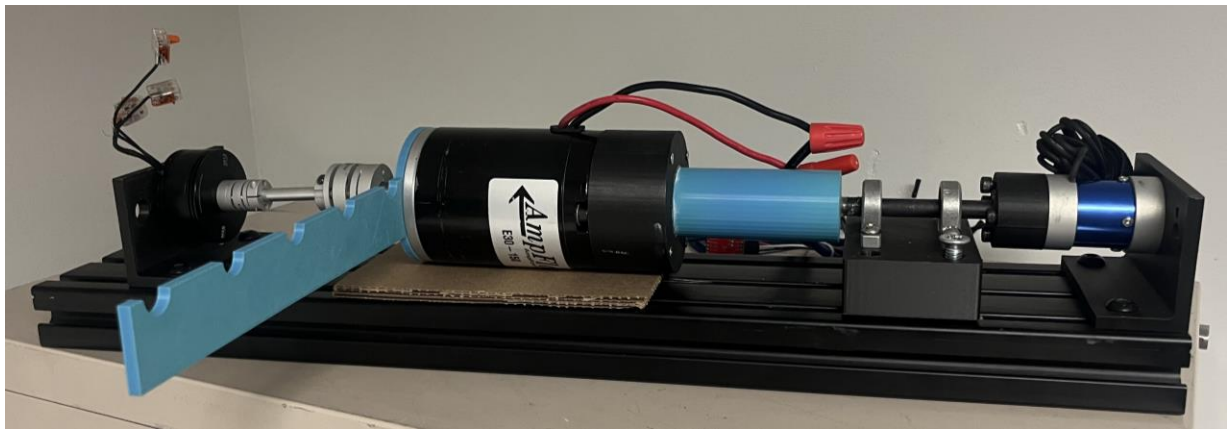


Figure 18: Dynamometer

Gantt Chart

67+% Build	Everyone	0%	9/26/25	10/16/25
Draft of Poster	Everyone	0%	9/26/25	10/30/25
100+% Build	Everyone	0%	10/17/25	11/6/25
Final Poster	Everyone	0%	10/30/25	11/16/25
Inital Testing Results Video	Everyone	0%	11/7/25	11/20/25
Product Demo	Everyone	0%	11/7/25	12/4/25
Final Testing Results Video	Everyone	0%	11/21/25	11/26/25
Practice Presentation	Everyone	0%	10/30/25	11/16/25
TBA	TBA			
Testing				
Test Exisiting Generators	A.G., C.B., J.J.	0%	9/15/25	9/21/25
Test Our Generator	Everyone	0%	11/6/25	11/7/25
Hipot Test the Coil	K.R., N.E.	100%	9/14/25	9/21/25
Test fit all of the componests	Everyone	0%	10/5/25	10/11/25
TBA	TBA			

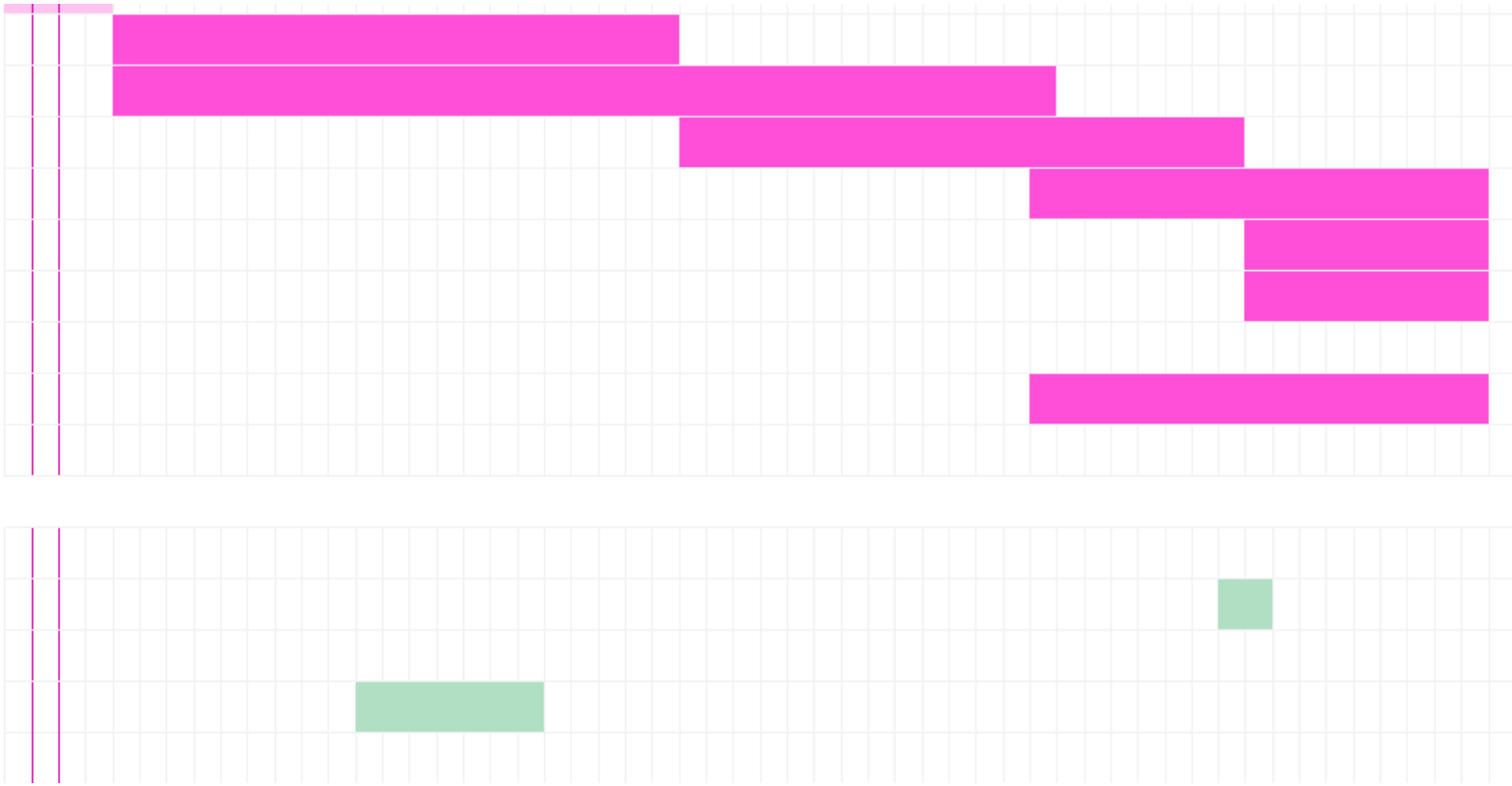


Figure 19: Gantt Chart

Thank you
Any questions?

References

[1] Climate Central, “A Decade of Growth in Solar and Wind Power: Trends Across the U.S. | Climate Central,” *www.climatecentral.org*, Apr. 03, 2024. https://www.climatecentral.org/report/solar-and-wind-power-2024
[2] “Moteur / Alternateur 3 phases,” Letmeknow, https://letmeknow.fr/fr/moteurs-et-servo-moteurs/1828-moteur-alternateur-3-phases-652733948892.html (accessed Sep. 22, 2025).

Appendix

Figure A-1: Complete first phase

Figure A-2: Complete second phase

Appendix

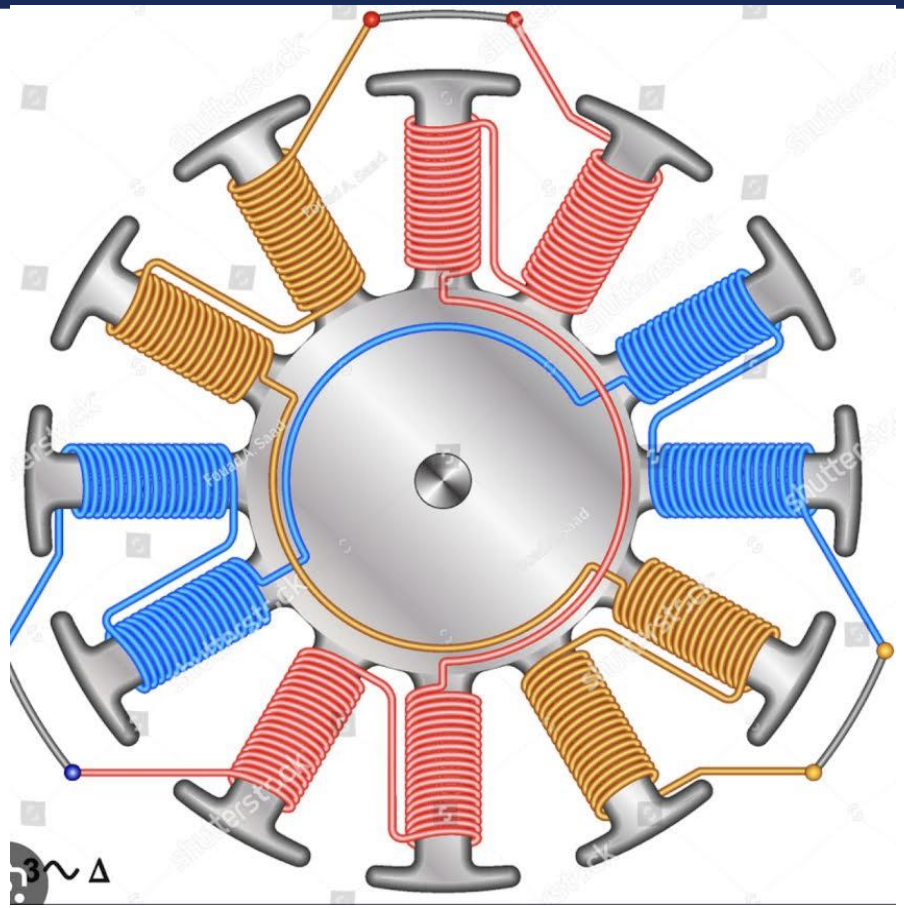


Figure A-3: Diagram Used for Winding

Appendix

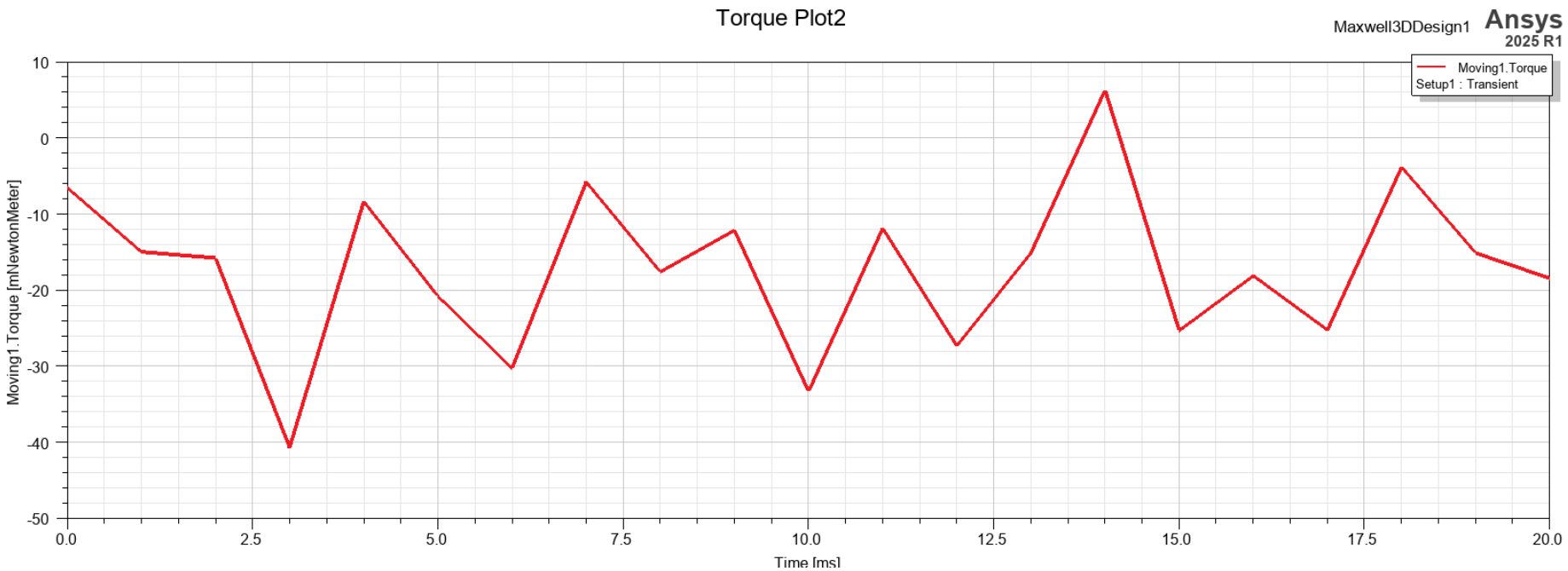


Figure A-4: Torque Graph from Ansys

Appendix

Video A1: Phase 2 Hipot Testing

Video A2: Phase 3 Hipot Testing