GNG 1103

Design Project User and Product Manual

DOOR HINGE DRILLING JIG FOR AMBICO

Submitted by:

Group 6 - Bo6 / Hinge Masters

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1 Introduction

This User and Product Manual (UPM) provides the information necessary for workers to effectively use the Door Hinge Drilling Jig (DHDJ) and for prototype documentation.

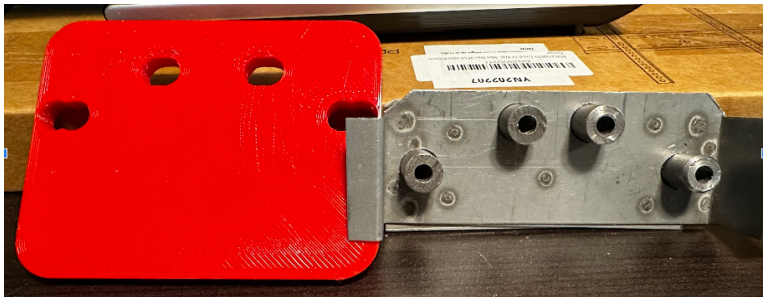
This document is split up into multiple sections detailing each step in setup, usage, and construction of the Door Hinge Drilling Jig (DHDJ), it is intended to aid workers–as well as anyone else who may wish to use, replicate or improve the device–with its use and manufacture.

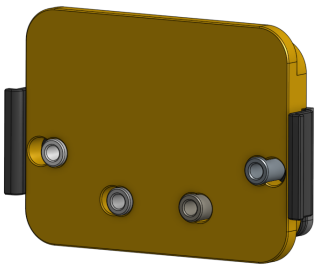
The activities described in this document involve drilling, tapping, welding, 3D printing, bending sheet metal, woodworking and the use of tools such as a router and a lathe. If you have not already, it is greatly recommended that you familiarize yourself with the safety precautions associated with those activities before proceeding. Remember to always wear Personal Protective Equipment (PPE)–such as eye protection and steel toes–when working with power tools to avoid serious injury.

2 Overview

AMBICO came to us because their current method for marking, drilling and tapping screw holes for the hinges in their wood-covered doors is time consuming and inefficient, since they have to manually mark, drill and tap each hole without any support or guidance system. Thus, we established the following problem statement: "A need exists for an **innovative**, **adjustable**, and **stable** jig solution that effectively streamlines the wooden door manufacturing processes across diverse global facilities, is **lightweight**, **dust resistant**, and integrates precision-drilling as well as **cost-effectiveness.**"

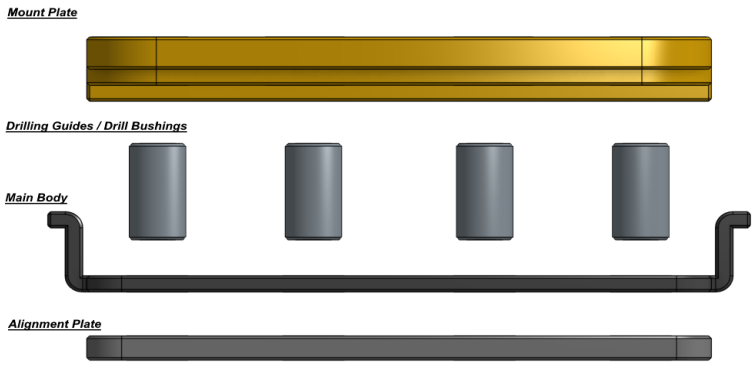
Our product differs from others because it is designed specifically to suit AMBICO's existing tooling and expertise, while optimizing their manufacturing process. Our jig is made to take advantage of AMBICO's existing router jigs, using them as a stable, fast and simple mounting surface, this also removes the need for a separate station dedicated to drilling and tapping the screw holes, cutting down on transport time and opening up space in their manufacturing facilities for other processes.





This jig is designed to aid the worker in drilling and tapping the screw holes by removing the need for marking and providing a stable, secure and rigid guide for their tool that drops directly into their existing router jig without the need for additional clamps or mounting mechanisms of any kind.

The jig is designed as a collection of seven main components: one alignment plate made out of a 3/16” thick stainless steel bar, four steel drill bushings, one main body built either from 1/8” stainless steel or sheet metal, and one mounting plate made out of either wood or plastic.



2.1 Cautions & Warnings

When using the drilling jig keep gloves or loose clothing away from the drill to avoid catching. Additionally, if using a model made from steel, be sure to wear gloves to prevent cuts caused by potentially sharp edges.

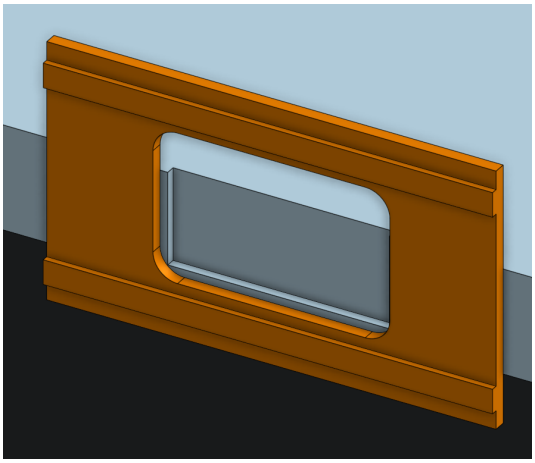
3 Getting started

3.1 Configuration Considerations

To use this jig you will need a door to use it on, an existing router jig made for the size of hinge you intend to use, a router, a drill, and the correct size of drill bit and tap.

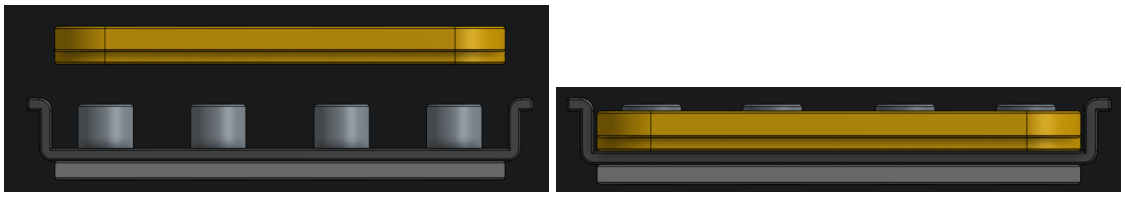
Begin by installing the router jig onto the door and cutting out a pocket corresponding to the size of your hinge. Keep the router jig securely fastened to the door for the rest of the process.

By the end, you should have something resembling this:

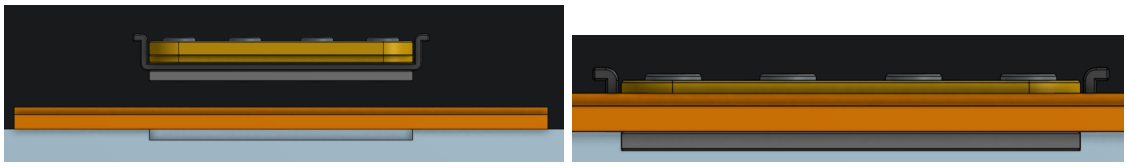


3.2 Accessing/setting up the System

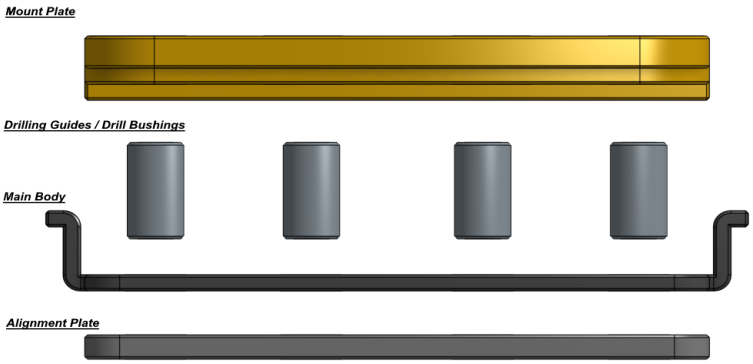
Attach the mounting plate to the main body by sliding it along the drilling guides.



Then, drop the drilling jig into the router jig, sliding it in until the alignment plate hits the door and the mounting plate hits the jig.



3.3 System Organization & Navigation



3.3.1 Mount Plate/Mounting Plate:

Made from wood or plastic, slides along the drilling guides and sits on top of the main body. When the jig is assembled and installed, this component stabilizes it along the vertical axis.

3.3.2 Drilling Guides / Drill Bushings:

Steel drill bushings that guide the drill bit/tap to improve precision.

3.3.3 Main Body:

Made from sheet metal or 1/8” stainless steel bar bent into a U shape, it is the central component of the jig. Attached securely to the drilling guides through a press fit. When the jig is assembled and installed, this component’s wings (the raised sides) stabilize it in the horizontal axis.

3.3.4 Alignment Plate:

Made from 3/16” stainless steel bar, cut to fit snugly into the pocket cut out with the router for the hinge. Attached to the drilling guides through a press fit, may also be spot welded to the main body. When assembled and installed, it ensures accurate placement of the screw holes.

3.4 Exiting the System

Insert a fingernail, flat-head screwdriver or another flat implement between both wings of the drilling jig’s main body and the router jig. Use leverage to pull the drilling jig out of the router jig. Remove the mounting plate from the rest of the jig.

4 Using the System

4.1 Drilling

- Attach drill bit to drill;
- Insert drill bit into drilling guide / drill bushing;
- Pull trigger;
- Apply pressure until no resistance is felt;
- Release trigger;
- Remove drill bit from drilling guide / drill bushing;
- Repeat for the remaining 3 holes.

4.2 Tapping

- Repeat the same steps used for drilling, but using a tap instead of a drill bit on the already drilled holes.

5 Troubleshooting & Support

If the drilling jig comes loose from the router jig while drilling, release the trigger on the drill, pull the bit/tap out of the drill bushing / drilling guide and set both the jig and the drill down onto a table. Inspect the drilling jig for damage, if any parts are excessively worn down the use of shims or the replacement of said part may be necessary. If repair is not viable, usage of the jig may continue, but the user must always apply steady pressure with their free hand to the jig's mounting plate to ensure this does not occur again.

5.1 Maintenance

Before and after use, use compressed air to blow out any dust and debris that may be present on the jig to ensure that no premature wear and tear occurs. If any of the drilling guides / drill bushings become too worn down and their inner diameter becomes more than 1 mm greater than the outer diameter of your tap, replace them with a new set or use a liner to bring the inner diameter back down to an appropriate size.

5.2 Support

If you experience any issues with the door hinge drilling jig, please contact our team members. Our email addresses can be found below:

- Samuel Agripino de Souza - sagri039@uottawa.ca
- Rayan Alouzi - ralou067@uottawa.ca

- Nikola Kulic - nkuli006@uottawa.ca
- Benjamin Dellah - bdell078@uottawa.ca
- Mark Balibali Mikaya - mbali087@uottawa.ca

6 Product Documentation

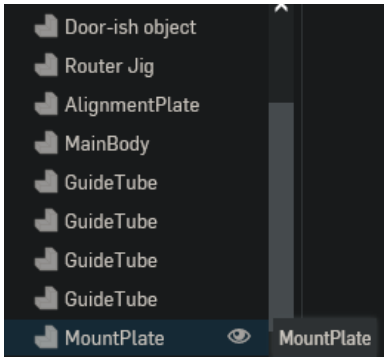
6.1 Mounting plate

6.1.1 BOM (Bill of Materials)

- ~100g of PLA plastic

6.1.2 Equipment list

- 3D printer (the printer we used was an UltiMaker 2+)
- UltiMaker Cura
- SD card
- SD card adaptor (if your computer lacks an SD card slot)



6.1.3 Instructions

- Open onshape document “AMBICO Jig Type 2”
- Right Click on “MountPlate”
- Left click on “export”
- Set format to STL and units to millimeter
- Save the STL file
- Open the STL file in Cura
- Set infill to 50% and the number of walls to 3
- Click on slice
- Click on save to disk
- Move the saved .GCODE file to your SD card
- Eject and remove SD card from computer
- Place SD card into 3D printer and turn it on
- Select your file and begin printing
- Remove part from printer when finished

6.2 Main Body + Alignment Plate + Drilling Guides

6.2.1 BOM (Bill of Materials)

- 1 Stainless or carbon steel, sheet metal or a bar up to an ⅛” thick (the exact thickness is not important so long as your equipment can bend / cut the metal)
- 1 Stainless or carbon steel bar, 3/16” thick
- 4 0.221” inner diameter drill bushings

6.2.2 Equipment list

- Scribe
- Drill press
- Corner cutter
- Bending tool / brake
- Spot welder
- Welding gloves
- Protective goggles

- Steel toes / Steel toed boots
- Adjustable square
- Sheet metal shearing tool
- Hydraulic press (A vice may work in a pinch)
- Printer

6.2.3 Instructions

- Print out templates onto standard ISO A4 paper
- Put on PPE before beginning
- Mark sheet metal and / or metal bar(s) with scribe, outlining the points that need to be bent, cut, or drilled according to the templates provided (use the one that matches the size of your hinge, the red sections need to be removed, the green marks all that should remain on the alignment plate)
- Cut, bend and drill the metal according to the patterns marked previously, for both the parts that will become the main body and alignment plate
- Press drill bushings into their corresponding holes in the alignment plate, then press the main body onto that.
- Alternatively, spot weld the main body onto the alignment plate, then press drill bushings into their corresponding holes.

6.3 Testing & Validation

Drilling and stability tests were performed to ensure the jigs could operate in real world environments at any angle one can reasonably expect to drill from, to ensure they can provide accurate hole placement and not easily fall out of the router jig.

7 Conclusions and Recommendations for Future Work

This project has significantly improved our skills with all tools involved. It has also taught us how to organize our time to fulfil our goals better.

We originally intended to use wood for our mounting plate, but were unable to do so due to time constraints. Additionally, the quality of our steel prototype was unsatisfying. In the future, we believe it would be best to better plan the way in which the jig is built and assembled. One possible improvement is to use a laser cutter / engraver when first marking the steel, to avoid inaccuracies created by human error. Also, the use of 3D printed jigs could simplify the manufacturing process of our drilling jig and improve its dimensional accuracy significantly.

APPENDICES

8 APPENDIX I: Design Files

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
MakerRepo Project	https://makerepo.com/nikola/1797.group-b06	11/06/2023
Testing Video 1	https://drive.google.com/file/d/1UJmUSehr6btMn1X8c385rtx23zC00c3f/view?resourcekey	11/28/2023
Testing Video 2	https://drive.google.com/file/d/1bvod7ZN2o8lbLuE84gVNisbhpvqlXP8i/view?resourcekey	11/28/2023
Onshape Document	https://cad.onshape.com/documents/6e856bee3adcadd8befd708f/w/280e9857007d4adbeaf93c58/e/7153f57e88680e66948f42b6?renderMode=0&uiState=657687bb017bf42f6a3fb830	12/10/2023
Templates	https://drive.google.com/drive/u/0/folders/1AhRojp_jTLknKFlSZLCFJijK3dXFt93D	12/10/23