Problem Formulation and Project Plan

Electric Torque Machines Inc.

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Overview

- Client Information
- Need Assessment
- Project Goal
- Currently Used Process
- Objectives
- Constraints
- Quality Function Deployment
- Project Schedule
- Conclusion

Electric Torque Machines, Inc.

- New class of BLDC known as transverse flux motors
- Flux path is transverse instead of parallel to rotor motion
- Low-resistance coil, high pole count
- Low-RPM/High-Torque Applications

What they need…

- Reduce production time of bicycle hub motor
- Motor rotor shell assembly currently takes 15 minutes
- A large portion of that time is the loading of magnets and concentrators

Bike Motor

Source: (http://etmpower.com)

Need Statement

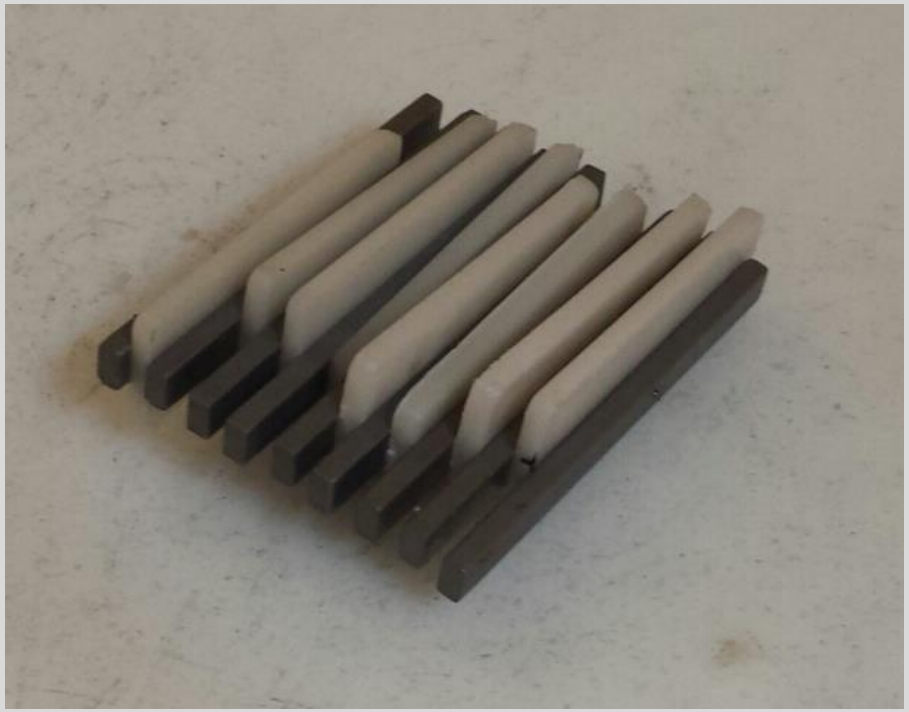
- Loading magnets and concentrators takes too long

Finished Rotor Assembly

Assembled Rotor

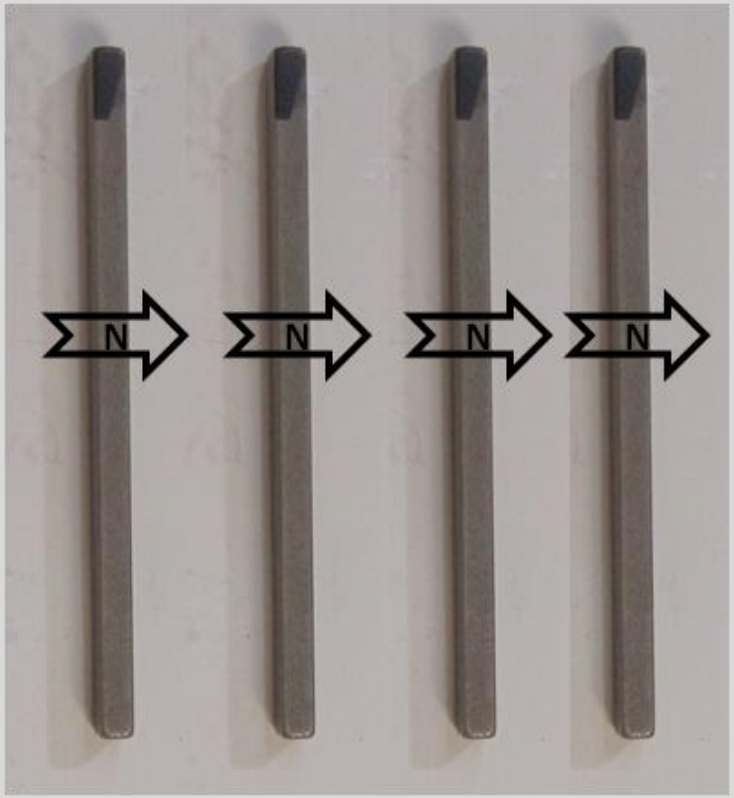
Magnets as Packaged

Magnets as Packaged



Magnets

Marked Magnets

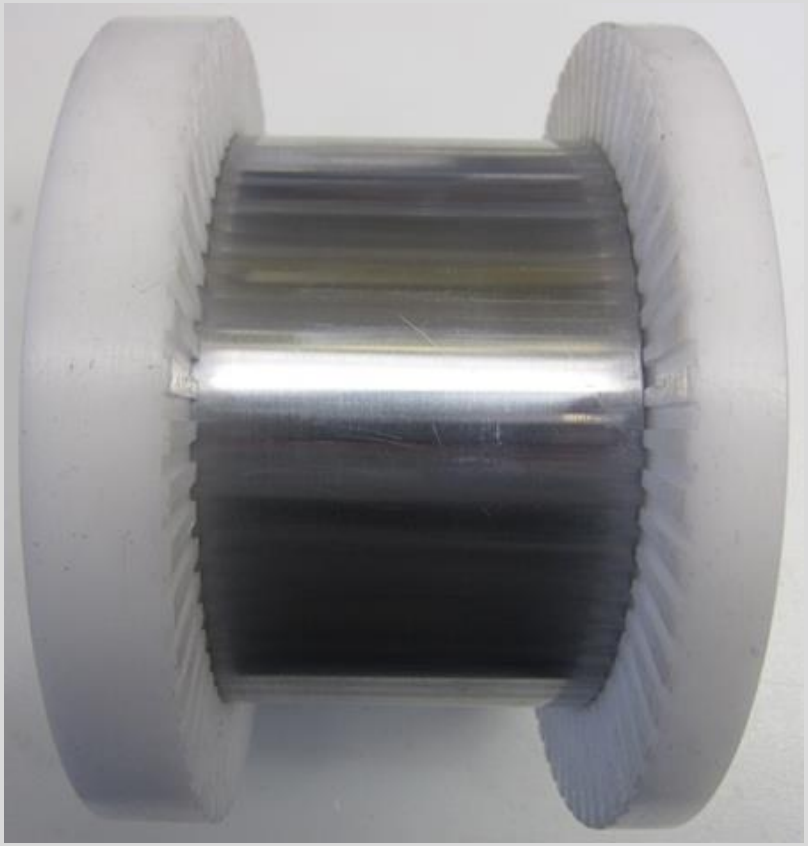


Mandrel

Mandrel

Mandrel and End Caps

Mandrel and End Caps



Mandrel Loaded with Magnets and Concentrators

Loaded Mandrel

Mandrel without End Caps

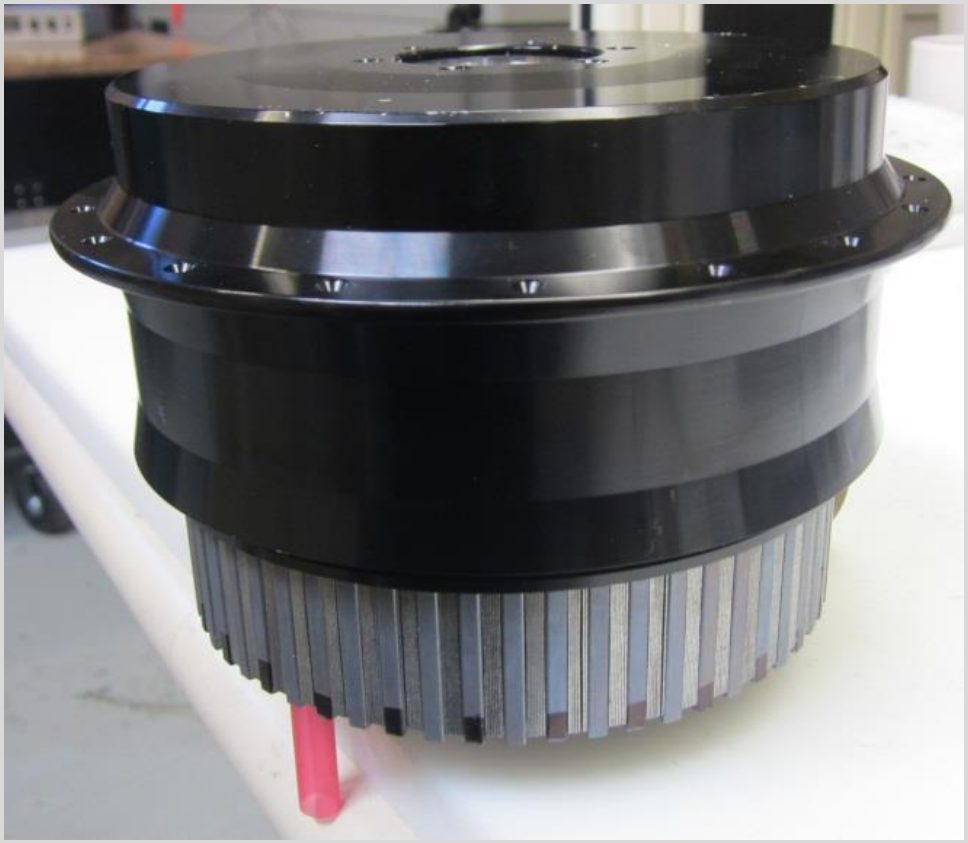
Loaded Mandrel

Potting the Rotor

Epoxy Straw in Mandrel

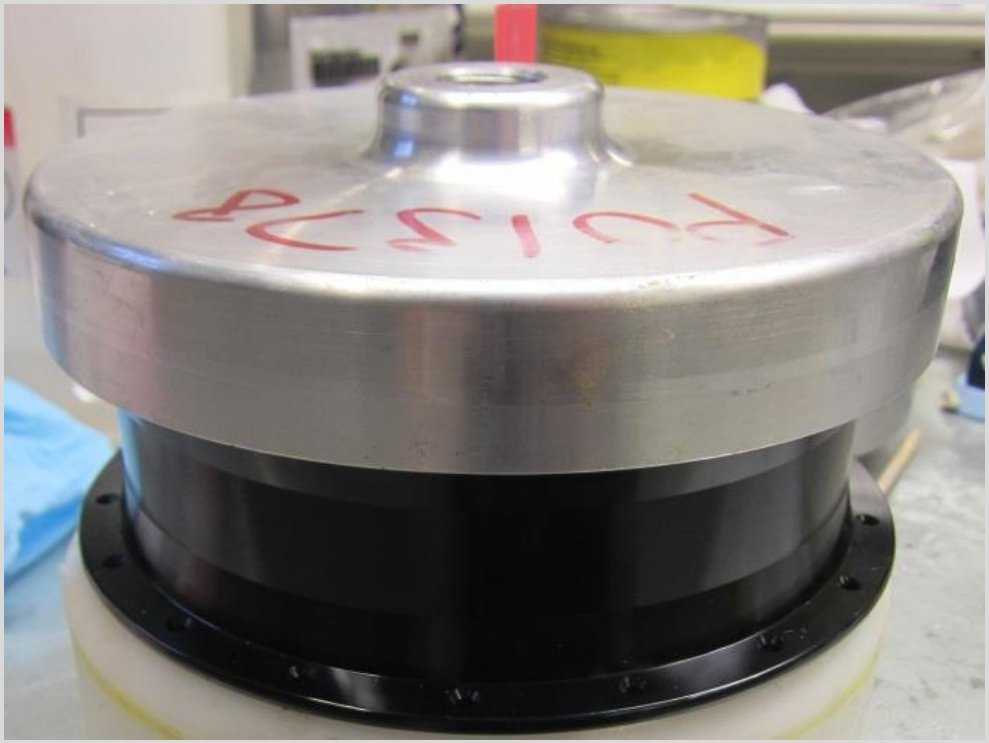
Inserting Mandrel Into Rotor Shell

Mandrel and Shell



Preparation for Oven

Rotor Lid



Rotor

Rotor

Goal Statement

- Design a system/process that decreases magnet and concentrator loading time.

Objectives

- The magnets and concentrators must be loaded in less time than the existing processes is capable of
- The system must be inexpensive to build, operate, and maintain
- The magnets and concentrators must be precisely loaded into motor casing in terms of axial and rotational alignment

Constraints

- Entire system must fit on workbench
- The system must be operable by one person
- The magnets and concentrators must remain intact
- Magnets must be aligned within X degrees of the rotational axis of the motor
- The runout between the magnet ends must be Xmm or less.

QFD

		Engineering Objectives							
		Cost to Build	Cost to Operate	Cost of Maintenance	Material Strength	Time	Space	Weight	Precision
Customer Requirements	Fit on Work Bench						X	X	
	Process completion in < 5 min.		X			X			X
	Aesthetics								
	Meets OSHA Requirements	X	X		X				
	Ease of Operation		X			X	X	X	
	System Lifespan	X	X	X	X				
	Concentrator Alignment	X				X			X
	Magnet Alignment	X				X			X
	Magnet Condition	X				X			X
	Unit of Measure	$	$/yr	$/yr	MPa	min	ft^2	lbs.	mm.
	Technical Target	TBD	TBD	TBD	TBD	5	2'x2'x4'	200lbs.	

QFD Explanation

- Importance of objectives
- Correlations the objective has with the customer requirements
- A higher correspondence = more importance

Project Schedule

Task Name:	Weeks								
	Oct 7-13	Oct 14-20	Oct 21-27	Oct 28-3	Nov 4-10	Nov 11-17	Nov 18-24	Nov 25-1	Dec 2-8
Concept Generation									
Concept Selection									
Magnet Analysis									
Alternative Design Analysis									
Final Design Analysis									
Proposal Generation									

Conclusion

- Client Need
- Project Goal
- Currently Used Process
- Objectives
  - Decrease time, low cost, high precision
- Constraints
  - Space, operability, magnet location and condition

Conclusion Cont.

- Quality Function Deployment
- Project Schedule

References

- www.etmpower.com
- Jerry Crawley, Director of E-bike at ETM