GNG 1103

Design Project User and Product Manual

The SimplyDrilla Hinge Jig

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Glossary

Table 1. Glossary

Term	Definition
Jig	A tool holder that directs the tools being used on a piece of work
Routing Jig	A tool holder that directs the routing tool to cut the right dimension of the hinge.

1 Introduction

This User and Product Manual provides the information necessary for AMBICO workers to effectively use Team Banana's door hinge jig and for prototype documentation. User and product manuals should not be widely shared with individuals not intended to use the product.

2 Overview

AMBICO is a door manufacturing company that produces hundreds of doors a year. Each one of these doors need at least three door hinges. To mount these door hinges a process of routing, tapping, and drilling must be executed, however, this process takes them around thirty minutes. Our goal with our jig is to be able to make processes faster and more efficient.

For this product to function the user will have to know how to mount the jig onto their routing jig and be able to safely use an automatic drill.

When creating this final door hinge jig, we had three main goals in mind: Keep it cheap, keep it simple, and help reduce the time it takes to tap and drill the holes. This was all done by making an extremely simple yet versatile prototype that includes zero moving parts and needs no maintenance whatsoever.

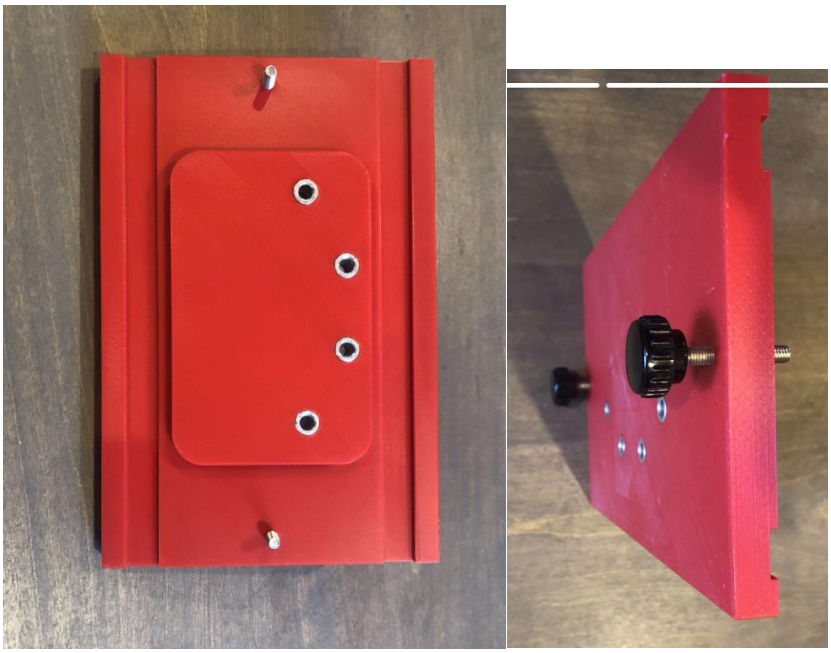

Figure 2.1: Final product front and side view

The main function of our design is that there are absolutely zero moving parts apart from the screws used to fasten the plate to the routing jig. The walls of the drilling holes are made from metal to the plastic would not get drilled out over time. These metal spacers also make sure that the drill bit stays perpendicular when drilling the holes. Finally, the two channels found on the bottom make sure that the jig will not move at all when being used.

The jig is made from 3D printed plastic (PLA) so it is super light and cheap to manufacture if needed to replace over time. The metal washers which are pressure-fitted into the holes are there to ensure strength and durability.

2.1 Conventions

Before operating the drill with the jig, make sure that the plate is properly fastened to the routing jig to ensure it will stay in place and nothing will fall out of place. This could lead to injuries, therefore make sure both screws are tightened as much as possible without damaging the plastic frame.

3 Getting started

Section 1: Setup

Step 1: Gather Materials
Ensure you have the door routing jig and the jig hinge.
Step 2: Door preparation
Once you have routed out the area for the holes, choose the proper jig hinge that corresponds with the door.

Section 2: Application

Step 3: Align the Jig Hinge
Place the jig onto the routing jig, ensuring proper alignment with the existing holes.
Step 4: Secure the Jig Hinge
Once aligned, securely screw in the jig hinge using the provided tabbed screws.
Step 5: Position Door
Position the door securely so the user can drill easily with force.
Step 6: Drill holes
Use the jig hinge to drill holes in the door until the desired depth is met.

Section 3: Exit

Step 7: Remove The Jig Hinge
Unscrew and remove the jig hinge from the routing jig.
Step 8: Clean and store for future use.

By following this structured approach, even someone without engineering expertise can be able to use the prototype effectively.

3.1 Configuration Considerations

1. **System Components**

Door routing jig
Jig hinge prototype
Tabbed screws (provided)

2. **Tools Needed**

Drill
Appropriate drill bit

3. **Considerations**

Jig Compatibility:
These jigs *only* work with the pre-existing routing jig and its measurements
Plate Selection:
Ensure the plate size is correctly chosen based on the door

Drill Speed:
Adjust the drill speed and depth according to the door material to prevent damage to the door and drill bit.

Safety Gear:
Use appropriate PPE when operating the drill.

Documentation:
Include comprehensive user documentation with the prototype, detailing, setup, usage, and any troubleshooting steps.

Considering these factors will contribute to a smoother and more reliable experience when using the Jig Hinge prototype for door-drilling applications

3.2 User Access Considerations

Different users/groups:
Many user groups like; professional carpenters, home renovators, construction crews, specialized door installation services and door manufacturers can use our product.
The exception is that they already own or are planning to purchase the routing jig that the hinge is measured to.

The accessibility restrictions for the Jig Hinge includes:
Skill Level:
The user should have a basic understanding of carpentry and door installation.
Tool Familiarity:
The user should be familiar with the use of a drill
Physical Strength:
The user should have sufficient physical strength to handle tools and operate the drill
Safety Gear:
User must wear appropriate PPE to use this device
Compatibility:
The Jig Hinge is designed for the use with specific routing jigs.

3.3 Accessing/setting up the System

To access the Jig Hinge, collect from the last place.

1. **Align the Jig Hinge**

Place the jig hinge onto the door routing jig

2. **Selecting the Plate Size**

Choose the appropriate plate size on based on the door thickness.

3. **Securing the Jig Hinge**

Use the tabbed provided screws and tighten the jig hinge onto the routing jig. Ensure a tight and secure fit.

3.4 System Organization & Navigation

The jig hinge contains 3 main parts; the tabbed screws, metal spacer and the plate.

3.4.1 Tabbed Screws

Location:
The tabbed screws are found at the top and bottom of the plate and can be removed from the plate (it is suggested to leave them in their holes).
Function:
The tabbed screws play a crucial role in securing the Jig Hinge to the Door Routing Jig.
Tabs on the screws help in providing a secure and tight fit, preventing any movement during the drilling process.
Adjustment/Usage:
Use your hand to tighten the tabbed screws securely.
Ensure that the tabs engage properly with the Jig Hinge and Door Routing Jig to maintain stability.

Figure 3.4.1: Tabbed screw

Location:
The plate is the main component and holds everything together.
Function:
The plate on the Jig Hinge serves as the guide for drilling holes in the door.
Different plates are available to accommodate various door thicknesses.
Adjustment/Usage:
Select the appropriate plate size based on the door thickness.
Ensure the plate is securely attached to the Jig Hinge to maintain accurate alignment during drilling.

Figure 3.4.2: Plate

3.4.2 Metal Spacer

Location:
The metal spacers are found inside the 4 holes in the center of the plate.
Function:
Inner metal spacers are designed to prevent wear between moving parts of the Jig Hinge.
They reduce friction and ensure smooth movement, enhancing the overall durability of the system.
Adjustment/Usage:
Confirm that the inner metal spacers are correctly positioned within the Jig Hinge during setup.
Regularly check for wear and replace as needed to maintain optimal functionality.

Figure 3.4.3: Metal spacers

3.5 Exiting the System

Step 1: Remove the Jig Hinge
Using your hands unscrew and carefully remove the jig hinge from the door routing jig.

Step 2: Inspect for Wear or Damage:
Thoroughly inspect The jig hinge for any wear, damage, or debris.
Check the tabbed screws, plate and metal spacers for their condition.
Step 3: Clean the Jig Hinge
Using a soft brush or cloth, clean any acucumulated dust or debris from the jig hinge.
Step 4: Securely store the Jig Hinge
Store the jig hinge in a designated container. Alternatively store the jig hinge in a secure and dry area to protect it from environmental factors.

Overall Integration:

The tabbed screws, plate, and inner metal spacers work in harmony to provide a reliable and precise drilling experience.The tabbed screws secure the entire system, while the plate guides the drilling process, and the inner metal spacers contribute to wear prevention.

User Considerations:

Users should follow the provided documentation to ensure correct assembly and usage of each subsystem.

Regular maintenance checks are crucial to prolong the lifespan of the tabbed screws, plate, and inner metal spacers.

Understanding the functions, adjustments, and maintenance requirements of each subsystem helps users maximize the efficiency and longevity of the Jig Hinge system during door installation.

4 Using the System

This system has one single subsystem and that is the tightening mechanism. This subsystem was created to keep the jig flush, on the already-in-place, routing jig. This part of the system is crucial for the accuracy of the jig. The required input for this section of the jig, is the user must place the jig on the routing jig lining the holes up with the screws to make sure they thread properly. The user uses their fingers to turn the screws clockwise to tighten the jig onto the routing jig. There is another function and that is the holes on the face of the plate, this is used for drilling and tapping holes for the door hinge holes. The required input for this is for the user to make sure the jig is flush on the routing jig, and then start drilling using the holes in place to guide it.

4.1 Tightening mechanism

This mechanism is used to keep the jig attached to the routing jig. This is achieved by using threaded holes on the routing jig, the holes in the hinge jig will be kept unthreaded to allow for versatility, meaning the jig is able to be held on with their hands or using the screws. Some functionalities that the user must master are minimal, there are only two things the user should be able to do. That is, align the jig with the threaded holes and turn the screw clockwise to tighten it onto the jig. There should not be any sort of malfunction with the screw but in case of malfunction where a screw breaks due to over torque or just general use. It is possible for the jig to be used without being held onto the routing jig with the screws. Slot the jig into the routing jig then hold it on with your hand with pressure.

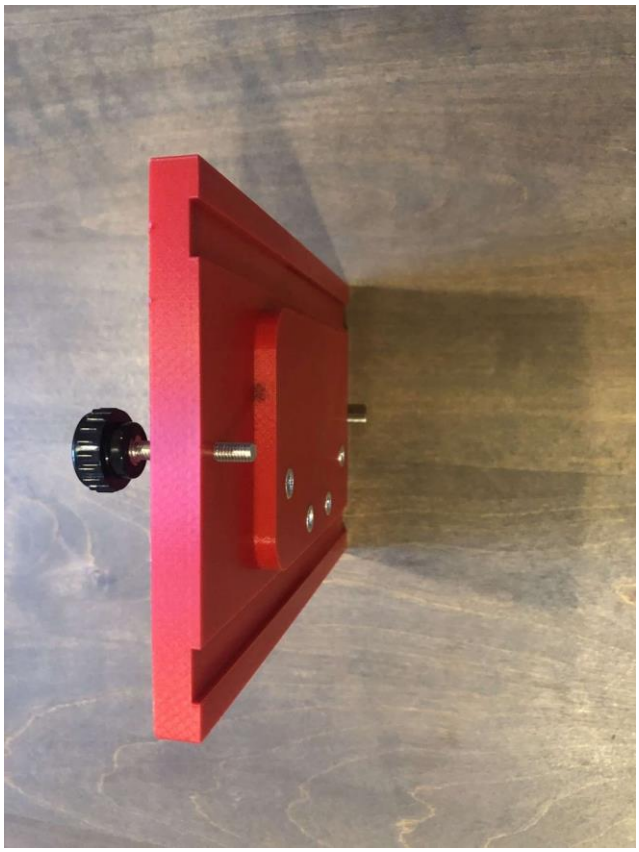

Figure 4.1 : Tightening mechanism

5 Troubleshooting & Support

5.1 Wear and Tear

Over time, simplydrilla jig may experience wear and tear, particularly with the black handles used for securing our jig onto the routing jig. The potential issue lies in the threaded hole in the plastic. As you repeatedly screw and unscrew the tabbed screws, the friction and pressure can lead to the gradual degradation of the threads, thus making the jig less precise and secure on the routing jig. To prevent the issue, do not overtight the screws. We recommend screwing the tabbed screws tight enough so it holds onto the routing jig while being stable. If this problem still occurs, we recommend printing a new plastic jig and placing new metal spacers, but keeping the same handles to save on cost.

The metal spacers may experience some wear and tear after a long time of usage. If they have a visible fracture or are thinner than usual, you will have to 3D print a new plastic body and insert by pressure new metal spacers in every hole. Unfortunately, they cannot be reused, unlike the tabbed screws.

5.2 Large Impact

If the jig suffers a large impact and a crack has formed on the plastic body of the jig, the jig will have to be reprinted. The pieces that are still intact can be reused on the new jig such as the handles. However, the metal spacers will have to be replaced.

5.3 Maintenance

We recommend doing monthly maintenance on our jig. The inspector should verify if the threads inside the handle holes are still intact and aren’t worn out. They should look for any cracks in the plastic and see if the metal spacers are still useful, meaning they prevent any damage caused to the plastic. If any of these problems are observed, we can solve them by referring to sections 5.1 and 5.2 above.

5.4 Support

If the user requires immediate assistance concerning a defect in the simplydrilla, they can email one of the following persons providing the specific location of the problem (metal spacers, handles, or plastic body), how it happened, and attach a clear picture of the defect.

Contacts:

Emma Stuart - estua010@uottawa.ca

Dani Oroszlan - doros019@uottawa.ca

Doc Rocque - drocq013@uottawa.ca

Joey Barros - jbarr010@uottawa.ca

Zoe Desgagné - zdesg080@uottawa.ca

6 Product Documentation

The final prototype was built by combining three subsystems: the block, the clamp and the spacers. Our prototype design is a mostly flat plastic block and the dimensions are 8 by 5 ¼ inch. There is a raised plastic piece in the block that fits perfectly into the routing jig to prevent movement, as well as raised ridges that sit on top of the ridges in the routing jig to further prevent vertical movement. There are two different plates to accommodate the different hole spacings/sizes. It also has 4 holes in it to drill through into the door, thus helping the worker to be precise. Finally, there are two little holes in the side that align with the brown plate of the routing jig to make sure our jig is secure. We used little tabbed screws to set in place our jig on the routing jig.

6.1 Block

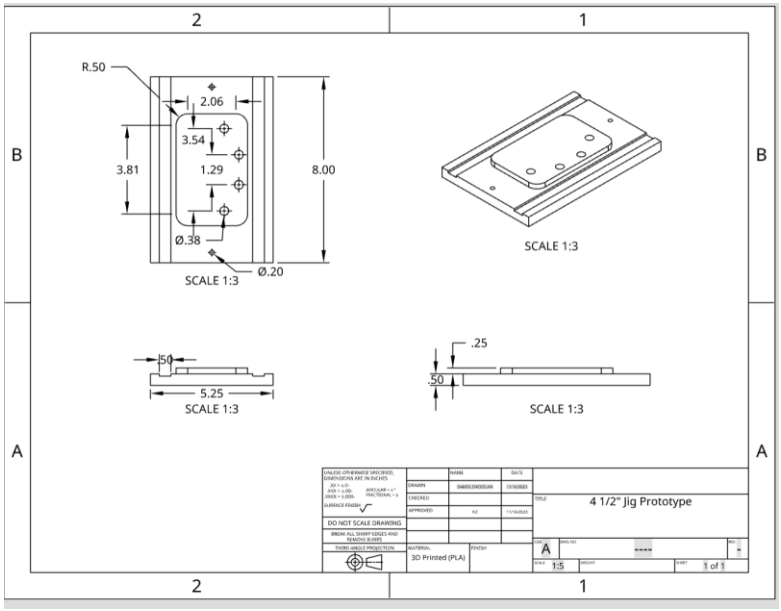

Figure 6.1: Technical drawing of the jig for 4 ½”

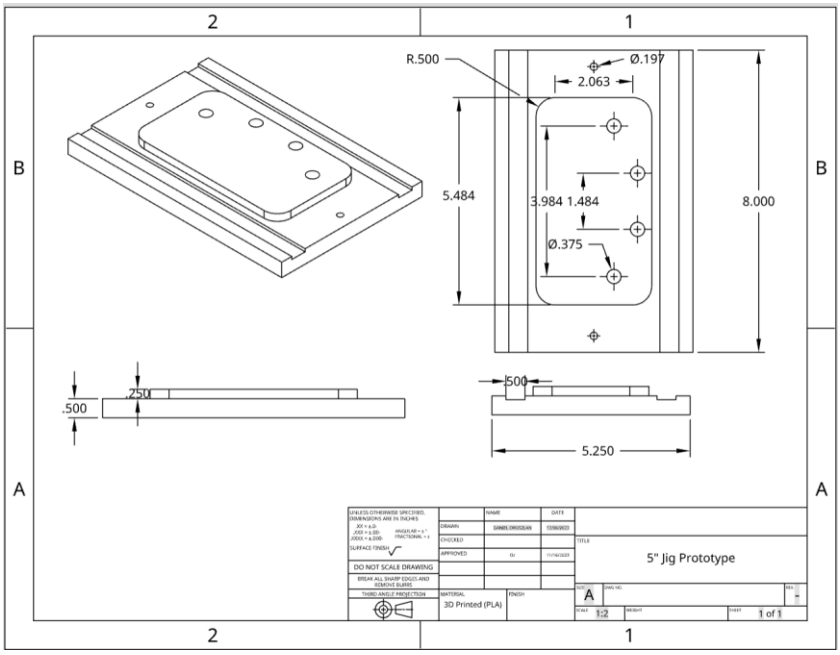

Figure 6.1.1: Technical drawing of the jig for 5”

The block subsystem prevents movement of the jig, ensuring precision and accuracy in drilling. It is also the main frame of our jig where all of our subsystems are located.
See more under 3.4.2

6.2 Clamp

The threaded hand knobs (screws) attach into the already existing routing jig, acting as a clamp, to secure it without having to hold it in place manually. The screws additionally prevent the jig from moving along the x-axis, enduring more accuracy when drilling.
See more under 3.4.1

6.3 Spacers

The metal spacers increase the durability of our prototype. They are located inside each of the holes on the block. They are used to protect the plastic of the block being destroyed from the movement of the drill bits.

See more under 3.4.3

6.4 BOM (Bill of Materials)

Description	Qty	Link	Cost		
3D Printed Plate	4	www.uOttawa.ca	$0		
Hand Knob, Threaded	1(10 total)	https://www.amazon.ca/-/fr/dp/B07KPGNR6Y?smid=A30WUG2ZDGM0XM&ref_=chk_typ_imgToDp&th=1	$11.99	$13.55	
Inner Aluminum space	10	https://www.mcmaster.com/92510A667/	$12.80	$43.45	
		Total	$28.01	($57.00)	WITH SHIPPING
					AND USD

6.4.1 Equipment list

Equipment needed to create final prototype:

- 3D printer (to print the block)
- Fusion 360 (to design the block)
- Hydraulic press (to attach the spacers)

6.4.2 Instructions

Here are the instructions for creating each subsystem, and the final prototype.

Subsystem 1 (block):

1. Design block using CAD software
2. 3D print the block

Subsystem 2 (clamp):

1. Order and receive the screws

Subsystem 3 (spacers):

1. Order and receive the spacers

Final prototype:

1. Attach spacers to the block using hydraulic press
2. Attach screws to the block using hands

6.5 Testing & Validation

Our final test was to ensure all sizes of the holes fit snugly with our already-made holes including the spacers. We used the same drill bit as our client's to make sure that it fit nicely and to ensure precise drilling at the right places.

Test #	Size	Is it Snug?
1	Attachment to routing jig	Y/N?
2	Spacers in drill hole	Y/N?

Our criteria consisted of checking the tension and the stress levels of our pieces altogether.

According to the results of our final test, both the attachment to the routing jig and the spacers in the drill hole fit snugly, so there were no further improvements to be made to our prototype. Therefore, we declared this prototype as our final prototype.

7 Conclusions and Recommendations for Future Work

During the processus of creating of our product, we learned many things about designing prototypes. The first and most important lesson we learned is to start simple. If we would have applied this knowledge when first designing our jig, it would have saved us a lot of time and money. The second lesson learned was to always stay ahead of deadlines, making sure prints are done in advance can save a lot of time because it isn't easy to get printers all the time in the makerspace lab. Our third lesson was that some of the most productive times are in meetings outside of the lab and bonding as a team. This can help discover everyone's strengths and increase production of prototypes and ideas by assigning the right task to each team member. If we had more time to work on our jig, we would have improved the clamping mechanism. This would be improved using actual clamps instead of using a threaded screw hole so it would be faster to clamp and unclamp our jig to the routing jig.

APPENDICES

8 APPENDIX I: Design Files

Table 2. Referenced Documents

Document Name	Document Location and/or URL
CAD file	https://cad.onshape.com/documents/4e3cd9cb7786d77013693432/w/3f37471665389c405bc2accb/e/7d17fbe1a9d6ebdd082e5ba3 https://cad.onshape.com/documents/115693df02a9c55e2b6fbaf5/w/8f06d1441a9184e07be98ce1/e/ee62c244fd6db9f4e985ff53
BOM	Section 6.4
Technical drawings	Figure 6.1 and 6.1.1
Maker repo	https://www.makerepo.com/Emma/1812.team-banana