Louisiana State University, College of Engineering

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Reverse Engineering Project: Rotary Sander

Figure 1: Complete Rotary Sander

Abstract (OAR)

A rotary sander, a device used to manipulate a surface through rotational abrasion, was reverse engineered to determine functionality of parts (electromechanically, in human interfaces, and the driveshaft) and identify areas of improvement. To improve electrical safety and device durability, the drive shaft will be made of stronger material, and wires will be more safely secured. To increase adaptability, the device will include an attachment for a vacuum. The proposed improvements would improve performance, safety, and versatility, elevating user experience.

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Introduction: (KDR)

Mechanical systems are used in many everyday tools and devices, allowing energy to be converted into motion. Rotary sanders are a common example of this kind of system, transforming electrical energy into mechanical energy to perform work. A rotary sander is one such device, designed to smooth or remove material from a surface using a fast, rotating sanding disk.

Although the tool may appear quite simple, based on its external design and components, it contains several complex subsystems that contribute to the overall function of the device. These include the drivetrain, responsible for transferring mechanical energy to the sanding pad; the electromechanical system, responsible for converting electrical energy into rotational motion through a motor; and the human interfaces such as switches, grips, and housing, enabling the user to control the tool safely and effectively. The successful operation of the sander relies heavily on carefully designed parts, that vary in shape and size, all of which influence the overall performance of the device.

The purpose of this report is to use a process, known as reverse engineering, to examine and understand how a rotary sander works. This process involves taking apart the device to analyze the form, fit, and function of each individual component within the overall subsystems. By examining these parts and figuring out how they work, it allows one to discover improvements that could potentially be made to better the device as well as how it works and how it is designed. In addition, by disassembling this device, we can now further understand the process of communication, teamwork, and the deconstruction of mechanical tools.

Procedure for Deconstruction: (ED / KDR)

1. Safety glasses were put on and worn throughout the deconstruction process.
2. The device was placed on a clean and flat workspace to prevent any loss of parts.
3. The sander was turned upside down to access the sanding pad and screws.
4. A screwdriver was inserted into each of the four screws, securing the sanding pad to the base, and the screws were removed (placed aside).
5. The sanding pad was carefully lifted from the base and placed aside for later inspection.
6. The outer plastic housing was carefully pried apart to avoid any damage, cracking, or deformation to the shells.
7. Once loosened, the top shell of the housing was gently lifted off, exposing the wires and inner components, while ensuring no internal parts were damaged.

8. Any screws or wire connections securing the motor in its internal location were identified and removed as needed.
9. The main drive shaft was carefully pried from its original position, in the center of the housing, making sure to avoid damaging any surrounding components.
10. The wires connecting to the rest of the motor were detached fully from the motor, isolating the motor to itself.
11. Once free, the motor was lifted out of the housing and/or drive shaft and set aside.
12. The bearing cap, attached to the fan, was unscrewed separating the fan from the driveshaft assembly.
13. The plastic fan was removed from the driveshaft by applying a gentle force to the location in which the two components met, allowing them to loosen without damage.
14. The bearing cap connected to the counterweight was then removed, completing the disassembly of the driveshaft components.
15. All components were arranged and documented using images and sketches
16. The disassembly process was finished once each of the separate components within each system was examined for form, fit, and function

Functional Decomposition Tree (ES / KDR):

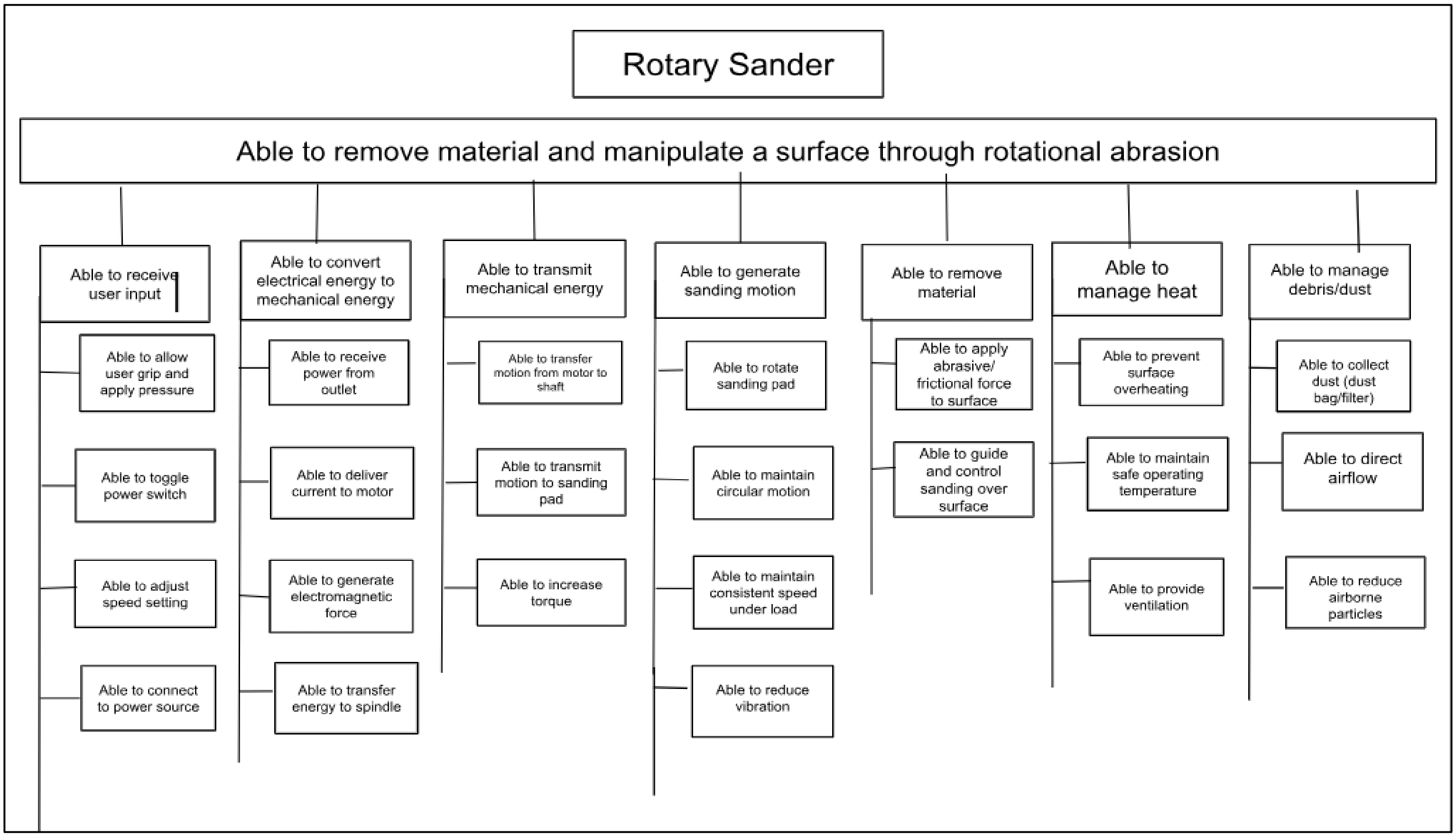


Figure 2. Functional Decomposition Tree for the functions and sub-functions of a rotary sander

Functional Decomposition Tree Description: (KDR)

The functional decomposition tree of the rotary sander breaks down the overall purpose of the tool, removing material and manipulating a surface through rotational abrasion. It is further broken down into smaller functions that describe how the system operates. Starting with user input, the operator is able to control the power, speed, and applied pressure. Electrical energy is then converted into mechanical energy, through the motor and other internal components, to rotate the sanding pad. This rotational motion allows the sander to apply abrasive, frictional force to the surface, removing material and smoothing or shaping a surface.

Additional supporting functions, such as heat management and dust collection, play a critical role in ensuring safe operating conditions by preventing overheating and reducing airborne particles. Overall, the decomposition clearly shows how multiple systems work together to transform electrical input into mechanical output, and the role each part of the device plays, contributing to the overall performance of the rotary sander.

Form, Fit, and Function (Human Interfaces): (OAR)

Figure 3. ON/OFF switch

Form: The on/off switch is a small, rectangular shape, forming a peak, allowing for a pivot between both the on and off settings. It is positioned and mounted on the outer housing of the rotary sander for easy thumb or finger access. The switch contains internal metal conductors and a spring like system enabling feedback. The switch is connected to the internal wiring, electrically, via conductive terminals. It is further housed in a protective, clear case to prevent dust for entering and ensure durability during repeated use.

Fit: The switch is placed in a specific, molded opening on the sander's outer housing to ensure a secure fit, preventing any unwanted movement. It is aligned with the electric circuit, connecting to the power wires and motor directly. The placement of the switch allows for user comfortability while maintaining proper clearance from moving mechanical components and ensuring safe electrical connections.

Function: Able to receive user input by enabling/disabling power. The on/off switch allows the user to stop or start the sander's operation, acting as the primary interface for activating the electromechanical system by either allowing or blocking currents.

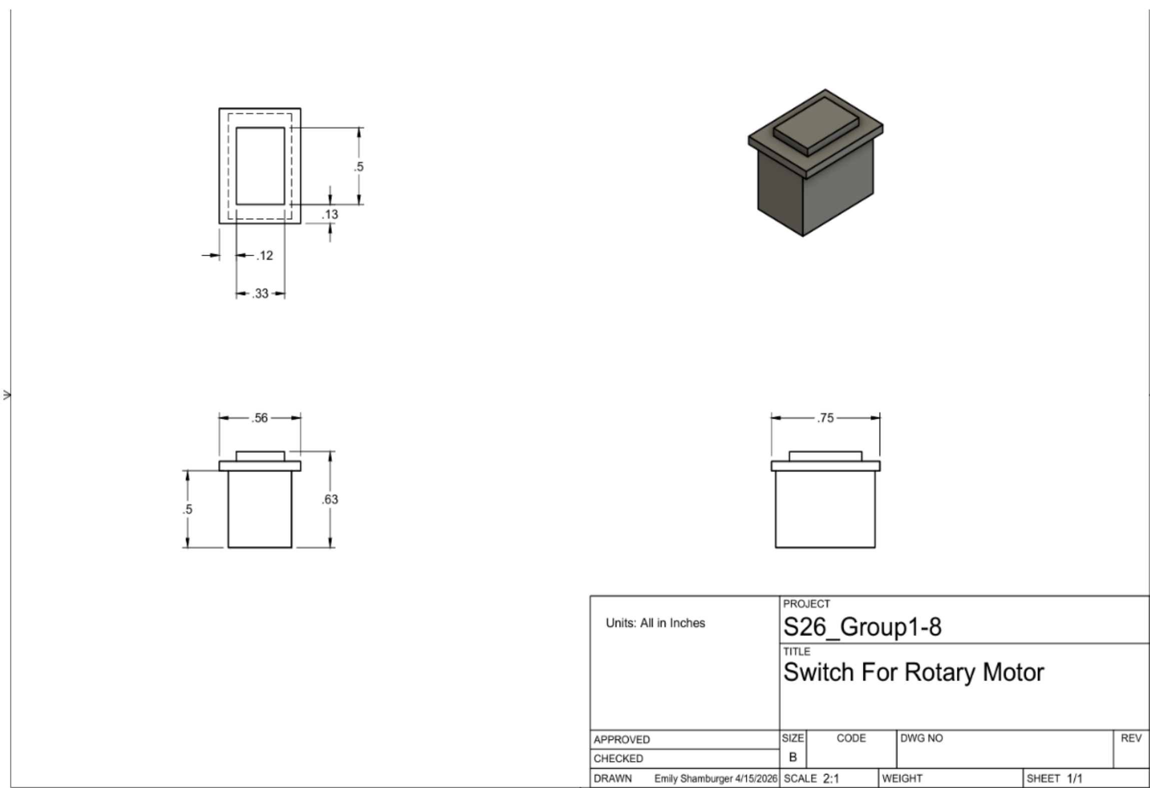


Figure 4. Fusion drawing of ON/OFF switch

Figure 5. Handle (outer casing)

Form: The handle, made of a hard plastic material, is cylindrically shaped to match the curvature of a person's hands. The size and curves are designed to allow a firm but comfortable grip during extended usage of the device. The texture and material improve grip and reduces vibrations felt by the user.

Fit: The handle is located at the top center of the device containing the on/off switch, speed dial, and the spinning shaft. The handle further aligns with the center of mass and the rotating sanding pad to provide balance and stability. It is securely molded as part of the outer casing and positioned to give users control over the tool.

Function: Allows users to easily grip and maintain stability. Further allows users to apply pressure from the top allowing for a more efficient sanding surface.

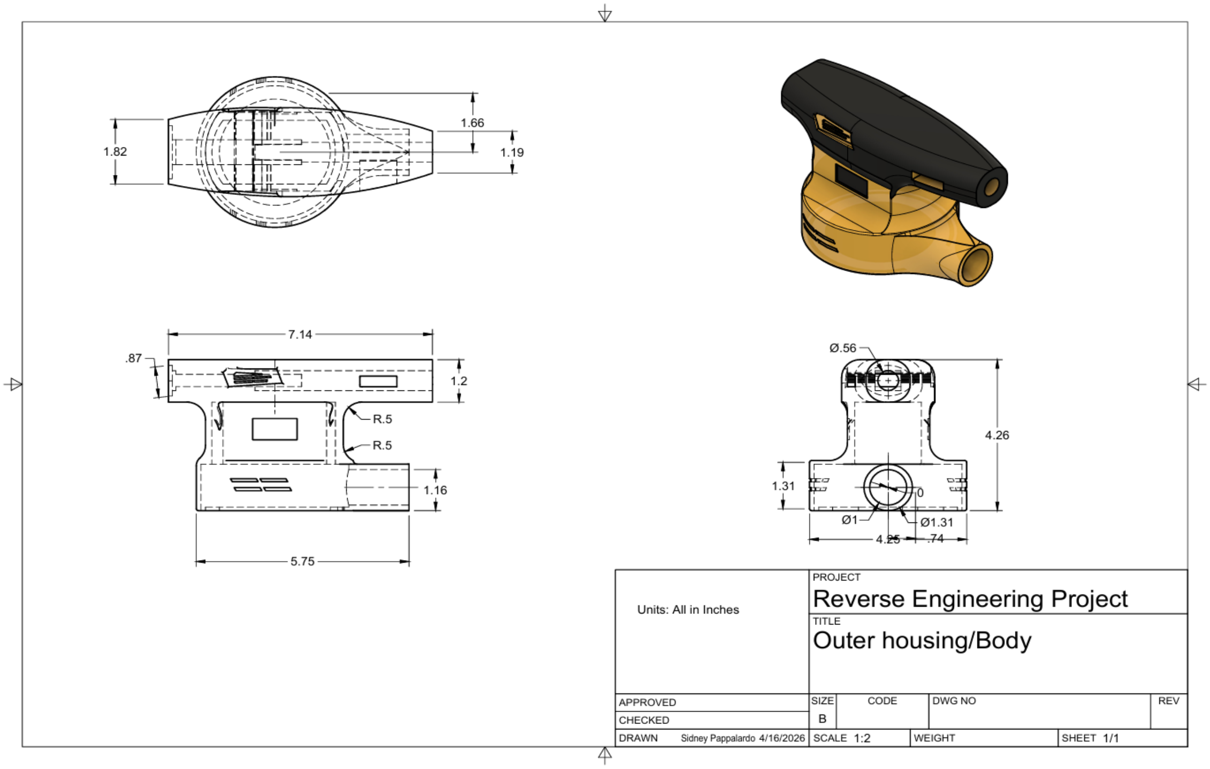


Figure 6. Fusion drawing of Handle (outer casing)

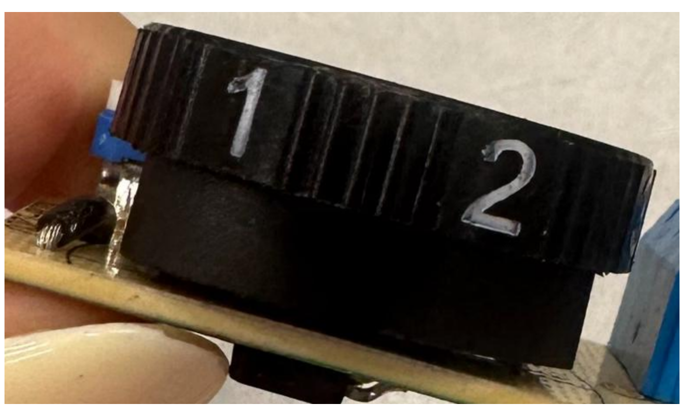


Figure 7. Dial

Form: The dial, located on the outer housing, is a circular knob made of durable plastic with textured edges and numbers to represent the speed levels. It has a diameter of 1.02 in +/- 0.05in with a thickness or height of 0.122 in +/- 0.05in. Internally, it is connected to electronic control components that adjust the motor's speed. The dial is designed to rotate, based on user input, providing tactile feedback at each of the different settings.

Fit: The dial is mounted into the side of the outer casing, sticking out minimally, allowing it to rotate freely while remaining in place. It is positioned in hand reach, near the top of the tool, making it easy for the user to adjust during operation. The dial is further aligned with the speed control circuitry and connected to the motor system but does not interfere with any of the other components.

Function: Able to rotate, allowing user input, to change the settings controlling the speeds of the sanding pad. Further it allows users to adjust speed as needed based on the numbers provided on the dial.

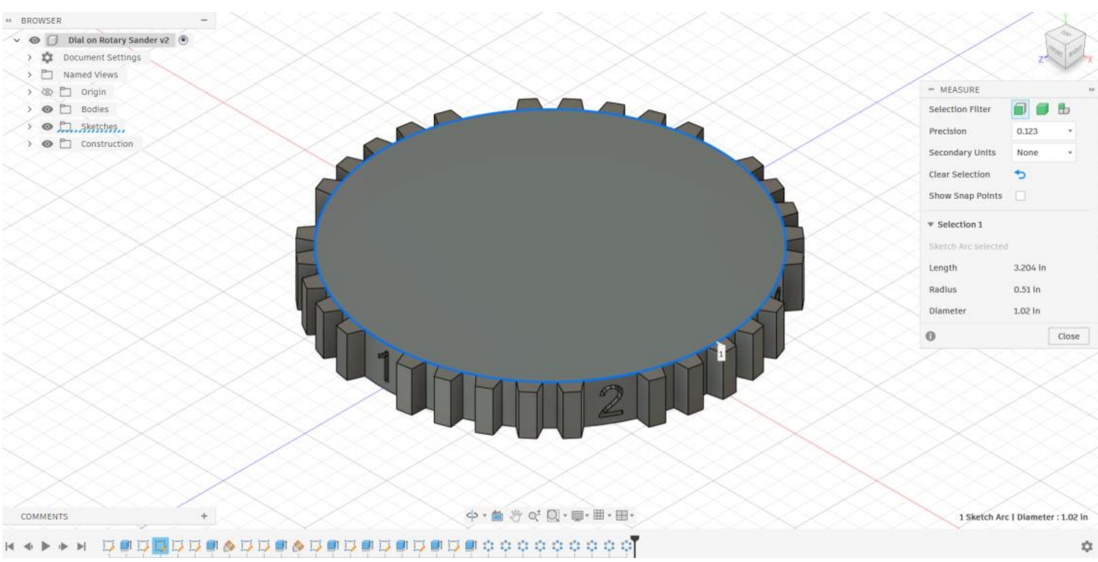


Figure 8. Fusion drawing of Dial

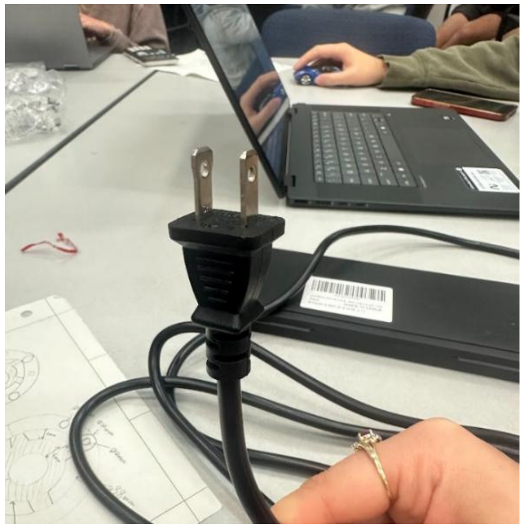


Figure 9. Plug

Form: The plug is a molded component, made of insulated plastic, that holds two metal prongs extending outward. The prongs are made of a conductive metal and are spaced according to specific standard electrical outlet configurations. The body of the plug is ergonomically shaped and compact, allowing for easy grip with internal connections that attach the prongs to the power cord wiring.

Fit: The plug emerges from the handle, on the outer casing of the rotary sander, and is on the opposite side from the on/off switch. The plug is designed to fit into the standard wall outlet along with specific prong dimensions ensuring proper alignment and secure insertion. The plug fits nicely within the user's hand for insertion or removal of the plug from the outlet while maintaining a tight connection to prevent accidental disconnection during use.

Function: Able to conduct and transport electricity. The length of the plug allows for flexibility in device movement and use while the prongs firmly attach the plug into the outlet. Insulation protects users from electrical current.

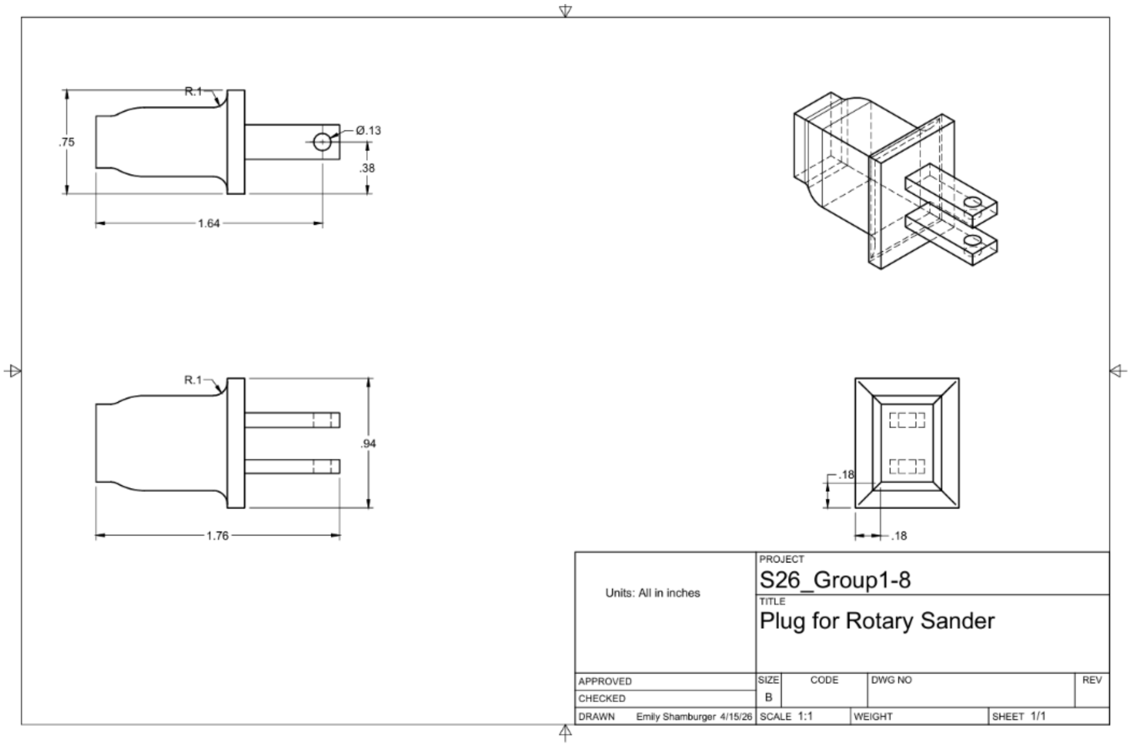


Figure 10. Fusion drawing of Plug

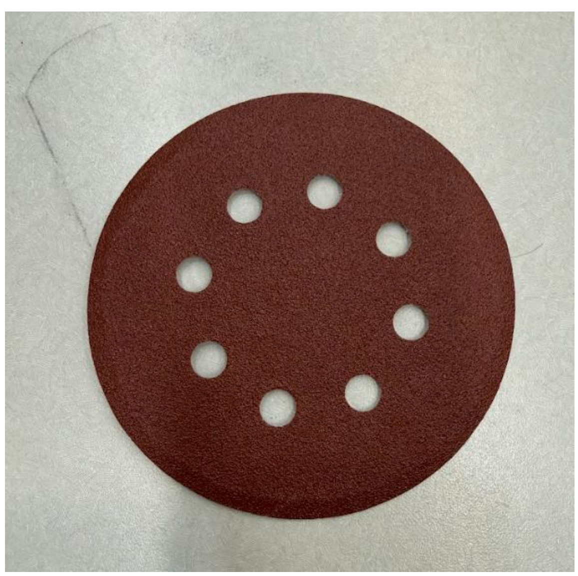


Figure 11. Interchangeable sanding pads

Form: These lightweight, thin sanding pads are circular disc of diameter 5in +/- 0.05in made of abrasive materials. The sanding pads are cut into a circle with a diameter the same size as the sander's Velcro bottom. The pads have 8 holes that align with the holes on the actual device. The surface is very rough to touch, with different grit sizes to determine the coarseness or fineness of the sanding action.

Fit: The sanding pads are designed to fit perfectly onto the Velcro bottom. It sits nice and tight against the bottom so that the entire surface of the pad makes contact with the workpiece during operation. The holes on the sanding pad align with the dust extraction holes to allow for efficient dust removal. The pad forms onto the bottom and surface while remaining securely held in place by the Velcro attachment system.

Function: Able to provide user input by changing the sanding pad and adjusting sanding material to different surfaces. It further allows the holes to aid in dust collection.

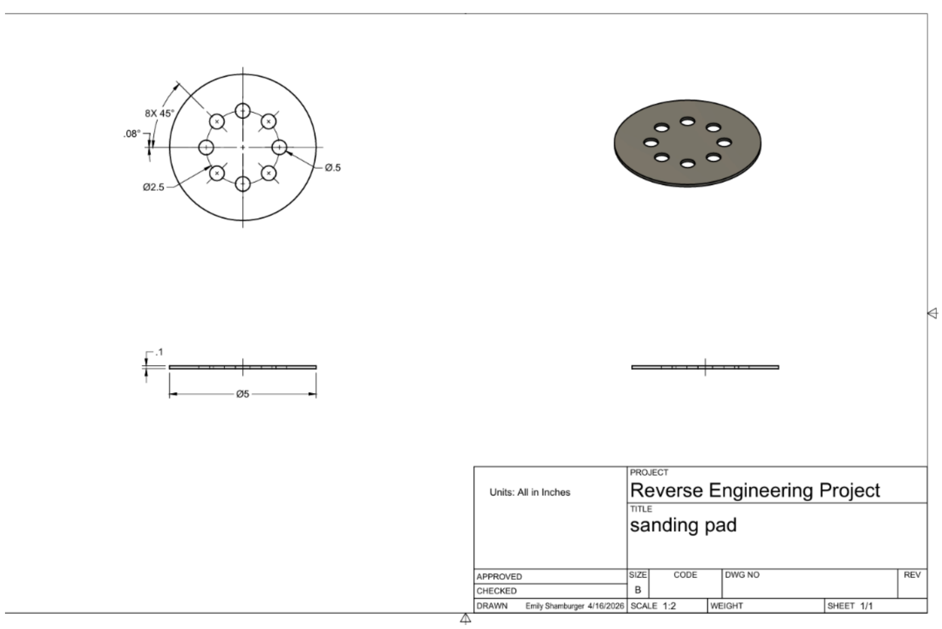


Figure 12. Fusion drawing of sanding pad

Figure 13. Dust Extraction Unit

Form: The dust extraction unit consists of a lightweight, black, cylindrical bag attached to the rear end of the rotary sander. It includes an inlet port where the dust enters the bag allowing air to pass through while trapping the dust particles inside. This component is detachable and allows for removal/dump when full.

Fit: The dust extraction unit clicks onto a cylindrical protruding from the main outer casing of the device. It is roughly 8.2 in long +/- 0.05in with a entry hole diameter of 1.22. The connection is a snap fit, locked in place, to prevent detachment during operation. The gasket seals the bag to control airflow.

Function: Able to collect sanding material to maintain a clean working environment, while further allowing users to empty the bag and reattach when it fills. This improves visibility, by reducing airborne dust particles.

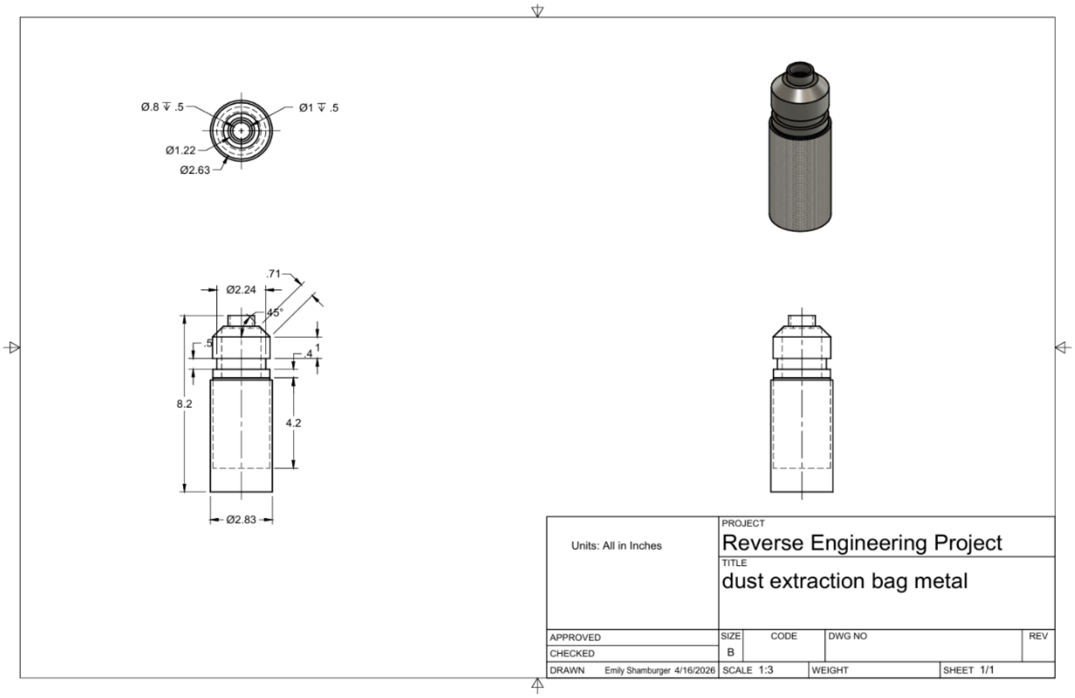


Figure 14. Fusion drawing of Dust Extraction Unit

Form, Fit, and Function (Drive Train): (KDR)

Figure 15. Drive shaft (main base)

Form: The drive shaft is a cylindrical rod, made of steel, running through the middle of the motor core. The length of the entire drive shaft is roughly 5 1/21 in +/- 0.05. The structure of this component includes special machined features such as threads and keyways to connect with other components.

Fit: This component of the tool connects to the motor via two black power boxes. It is mounted within the bearings inside of the shell, ensuring proper alignment and smooth motion. One end is connected to the electric motor, while the other end connects to the sanding mechanism. Specific interfaces within the drive shaft are designed tightly and aligned to prevent vibration or wobbling during operation.

Function: Allows rotational mechanical energy to be transferred from the motor to the sanding surface through kinetic energy. Keeping everything aligned while the fan spins at a very high speed.

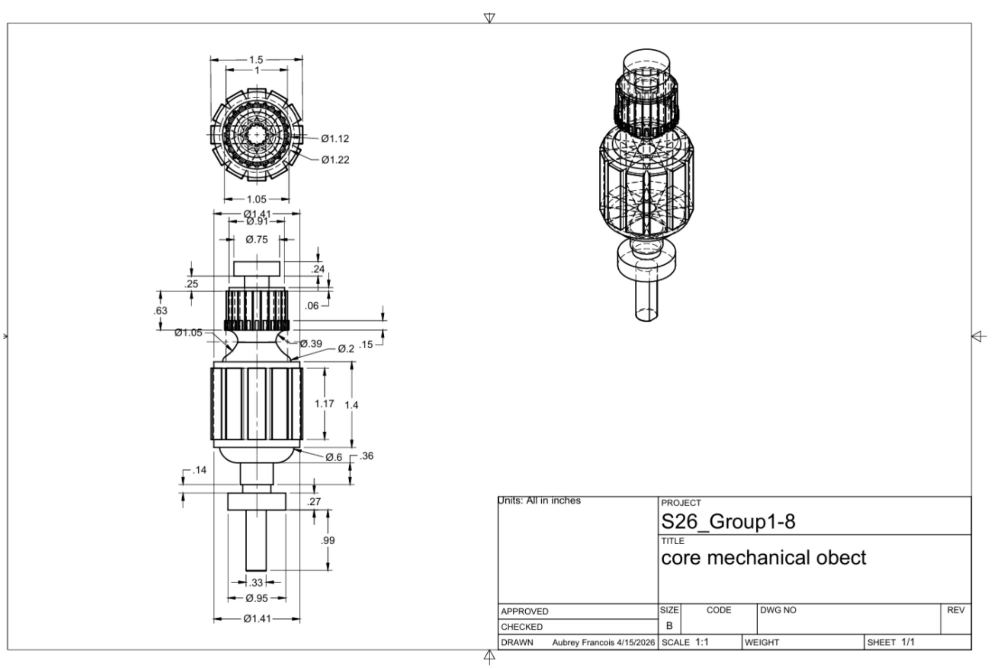


Figure 16. Fusion drawing of drive shaft

Figure 17. Counterweight

Form: This component of the device is flat and triangular but embossed at the top with a hole in the middle. Its diameter is roughly 0.83in +/- 0.05in with a top-hole diameter of 0.18in +/- 0.05in. The counterweight is typically made of steel, designed to off-center the mass distribution so the weight is not off centered around the axis. This component is built to withstand stress without deforming.

Fit: The counterweight is mounted and attached to the drive shaft. It further attaches to the bottom of the plastic fan through a divot on the fan's bottom. The embossed piece connects to the hole in the middle of the bearing cap. The counterweight is positioned precisely with the sanding pad to balance out the system. It must be tight and accurately placed to ensure the rotation synchronizes with the drive shaft to prevent it from shifting.

Function: Allows rotation to maintain stable by creating an offset motion causing the sander to vibrate instead of just spinning in a circle.

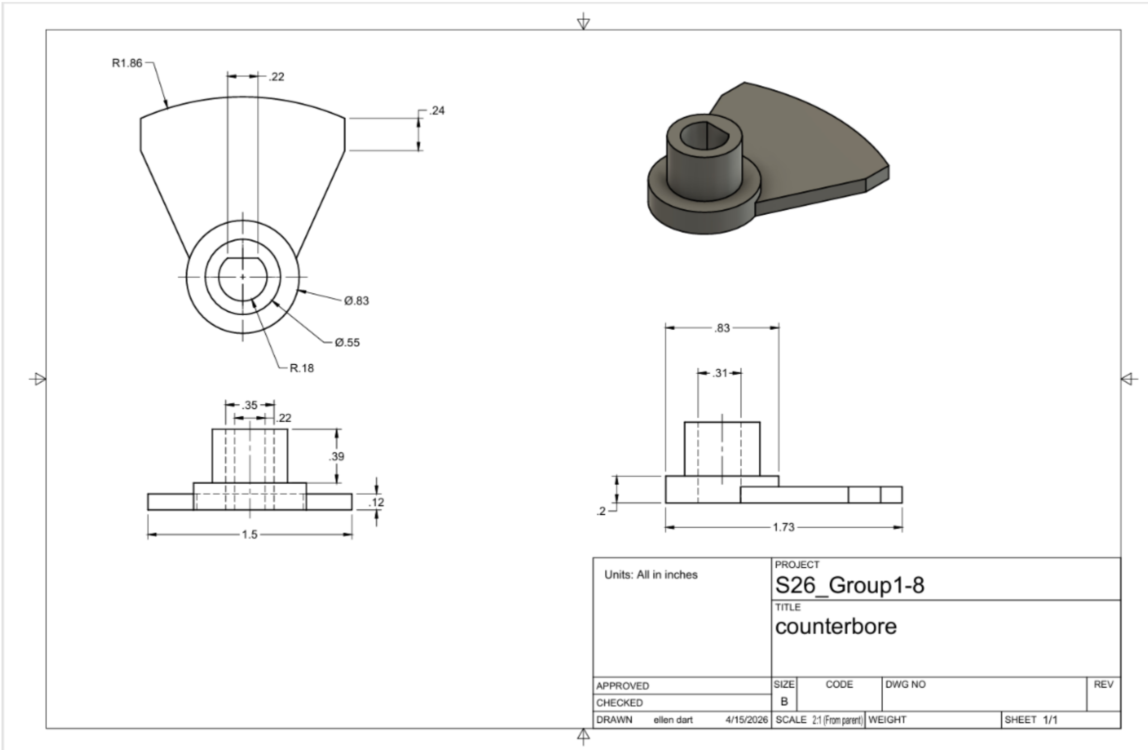


Figure 18. Fusion drawing of counterweight

Figure 19. Bearing Cap

Form: The bearing cap is a circular and rigid component made from aluminum or steel, designed to withstand lots of vibration and mechanical loads. This component features several evenly spaced bolt holes around the perimeter for secure attachment, as well as a central opening to house and support a bearing. The raised and ribbed sections increase the strength, load, and durability while minimizing deformation during use.

Fit: The bearing cap slides perfectly onto the spinning shaft, while fitting precisely into the device's housing, aligning with the rotating shaft and bearing. It further connects to the counterweight, via the hole in the center of the cap. It is stable inside of the device with bolts through the outer holes, further keeping the Velcro bottom attached. The inner diameter of the bearing cap aligns directly with the outer diameter of the bearing holding the bearing cap securely in position. With such a precise fit, it prevents any unwanted movement which could potentially impact smooth operation.

Function: Able to transmit mechanical energy by transmitting motion to the sanding pad. The shaft transfers motion from the motor to the sanding pad, so without the bearing cap, there would be no proper alignment, and rotation would not transfer properly.

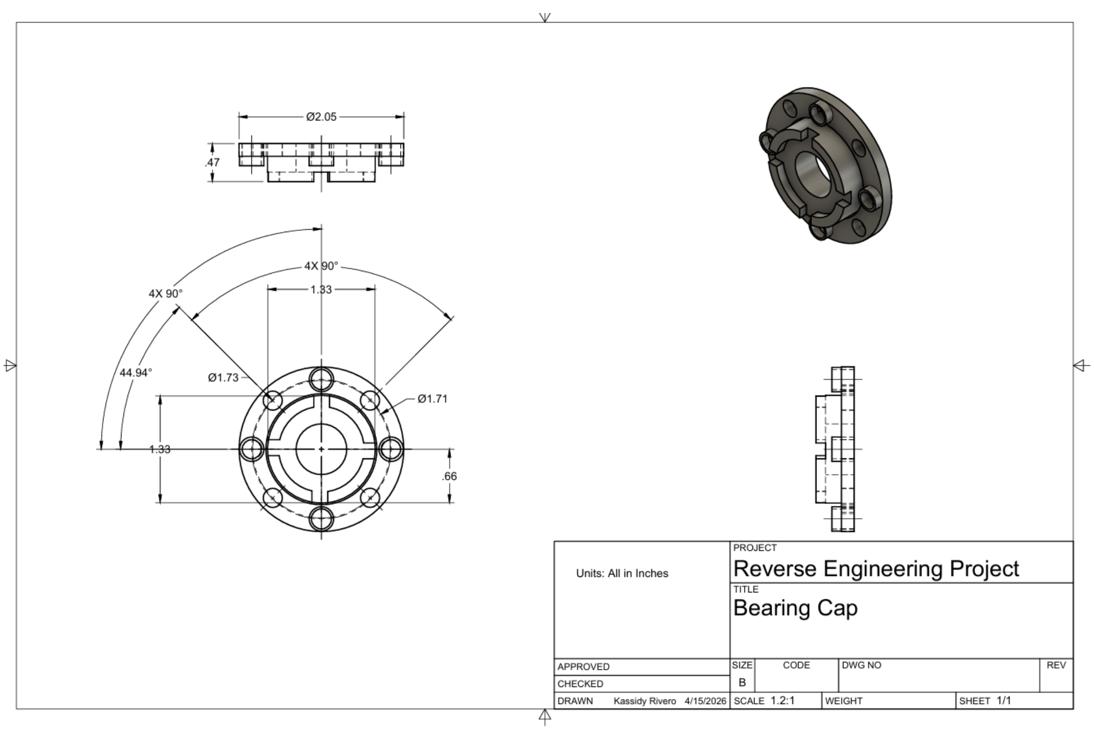


Figure 20. Fusion drawing of the bearing cap

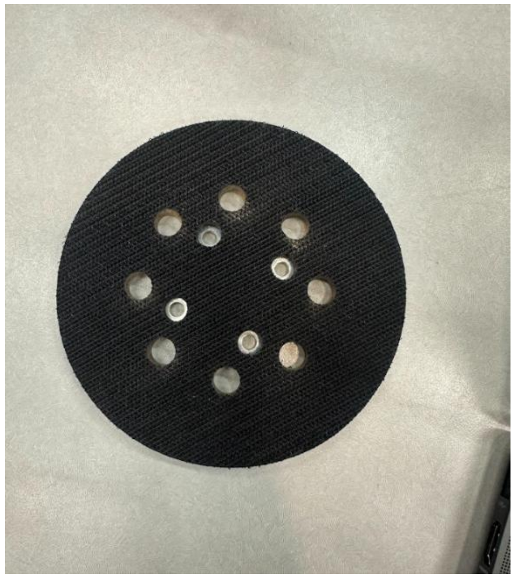


Figure 21. Velcro Bottom

Form: The Velcro rotating bottom, also known as the sanding pad, is a tapered, circular pad made of a very durable rubber and Velcro material. It has a diameter of roughly 4 7/8 in +/- 0.05 with small screw hole diameters of 0.407 in +/- 0.05. One face is covered with a hook-and-loop (Velcro) material while the other is designed for attachment to the drive train mechanism. The Velcro material allows the sanding discs to attach easily.

Fit: The Velcro bottom attaches directly to the bottom plate or output shaft of the rotary sander by screws in the bearing cap. It is centered to ensure there is a balance of rotation, preventing wobbling during operation. The sanding pads attach directly to the Velcro side which is designed to strongly grip these sanding pads, while also allowing for quick removal and replacement.

Function: Able to remove material and/or able to apply abrasive/frictional force to the surface. By rotating and maintaining contact with the surface, the pad allows for effective sanding while distributing pressure evenly, and when needed, allowing dust to be extracted through the holes and properly into the bag.

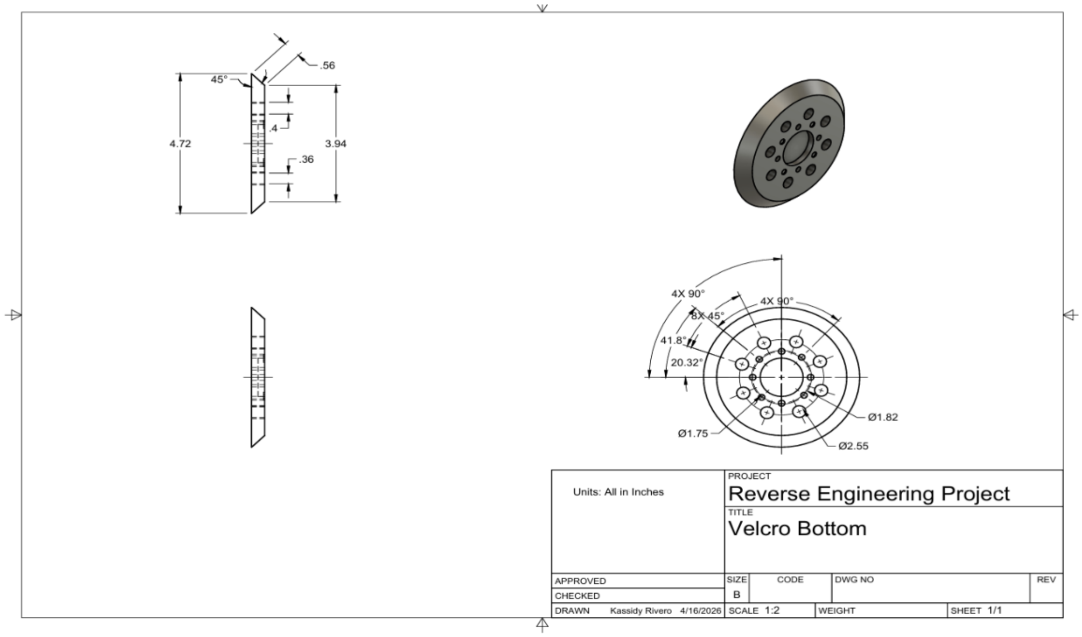


Figure 22. Fusion drawing of Velcro bottom (sanding pad)

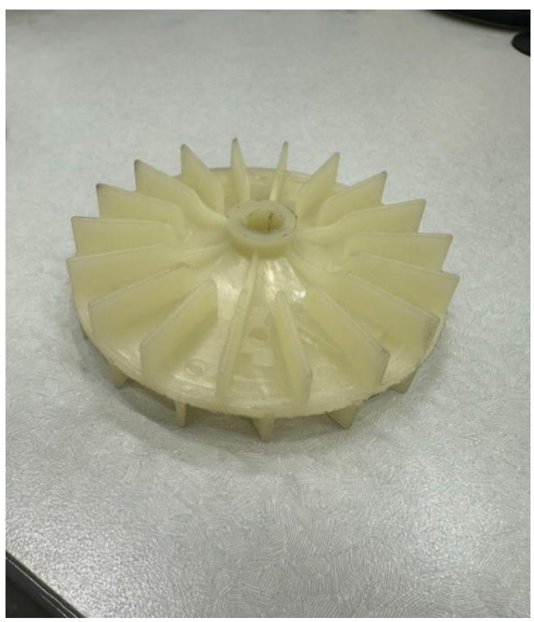


Figure 23. Plastic fan

Form: The plastic fan is a very lightweight, but durable, circular component made from plastic. Its diameter is roughly 3.29 in +/- 0.05in with blade lengths of 0.9 in +/- 0.05in. Featured on the fan is multiple evenly spaced angled blades extruded and angled outward, and a small central hole in the middle. The blades are curved and angled in a way to efficiently move air through the tool when rotated. The hole in the center allows the fan to be precisely mounted onto the motor shaft.

Fit: The fan fits directly onto the motor shaft via the center hole. It is secured with a small fastening or press to prevent slipping. The fan is positioned in the devices' main housing where airflow can be directed over all internal components. With proper alignment, the device can avoid imbalance while ensuring a proper and smooth operation.

Function: Able to manage heat, provide ventilation, and manage dust/debris. The plastic fan directs airflow as the fan spins with the motor. It circulates air through the sander, reducing heat buildup, while helping move dust away from the internal components.

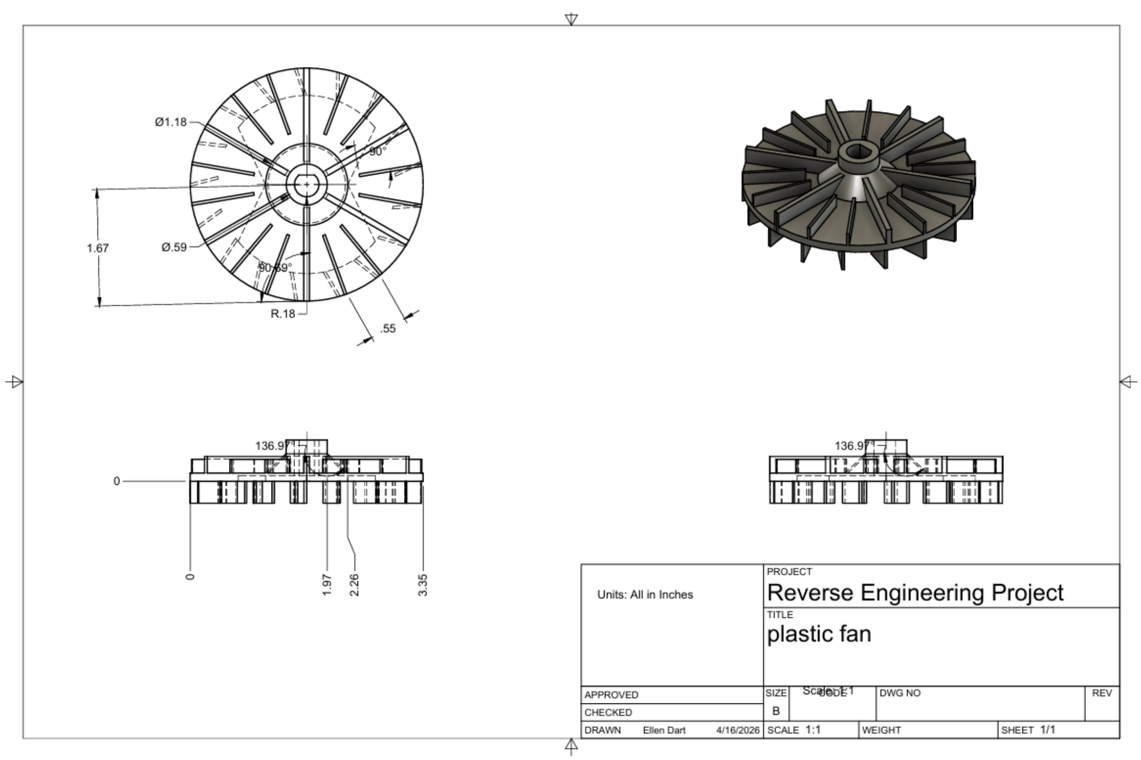


Figure 24. Fusion drawing of Plastic Fan

Figure 25. Washers

Form: The two small washers, used within the rotary sander, are very thin and flat but made of metal. They each have a large center hole allowing them to be placed around a shaft or fastener. The diameter of the large black washer consists of 2.05in +/- 0.05in. The small silver washers have a much smaller diameter but larger than the diameter of the screw. With their diameter being larger than the screw, in which they accompany, it provides a broader surface area for load distribution. The first washer is connected to the bearing cap and plastic fan, while the other sits on top of the bearing cap and is held in place with a screw.

Fit: The washers fit around the shaft or fastener and sit between surfaces of the bearing cap and the plastic fan assembly. They typically have a clearance fit around the fastener, meaning the inner diameter is slightly larger than the bolt allowing easy installation while maintaining proper alignment. The washers maintain flat and seated, not shifting laterally, during operation.

Function: Able to transmit mechanical energy, generate sanding motion, and remove material. The washer ensures a secure, flat connection for fasteners that hold the parts together allowing for torque to transfer without slipping or loosening. They further absorb vibrations and act as a load distributor by preventing the fastener from damaging the sanding pad material.

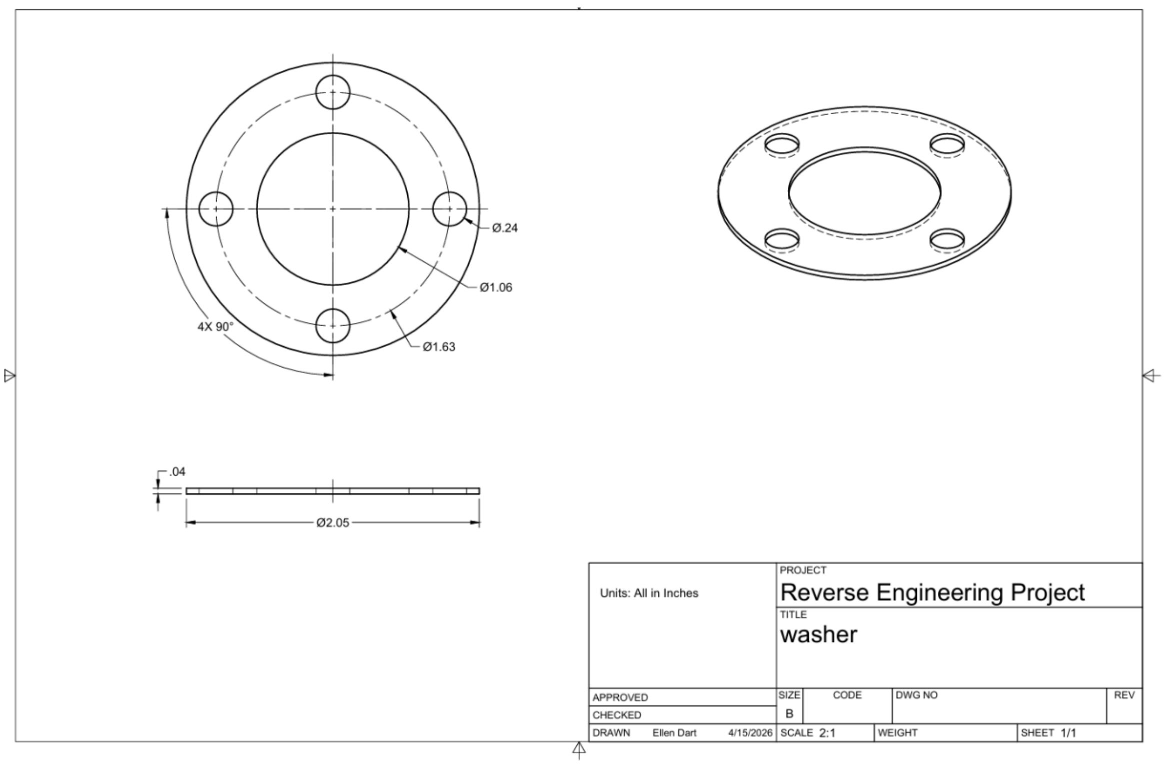


Figure 26. Fusion drawing of washer

Figure 27. Screws

Form: The screws in the rotary sander are small metal fasteners with a threaded cylindrical shaft and specific head (Phillips or Torx) allowing for tool engagement. The threads, along the shank, allow for rotational motion to be converted into a clamping force when installed. The screw head has a specific drive pattern allowing torque without slipping.

Fit: Each screw is designed to fit into the correct, corresponding threaded hole within the rotary sander. The fit is usually a clearance fit at the shank, and a threaded interference fit along the threads, ensuring the screw can be tightened firmly while maintaining proper alignment with different components, such as the bearing cap, washers, and the sanding pad.

Function: Able to hold the assembly together by generating and maintaining clamping forces between different components.

Form, Fit, and Function (Electromechanical): (SP)

Figure 28. Stator

Form: The stator, inside of the rotary sander, is composed of copper wire coils wrapped around laminated steel, a user-activated switch, a printed circuit board (PCB), and carbon brushes. It is further composed of thin metal laminations with slots or windings housed around the inner part. These slots are very precise holding the copper windings, arranged in specific patterns, to support electromagnetic field generation while reducing energy losses. Electrical connections are compact and disturbed within the motor housing and handle, with flexible insulated wiring enabling routing through confined internal spaces.

Fit: The stator is press-fitted into the motor housing to keep it completely stationary relative to the rotating components. It is aligned with the rotor, maintaining a small, uniform gap between the two allowing for efficient electromagnetic interaction without actual physical contact to prevent short circuits and ensure safe operation under 120V AC input conditions. The power cord enters the housing and connects to the switch, which is positioned within the handle for user accessibility. From the switch, current is routed through the PCB and into the stator windings and brush assemblies via insulated conductors. The outer dimensions of the stator and brushes align perfectly with the dimensions of the motor casing and electrical terminals, ensuring a properly aligned fit within the electromechanical system.

Function: Able to generate, deliver, and regulate electrical energy to the motor starting from the outlet. When the user activates the switch, the circuit is completed, allowing current to flow from the power source through the wiring and control components to the motor.

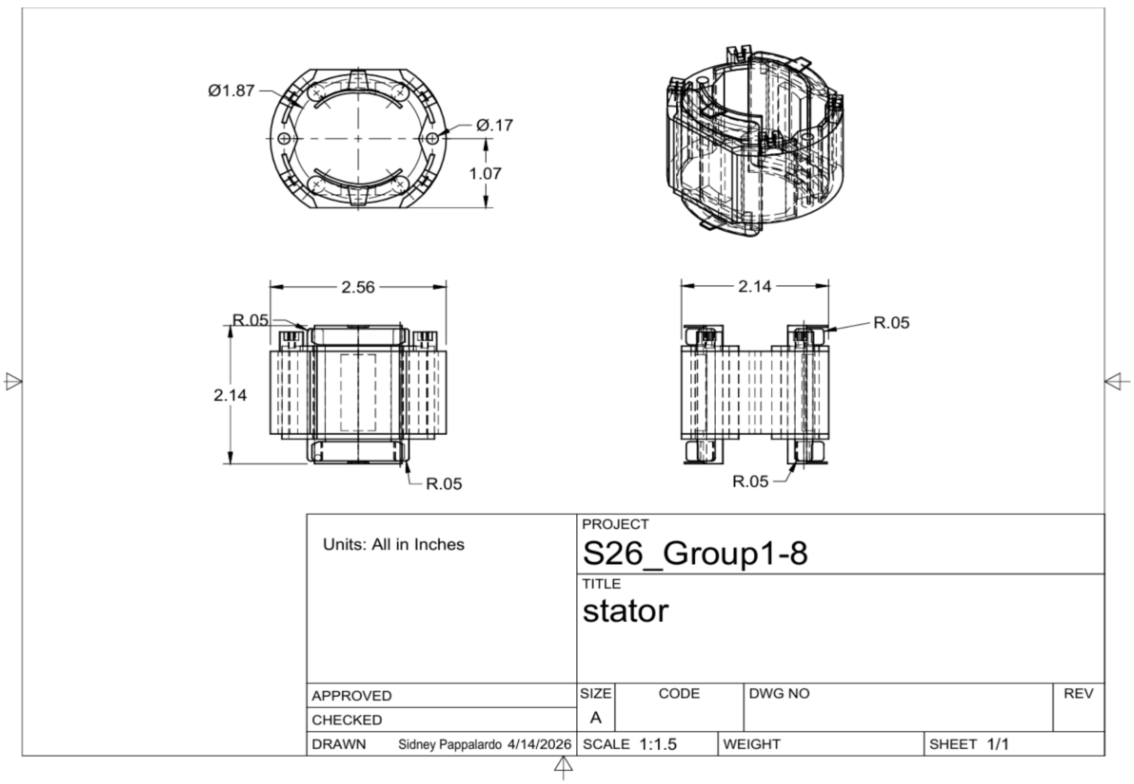


Figure 29. Fusion drawing of Stator

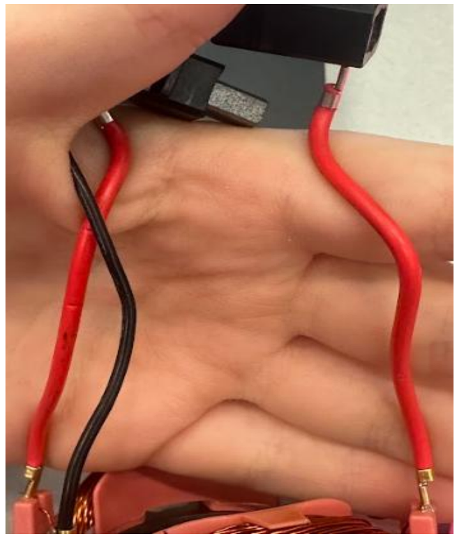


Figure 30. Red and black power cords

Form: The red and black power cords are typically made of copper wire with flexible plastic insulation. Both cords are known as insulated electrical conductors which are attached to the stator windings and other electrical components. The copper provides high electrical conductivity, while the insulation prevents short circuits and protects other internal components as well as the user.

Fit: These power cords are securely connected to the stator or connection points by fasteners, clips, or soldered joints. These connections are specifically designed to ensure a strong electrical and mechanical attachment, while further preventing loosening due to vibration. The wires are sized to match the features in the housing to maintain proper positioning and prevent movement.

Function: Able to deliver electrical energy from the external power source to the stator. The red wire serves as the positive conductor, and the black wire serves as the return path, completing the electrical circuit. Once current flows through the stator windings via these cords, a magnetic field is generated that drives the motor's operation. This further allows for a conversion of electrical energy into mechanical rotation for the sanding function.

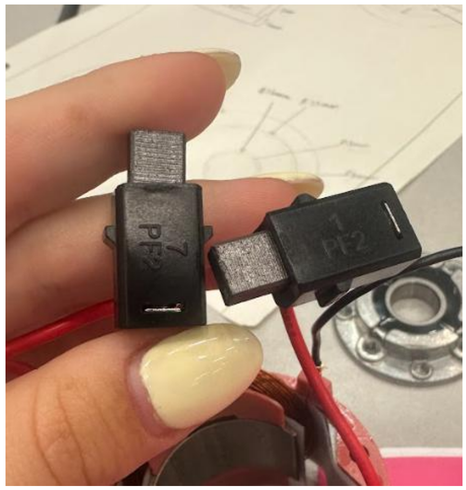


Figure 31. Black electrical boxes

Form: The black boxes attached to the red and black power cords are small, insulated electrical components. They are made of very durable plastic and hold internal metal contacts or circuitry. Their rectangular shape allows them to hold and protect electrical connections, with the entry and exit points for the red and black wires.

Fit: These components are in line with the red and black power cords and securely connected using crimping, soldering, and plug-in terminals. The wires enter and exit through the sealed openings. There are specific features preventing the wires from bending or coming loose. The boxes are positioned inside of the motor housing and along the internal wiring path so they can remain in one fixed position while maintaining reliable electrical contact.

Function: Able to manage and protect electrical connections within the rotary sander's circuit. Furthermore, they can serve as connectors joining the wires and switches that control the power flow. By having these enclosed electrical contacts, we can ensure consistent and safe transmission of electrical power from the cords to the stator and other components of the electromechanical system.

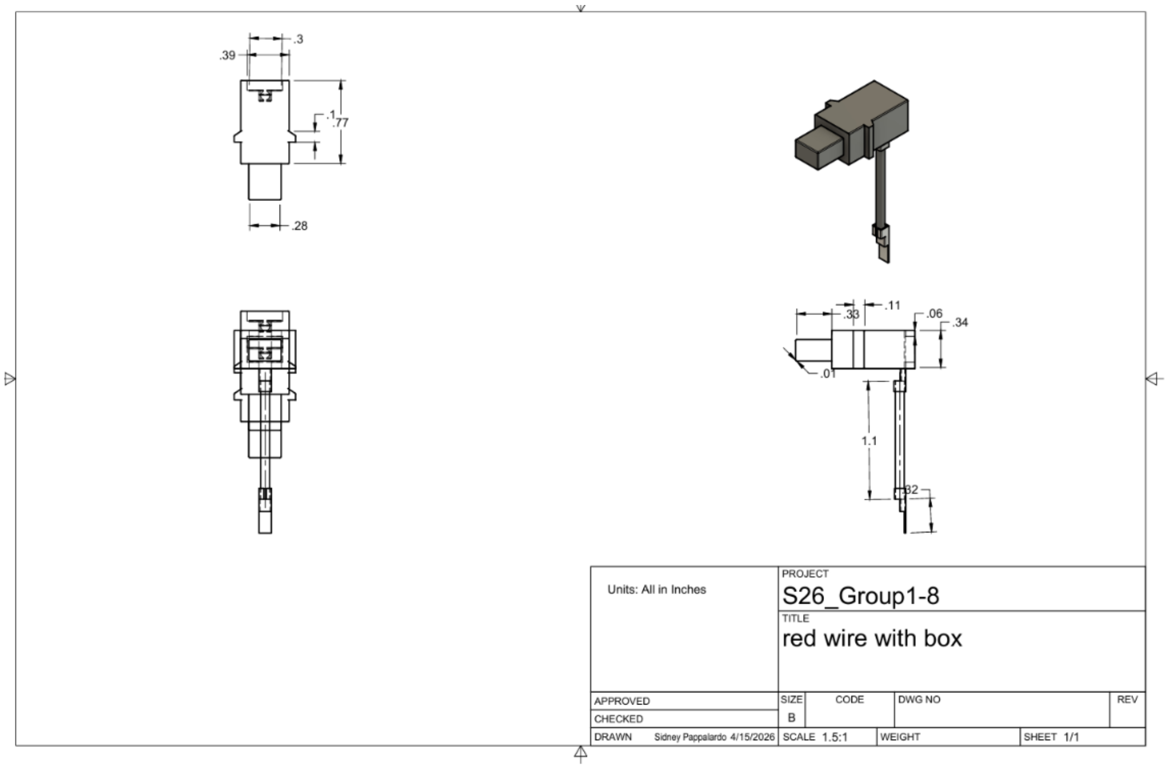


Figure 32. Fusion drawing of black electrical boxes.

Figure 33. Motherboard

Form: The motherboard inside of the rotary sander is a compact circuit board (PCB) made with thin copper traces embedded throughout. It contains a variety of electronic components such as resistors, diodes, and a speed control module that are soldered directly onto the boards surface. The board is rectangular and very thin, allowing it to fit within the small internal space of the tool without adding excessive weight.

Fit: The motherboard is securely mounted inside of the rotary sander's housing. It is positioned in the handle between the power input (cord and switch) and the motor assembly. It is held in a fixed position while connected through insulated wires to the power cord, on/off switch, and the motor. This placement allows the motherboard to act as a middle point between incoming electrical energy and all of the components that require controlled power, while staying protected from dust and vibration inside of the housing.

Function: Able to receive electrical input from the power source and interpret user input from the switch and speed control dial. The motherboard is able to adjust and regulate the voltage and current delivered to the motor, allowing the sander to maintain consistent rotational speed.

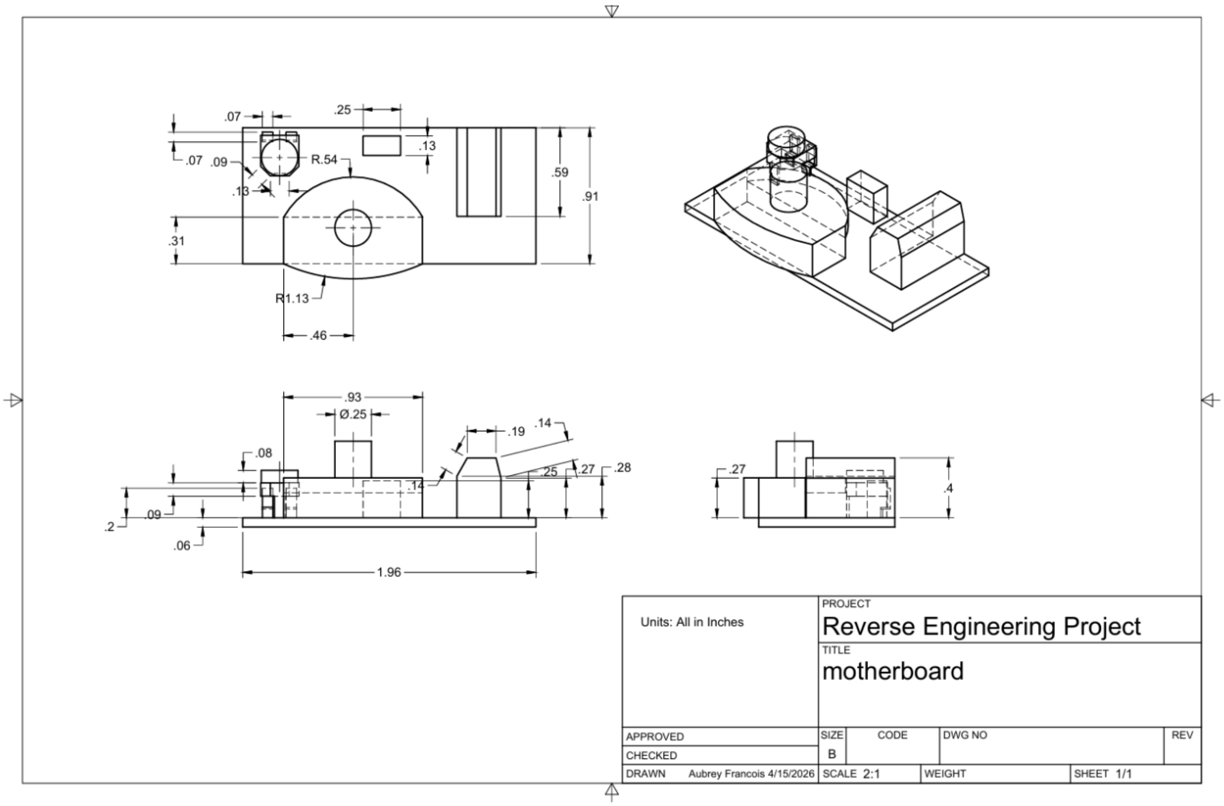


Figure 34. Fusion drawing of motherboard

Proposed Improvements and Recommendations:

1. Improve Wire Management (electromechanical) (SP)

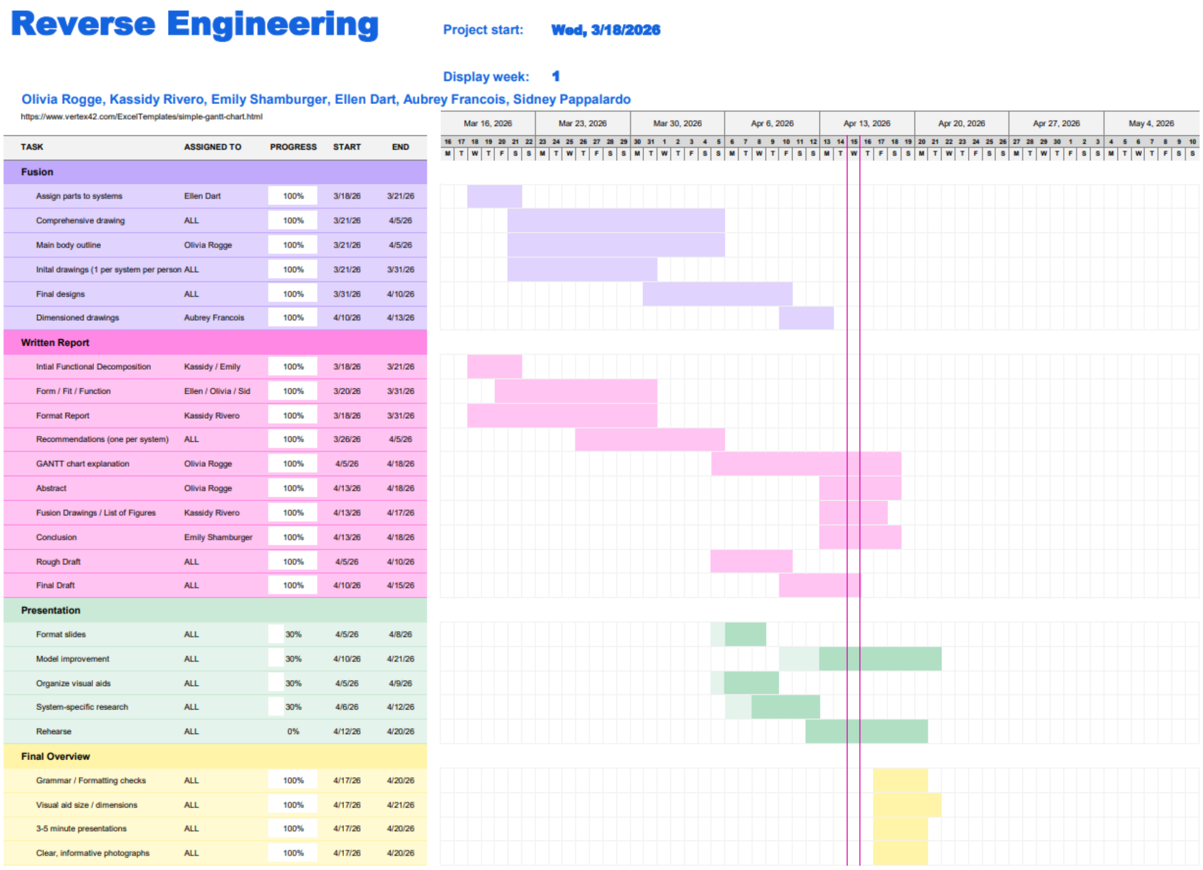
The current wire setup and management do very little to prevent or reduce stress caused by vibrations. This can lead to wear, disconnections, and short circuits during use. According to OSHA, “Cable assemblies and flexible cords and cables shall be supported in place at intervals that ensure that they will be protected from physical damage.” It is recommended to use clips, channels, or molds to hold the wires more securely in place while the rotary sander is in use. If there was even strain relief of the wire where it connects just inside the body from the wall, this could also improve stability of the wires inside of the body. With these changes and improvements, reliability, durability, and overall electrical safety would be improved.

2. Include vacuum adaptor attachment for dust collection (human interface) (OR / ES)

One key area for improvement is the dust collection system. The current dust extraction bag is made of fabric, making it very hard to effectively clean it. When it gets overfilled, the dust builds up and compromises the sander's ability, putting more stress on the device (Shanesy). For larger sanding jobs, users are continuously interrupted by emptying the bag. Providing a port that allows connection to an external vacuum would eliminate the need for constant emptying and completely contain all particles (Vevor). A vacuum adapter piece would fit perfectly on the device, costs less than $20, and would increase its lifespan as it takes some stress off the device from dust buildup. Adding this compatibility to the sander would allow users to benefit from better dust control, a cleaner work surface, and improved visibility during sanding, leading to a more comfortable and efficient user experience.

3. Make the shaft material higher quality (drivetrain) (ED)

By changing the material of the top of the drive shaft to a thicker titanium the user can get more longevity out of the sander as a product. As of now the top shaft material is a simple steel piece that can support the force of the sander for roughly 300 hours of sanding (depending on frequency of use and tool care). Making the shaft about 20% larger in diameter allows for roughly twice the lifespan due to the drop in stress on the part. Since "Shear stress varies from zero at the center to a maximum at the outside surface" by increasing the amount of outer surface the stress is less centralized. Also, by changing the material to a higher quality metal like titanium the tool has "better fatigue resistance, especially in corrosive environments or where weight reduction is critical". Overall, by making the shaft slightly thicker and titanium the tool is able to operate for longer with less resistance and worry for corrosion.



TASK	ASSIGNED TO	PROGRESS	START	END
Fusion				
Assign parts to systems	Ellen Dart	100%	3/18/26	3/21/26
Comprehensive drawing	ALL	100%	3/21/26	4/5/26
Main body outline	Olivia Rogge	100%	3/21/26	4/5/26
Inital drawings (1 per system per person	ALL	100%	3/21/26	3/31/26
Final designs	ALL	100%	3/31/26	4/10/26
Dimensioned drawings	Aubrey Francois	100%	4/10/26	4/13/26
Written Report				
Intial Functional Decomposition	Kassidy / Emily	100%	3/18/26	3/21/26
Form / Fit / Function	Ellen / Olivia / Sid	100%	3/20/26	3/31/26
Format Report	Kassidy Rivero	100%	3/18/26	3/31/26
Recommendations (one per system)	ALL	100%	3/26/26	4/5/26
GANTT chart explanation	Olivia Rogge	100%	4/5/26	4/18/26
Abstract	Olivia Rogge	100%	4/13/26	4/18/26
Fusion Drawings / List of Figures	Kassidy Rivero	100%	4/13/26	4/17/26
Conclusion	Emily Shamburger	100%	4/13/26	4/18/26
Rough Draft	ALL	100%	4/5/26	4/10/26
Final Draft	ALL	100%	4/10/26	4/15/26
Presentation				
Format slides	ALL	30%	4/5/26	4/8/26
Model improvement	ALL	30%	4/10/26	4/21/26
Organize visual aids	ALL	30%	4/5/26	4/9/26
System-specific research	ALL	30%	4/6/26	4/12/26
Rehearse	ALL	0%	4/12/26	4/20/26
Final Overview				
Grammar / Formatting checks	ALL	100%	4/17/26	4/20/26
Visual aid size / dimensions	ALL	100%	4/17/26	4/21/26
3-5 minute presentations	ALL	100%	4/17/26	4/20/26
Clear, informative photographs	ALL	100%	4/17/26	4/20/26

Figure 35. GANTT Chart

Project Management: GANTT (OAR)

Project management for the reverse engineering and design report of a rotary sander was highly effective in its completion ahead of schedule. In the beginning, the team split into pairs, each responsible for a subsystem. Parts for each system were identified and major deadlines were established. In the Lab, the group focused on measurements, Fusion, and photographs. Outside of the Lab, the pairs worked on aspects of the design report. The GANTT chart was made immediately, with deadlines for major tasks, such as Form / Fit / Function, Functional Decomposition, and Fusion milestones. Communication took place over Teams (for document sharing) and iMessage (for deadline reminders and check-ins). Everyone successfully completed their parts on-time and communicated this with group members. For Fusion, everyone contributed, with several of us helping with multiple different parts when needed. Overall, the project went seamlessly. One possible area of improvement would be consolidated communication on one app. In the beginning, the group had trouble finding pictures since they were in two different places, and then people would expect iMessages and not check Teams. It would've been easier and more efficient to have all the communication in one place. Other than that, the project was successful.

Conclusion: (KDR)

The reverse engineering of a rotary sander provided a clear understanding of how the main systems, the human interfaces, drivetrain, and electromechanical components work together to produce sanding motion. As a team, we were able to successfully disassemble and analyze each of the components within these three systems by describing their form, fit, and function as well as the relationships between parts. This information became evident, mainly in how electrical energy is converted into rotational motion through the motor and drivetrain.

By taking photographs, developing digital models, and taking detailed measurements of the components within the systems, we, as a team, were able to fully replicate the rotary sander in digital form. In doing this, each member of the team can visualize how the components interact within the entire system and their relationships are reinforced. This process highlighted key ideas to consider within the design process such as durability, manufacturability, and cost efficiency. Throughout the entire process of studying and designing, we found several flaws in the design of the rotary sander that we felt could be improved.

In the entirety, effective teamwork played a big role in completing each phase of the project and analysis. Each team member was given responsibility in terms of disassembling, measuring, documenting, and modeling, which improved efficiency, leading to accuracy in the results. Collaboration further allowed for multiple different perspectives when evaluating component functions and identifying design improvements.

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