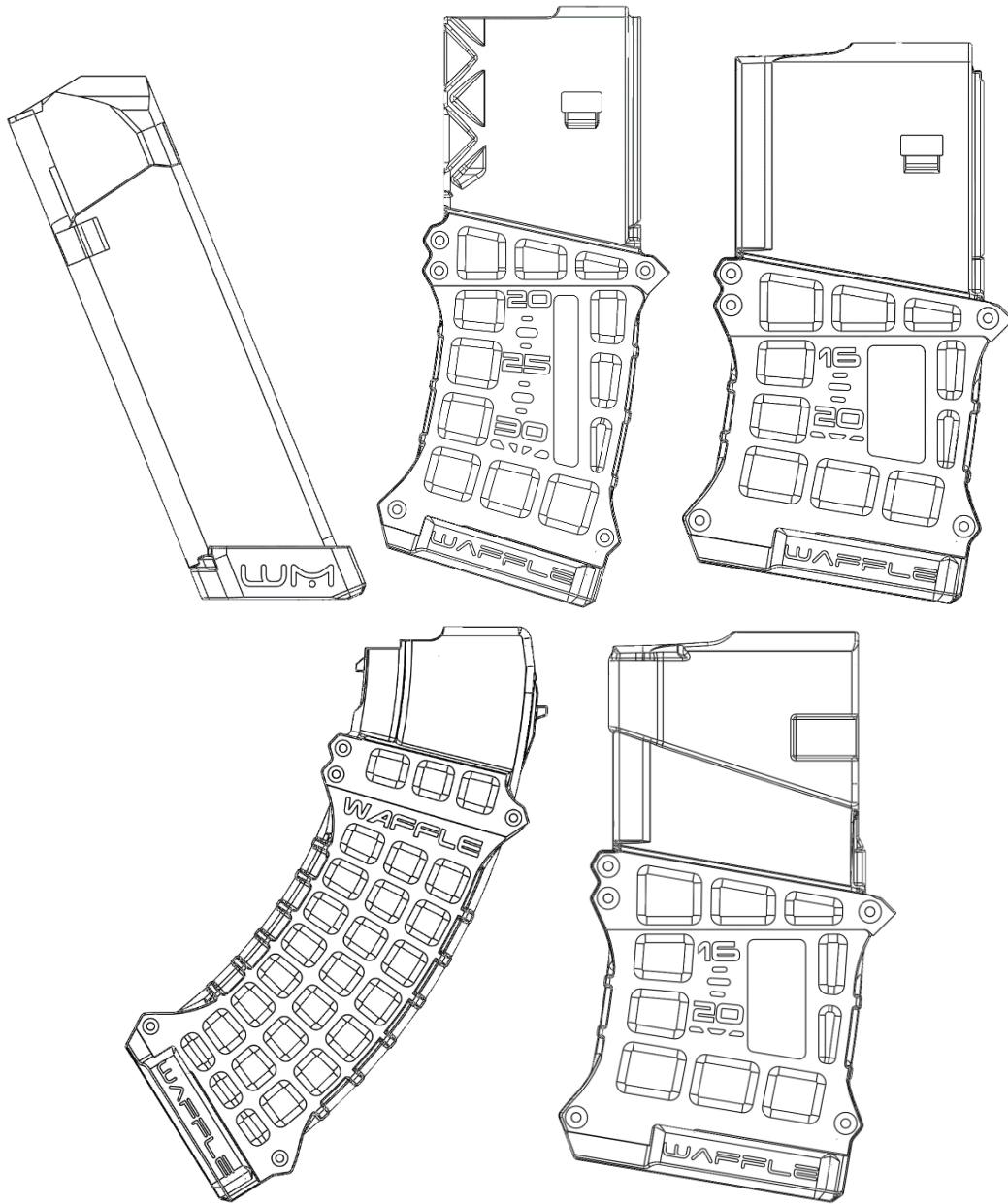# WAFFLE MAG

Version: 2.0

Modified and Designed by Spooky

Released: 1/9/23

Acknowledgements

Thank you to the Rocketchat beta team at Det_Disp that spent the better part of almost two years testing out builds, contributing ideas, and providing necessary feedback for the Waffle 2.0 Project. Because of the scale of this project, as well as the necessity for firearms that I am not able to test with, I could not have finished this project without them. Thank you to DarkScarecrow for the rapid builds and measurements for the CETME adapter, as well as Batto for his constant presence and support. Batto was the catalyst for Waffle 2.0 becoming a conglomerate project in general, so be sure to send your thanks his way. Also, shoutout to RiceCutta for the QuickDraw baseplate idea. Lastly, a big thank you to Ivan for the original AR magazine and Glock magazine model, and Defense Distributed for the AKM magazine model. I greatly appreciate all who helped!

-Spooky

Table of Contents

WAFFLE MAG 2.0 DETAILS

Below is a list of all the changes that went into Waffle Mag 2.0. I've included some photos to illustrate the changes alongside them to help better understand the reasoning behind each change.

- **Updated Waffle Magazine Frame Geometry / AR-15 Update**
  - When I first took on the task of making AR-15 Magazine's printable, I had three main goals in mind: *durability*, *reliability*, and *accessibility*. One of the main issues we had with printing AR-15 magazines prior to Waffle mags was that the feed lips needed to be reinforced after being printed via post-processing. Even still, this was not a guarantee that the feed lips would not fail. The great revelation with Waffle Mags came as a biproduct of splitting up the frame into 3 pieces, which made it possible to print the top of the magazine at an angle to enhance the strength of the feed lips using the natural material strength: no post-processing required. Once this problem was solved, reinforcing the bottom of the magazine, as well as the joints that connect the parts, was the next problem. Originally, all the "ridges" on the Waffle mag contained a bolt, totaling 11 bolts for one mag! This was quickly deemed unnecessary, however the geometry left over became a fan favorite, and the ridges were left in place. The iconic Waffle pattern originally was introduced as a material saving measure, however because memes control time and space, the pattern became the staple for both the magazine and its name in the community. Because the magazine is technically an assembly, the need for a baseplate was not a priority, so it was skipped in lieu of additional capacity frames. With **Waffle Mag 2.0**, the geometry of the magazine was completely overhauled down to the core with a model made from scratch. This allowed for much easier tweaking of the magazine during development, faster revisions, and accommodated calibers that weren't supported before, namely 300 BLK as well as

.458 SOCOM. The Waffle pattern was revised to be more aesthetic, the ridges were removed in favor of a more ergonomic texture, and of course a baseplate was added for a more "permanent" assembly of the magazine and faster, toolless takedowns. With all of this, Waffle Mags can still be printed using the cheapest, weakest filament possible and will remain durable and dependable.
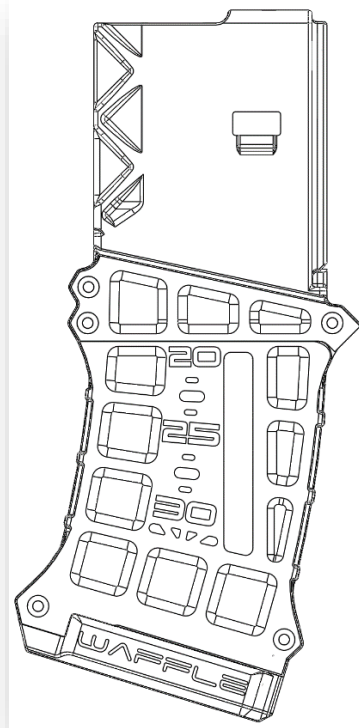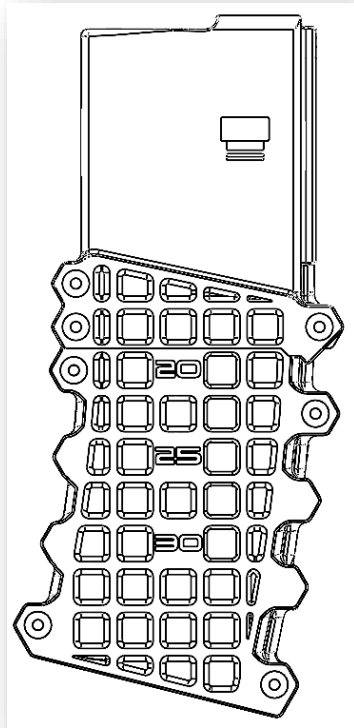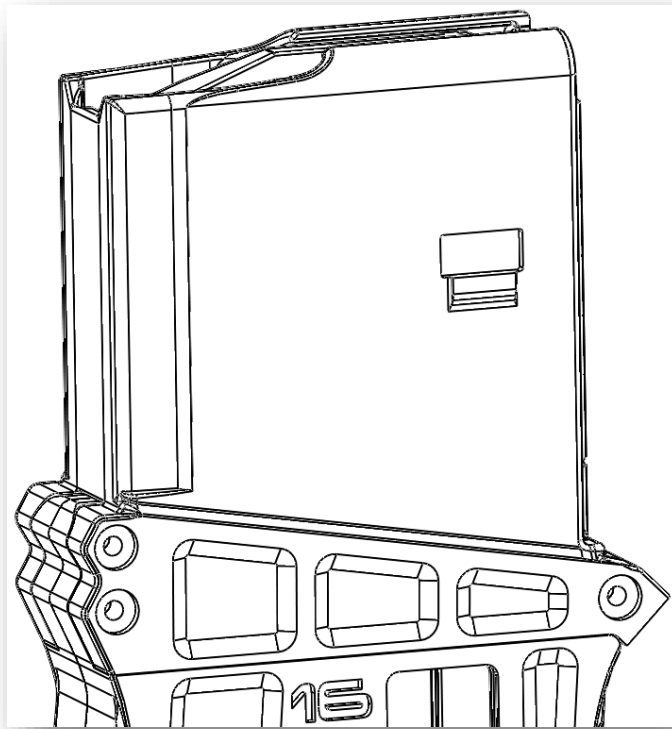
- **AKM Magazine**
  - The AKM Waffle Magazine is the strongest printed AKM magazine available currently. On top of a reinforced frame and updated geometry for ease of use for a multitude of AK magazine well patterns, the Waffle AKM Magazine was updated to utilize the more acquirable AR magazine spring. The AKM Magazine is available in both 30-round capacity and a 10-round capacity frame that uses a 20-round AR magazine spring.
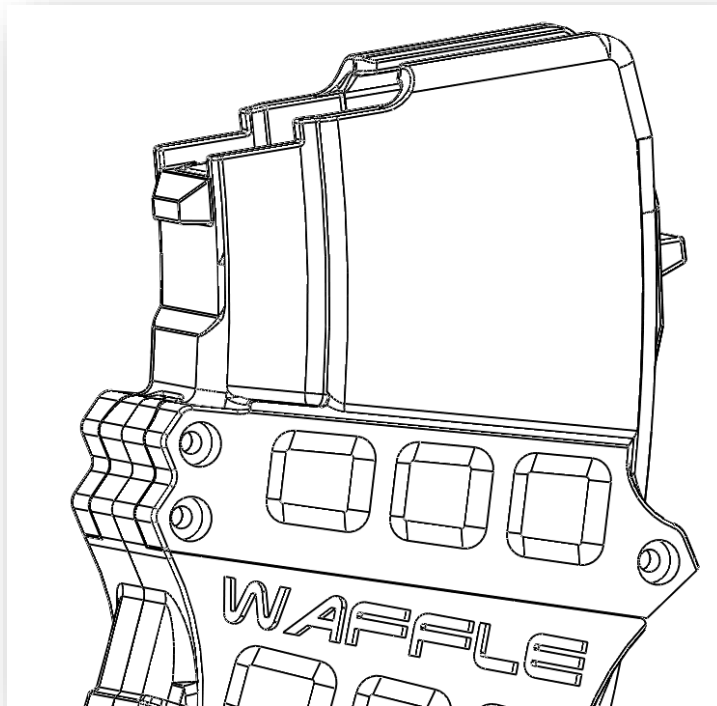
- **AR-10 Magazine**
  - *A world-first in Waffle Technology*: The Waffle AR-10 magazine is the only printable AR-10 mag available currently. The magazine features all the same amenities as the AR-15 Waffle magazine, including the utilization of an AR-15 magazine spring instead of the rarer (and expensive) AR-10 magazine spring. The Waffle AR-10 magazine comes in 20-round and 10-round capacities and has a windowed option using the same style of plexiglass as the AR-15 Waffle mag. LRBHO optimized.

- **CETME Adapter for AR-10 Magazine**
  - o With the Amigo Grande and like frames making waves in the 3DPG community due to surplus and affordability of the parts kits, it soon became obvious that a printed magazine solution was needed. Thanks to DarkScarecrow, the solution was found: an adapter part for the AR-10 magazine frame that functions with the CETME magazine well.
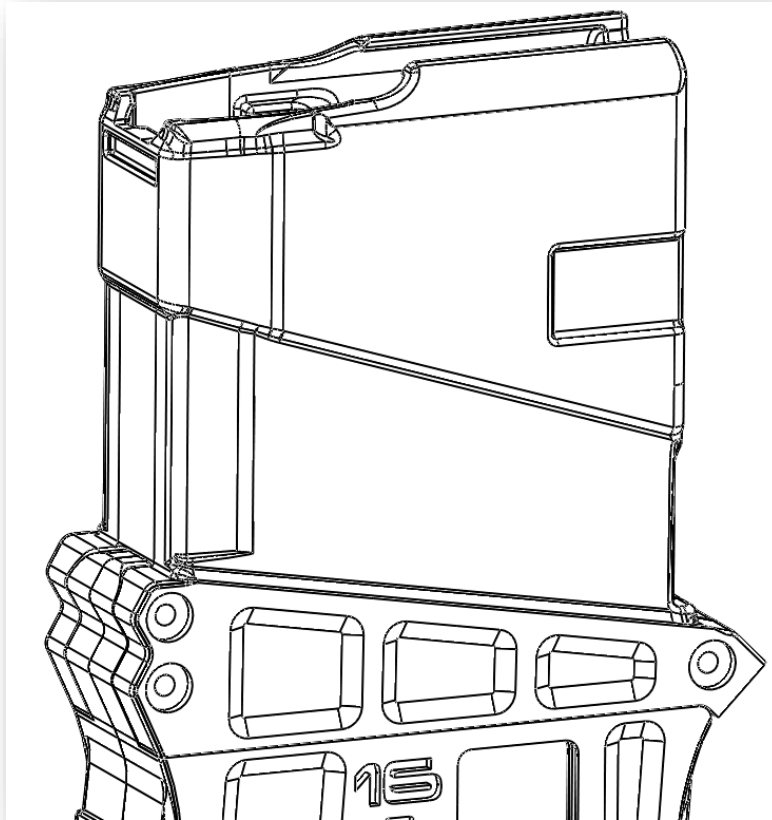
- **Glock 9mm Magazine**
  - What started as a side project with the simple addition of making the magazine catch area ambidextrous expanded into a reinforced, optimized, and extendable capacity Glock magazine that excels where other printable Glock magazines fall short. Additional capacity is achieved by printing a slide-over extension frame over the standard capacity frame, allowing for optimized print orientations of all parts while creating a more reliable and durable assembly. LRBHO optimized.
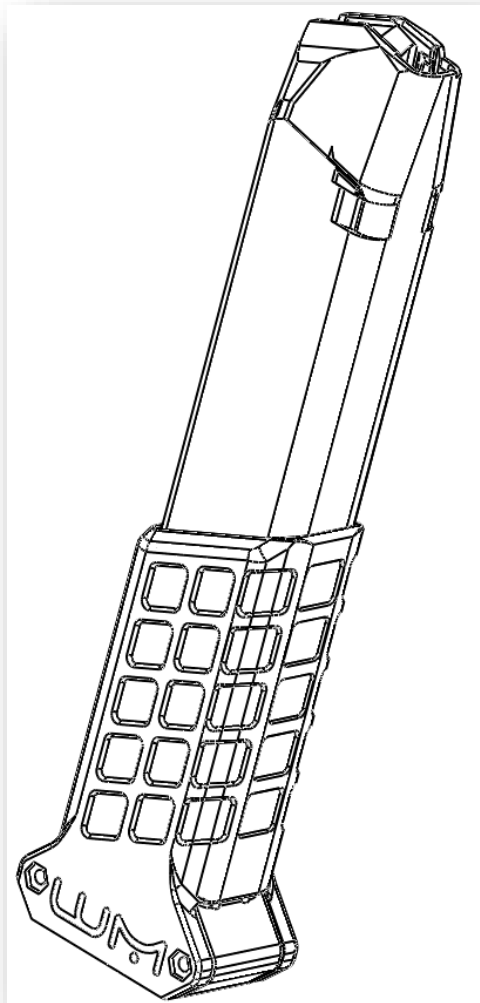
- **Boltless Assemblies**
  - Much to the dismay of the citizens of Cambodia, one of the innovations brought forth in Waffle 2.0 was the ability to assemble a Waffle magazine *without any bolts.* Instead, printed pins are installed in lieu of bolts, with the larger pins being secured with printed locking tabs. All frames accommodate boltless assembly with all subassemblies. **NOTE:** Boltless assemblies are not interchangeable with standard counterparts, and printed pins are **magazine specific.**
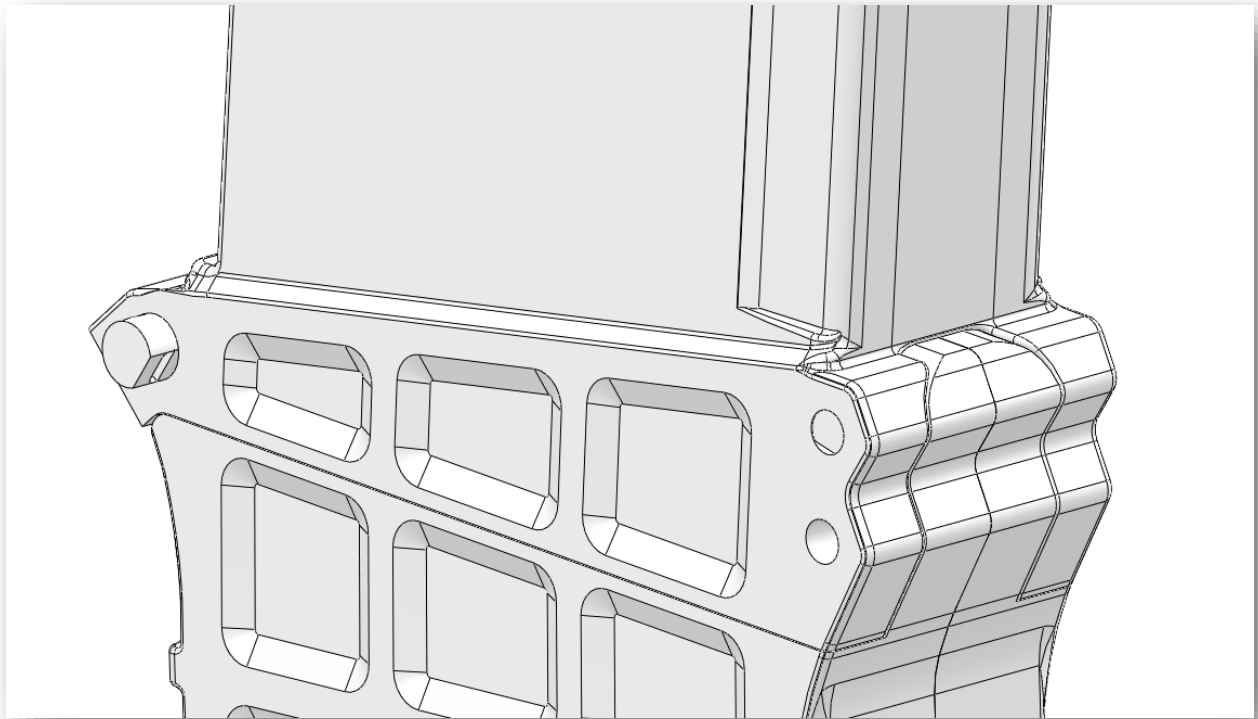
- **Custom Supported Magazine Top Parts**
  - Printing an entire magazine piece on two cm^2 feet, known colloquially as "the Dance," can be quite a challenge. It's no secret that Waffle magazines take a bit of finesse and calibration to get a top part to print correctly without fail. To aide our uncalibrated brothers who might not have a leveled bed, or too much z-binding, all magazine top parts come with an additional model that includes easily removable supports. Sand down the supported face after removal.
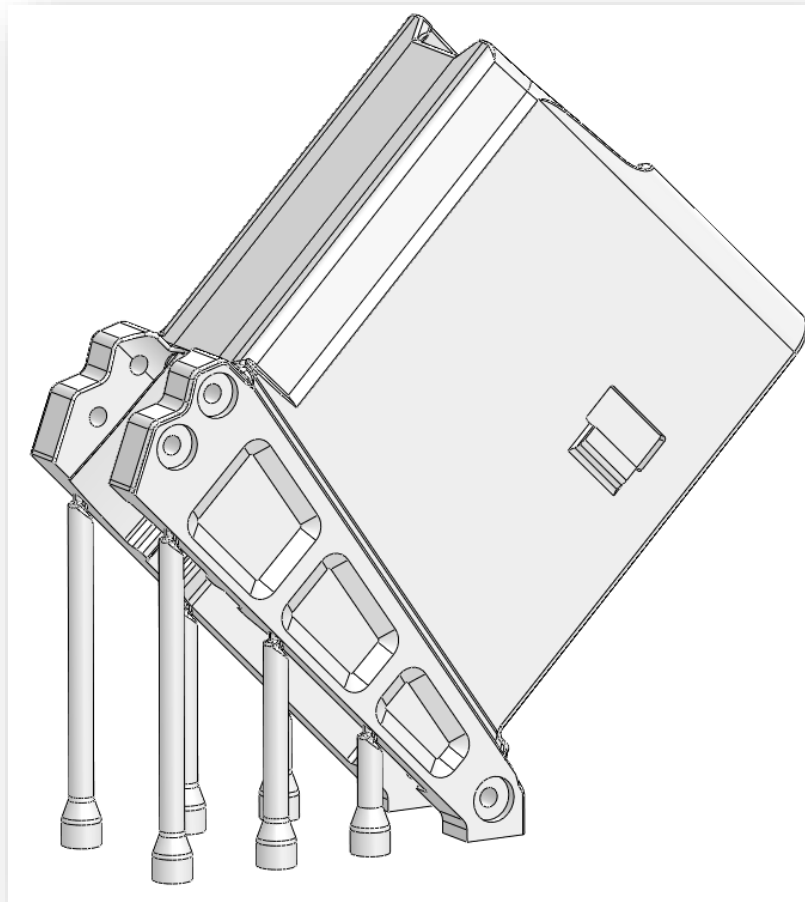
- **Quickdraw Baseplates**
  - Added with the *tacticool* user in mind, all frames contain an additional baseplate model that has an added hook for improved ergonomics and handling. The AR-15 magazine also has a special, *lewder* model with the bachelor operators in mind.
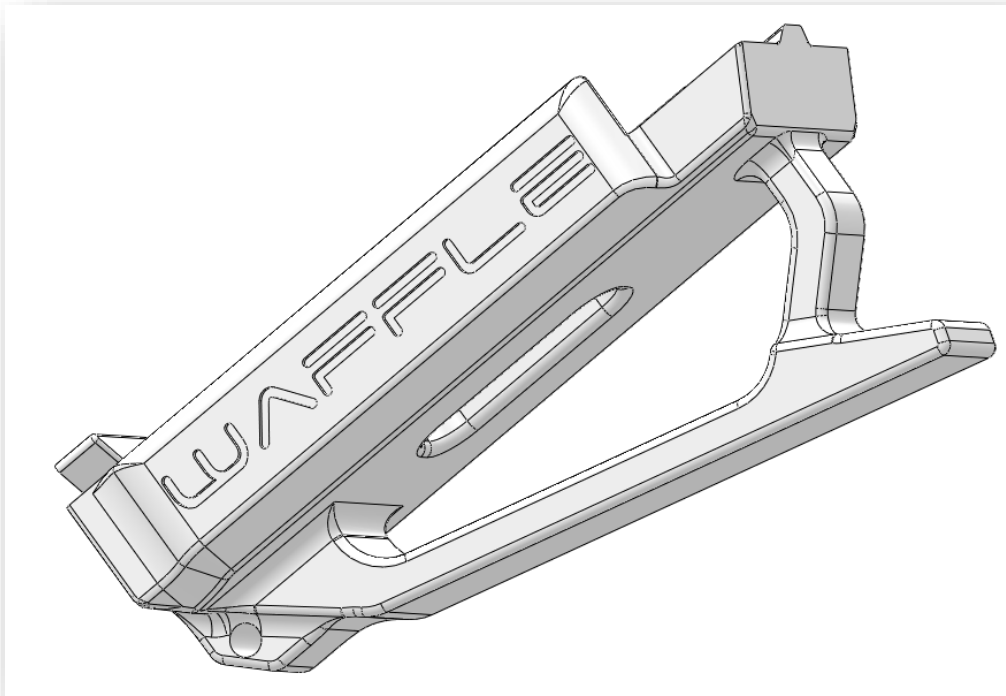
- **Solid Frame**
  - Added solid, unsplit STEP files for the AR15, AR10, and AKM frames for developers that want to modify or remix magazine geometry without having to hassle with assembling the files into a full frame. Only available for standard capacity frames (No extended, 20-round, windowed, or CETME solid frames.)
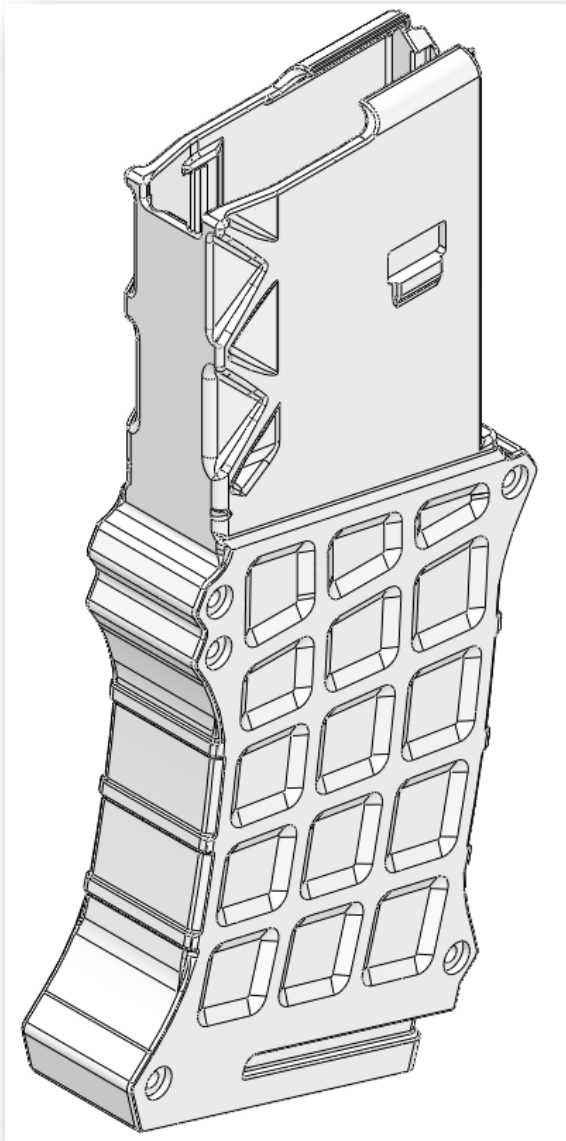
PRINTER CALIBRATION

If you have already spent a decent amount of time calibrating your printer and know how to do so, you can skip this section.

Printer calibration is a key aspect of using a 3D printer. Typically, out of the box your printer is probably not going to be printing exactly to spec. Ironing out the kinks and dialing in your printer *prior* to printing a lower receiver can save you not only time, but also material and headaches.

It should be noted prior to reviewing this section that your bed should be leveled properly. You can do this with either your preferred method, test prints, or using hardware like a BLTouch. Regardless, if your bed is not properly level, your print **will** fail.

There are two main points of calibration: your dimensions and your flow. Calibrating dimensions is as easy as printing a test cube, measuring it with calipers, and adjusting your printer's steps/mm accordingly. Flow on the other hand can be more tricky, and typically is the first point you want to address as adjusting your flow can change your printers dimensional accuracy as well.

To calibrate you're flow, the first thing you're going to need to do is calibrate your extruder. This can be done very simply by measuring 100mm of filament from the extruder entrance outwards towards the spool and marking the 100mm point. Then, heat up your hot end and extrude 100mm of filament. Depending on where the mark ends up, you might be over-extruding or under. Using the equation below:

$$\left(\frac{\text{Expected Dimension}}{\text{Observed Dimension}}\right) \times \text{Current Steps/mm} = \text{New Steps/mm}$$

Calculate your new extruder steps/mm and run the test again until you are reasonably within a small margin of error with the extruder. Next, we will calibrate your flow in your slicer.

Included in the files are three calibration test prints: Flow_Calibration.STL, Firebolt_Calibration_Test.STL, and Calibration_Cube.STL. Start by printing the

Flow Calibration print; it is a simple 20mm x 20mm shelled box that will print with 3 wall lines on the edges with a 0.4mm nozzle. Once this is printed, measure the walls of the print with a caliper. Each wall should be about 1.2mm wide. If your walls are considerably larger or smaller, take 9 test measurements and average them out, and plug them into the equation below:

$$\left(\frac{1.2 \text{ mm}}{\text{Averaged Dimension}}\right) \times \text{Current Flow Percentage} = \text{New Flow Percentage}$$

Like the first test, print another test print and dial in your flow rate.

Once your flow has been calibrated properly, print the included Calibration_Cube. The settings on this cube should be minimal, with 2-3 walls and ~15% infill, but keep your speed and retraction settings the same as you would print a Firebolt. This calibration cube consists of multiple printer test all in one, including multiple overhang test, dimension tests, inner dimension test, hole dimension tests, stringing tests, and an M3 nut cutout for practical measurement. The dimensions of all the features included in the cutout are viewable in the folder.

Once the print is finished, measure the outside sides first. The cube is exactly 30mm x 30mm x 30mm, with the M3 cutout on the Y-axis and the 7.5mm hole on the X-axis. Measure each side more than once and average out the measurements to determine if you need to adjust your printer's steps/mm on that particular axis using the first equation from before. If you would like a less time-consuming print, find an XYZ cube on Thingiverse to print.

Dimensional accuracy is critical when it comes to a lower receiver. Printing too large can throw off your takedown pin hole alignment, while printing too small can cause your buffer tube to not thread. Inner dimensional accuracy is also important, which is why the third file, Firebolt_Calibration_Test, is the last file *you are going to want to print* regardless if you feel like your printer is up to spec or not. This print includes **all** of the holes that you will find on an AR-15 lower receiver, including the Safety, Takedown pins, FCG pins, and the Magazine release button slot. Not only that, but also included is a short copy of the buffer threads, allowing you to thread your buffer tube through it to test if your printer is calibrated. If you cannot thread your tube or fit the magazine release button into the slot, consider using the Hole Horizontal Expansion setting in Cura (demonstrated here: https://www.youtube.com/watch?v=UUelLZvDelU) to fix this issue. This print is 50mm x 50mm.

PRINT SETTINGS

Material	PLA / PLA+ / ABS / PETG / Polycarbonate / Filled Nylon
Nozzle Size	0.4 mm
Filament Size	1.75 mm
Layer Height	0.12-0.16 mm
Top/Bottom Layers	15-20 Layers
Wall Line Count (Perimeters)	6-8 Walls
Infill Pattern	Triangle / Cubic
Infill Percentage	25-75%
Supports	Part Dependent, Included for Top Parts

MATERIALS LIST

Hardware

AR-15 Magazine: 5 x 25mm M3 screws and nuts (20, 30, and 40 rnd. capacity)

AR-15 Magazine Spring (30-rnds.), Extra Power AR-15 Magazine Spring (40-rnds.), 20-round AR-15 Magazine Spring (10- and 20-rnds.)

AKM Magazine: 5 x 25mm M3 screws and nuts (30- and 10-rnd. capacity)

AR-15 Magazine Spring (30-rnds.) or Extra Power AR-15 Magazine Spring (30-rnds.), 20-round AR-15 Magazine Spring (10-rnds.)

AR-10 Magazine and CETME Magazine: 5 x 30mm M3 screws and nuts (20-rnd capacity)

AR-15 Magazine Spring (20-rnds.) or Extra Power AR-15 Magazine Spring (20-rnds.), 20-round AR-15 Magazine Spring (10-rnds.)

Glock 9mm Magazine: 2 x 30mm M3 screws and nuts (33-rnd capacity)

Glock 9mm 17-round Magazine Spring (17-rnds.), Glock 9mm 33-round Magazine Spring (33-rnds.)

OPTIONAL FOR WINDOWED AR MAGAZINE FRAMES: 1/16" Thick Transparent Plexiglass sheet

Included Models

- **AR-15 Magazine - Standard**
  - **AR Mag Top**
    - AR Mag Top Supported
    - AR Mag Top Pipkin Pippa (*Exclusive!*)
    - AR Mag Top Restricted
  - **AR Mag Bottom Left**
    - AR Mag Bottom Left Windowed
    - AR Extended Mag Bottom Left
    - AR Twenty Round Mag Bottom Left

- o **AR Mag Bottom Right**
  - AR Mag Bottom Right Windowed
  - AR Extended Mag Bottom Right
  - AR Twenty Round Mag Bottom Right
- o **AR Ten Round Mag Body**
  - AR Ten Round Mag Body Supported
- o **AR Mag Body Solid (STEP only)**
- o **AR Mag Spring Base**
- o **AR Mag Baseplate**
  - AR Mag QuickDraw Baseplate
  - AR Mag Lewd Baseplate
- o **AR Mag Follower**
  - AR Mag Ten-Twenty Round Follower
    - **Note:** Used for twenty-round springs that have a different attachment location.

- **AR-15 Magazine – BoltLess [BL]**
  - o **AR Mag Top BL**
    - AR Mag Top BL Supported
  - o **AR Mag Bottom Left BL**
    - AR Mag Bottom Left Windowed BL
    - AR Extended Mag Bottom Left BL
    - AR Twenty Round Mag Bottom Left BL
  - o **AR Mag Bottom Right BL**
    - AR Mag Bottom Right Windowed BL
    - AR Extended Mag Bottom Right BL
    - AR Twenty Round Mag Bottom Right BL
  - o **Pin 6mm – AR15**
    - **Pin Lock 6mm**
  - o **Pin 4mm – AR15**
    - [**Note**: 4mm Pins do not use a lock and are simply interference fit]

- **AR-10 Magazine - Standard**
  - **AR10 Mag Top**
    - AR10 Mag Top Supported
  - **AR10 Mag Bottom Left**
    - AR10 Mag Bottom Left Windowed
  - **AR10 Mag Bottom Right**
    - AR10 Mag Bottom Right Windowed
  - **AR10 Ten Round Mag Body**
    - AR10 Ten Round Mag Body Supported
  - **AR10 Mag Body Solid (STEP only)**
  - **AR10 Mag Spring Base**
  - **AR10 Mag Baseplate**
    - AR10 Mag QuickDraw Baseplate
  - **AR10 Mag Follower**
    - AR10 Mag Ten Round Follower
      - **Note:** Used for twenty-round springs that have a different attachment location.

- **AR-10 Magazine – BoltLess [BL]**
  - **AR10 Mag Top BL**
    - AR10 Mag Top BL Supported
  - **AR10 Mag Bottom Left BL**
    - AR10 Mag Bottom Left Windowed BL
  - **AR10 Mag Bottom Right BL**
    - AR10 Mag Bottom Right Windowed BL
  - **Pin 6mm – AR10**
    - **Pin Lock 6mm**
  - **Pin 4mm – AR10**
    - [**Note**: 4mm Pins do not use a lock and are simply interference fit]

- **CETME Magazine Adapter**
  - **CETME Mag Top**
    - CETME Mag Top Supported
  - **CETME Ten Round Mag Body**
    - CETME Ten Round Mag Body Supported
  - **CETME Mag Follower**
    - CETME Ten Round Mag Follower
      - **Note:** Used for twenty-round springs that have a different attachment location.

- **CETME Magazine Adapter – BoltLess [BL]**
  - **CETME Mag Top BL**
    - CETME Mag Top Supported BL

- **AKM Magazine - Standard**
  - **AKM Mag Top**
    - AKM Mag Top Supported
    - AKM Mag Top Relief Cut Supported
      - **Note:** If you are having fitment issues with your AKM magazine in your mag well, try to use this model.
  - **AKM Mag Bottom Left**
    - AKM Mag Bottom Left Windowed
      - **Note:** Windowed version of AKM mag does not include installation of plexiglass. Use it at your own discretion.
    - AKM Ten Round Mag Body Bottom Left
  - **AKM Mag Bottom Right**
    - AKM Mag Bottom Right Windowed
    - AKM Ten Round Mag Body Bottom Right
  - **AKM Mag Body Solid (STEP only)**
  - **AKM Spring Base AR**
  - **AKM Mag Baseplate**

- ▪ AKM Mag QuickDraw Baseplate
  - ○ **AKM Mag Follower**
    - • **Note:** The AKM Mag Follower is adapted for either standard or twenty-round AR Springs.

- **AKM Magazine – BoltLess [BL]**
  - ○ **AKM Mag Top BL**
    - ▪ AKM Mag Top BL Supported
    - ▪ AKM Mag Top Relief Cut BL Supported
  - ○ **AKM Mag Bottom Left BL**
    - ▪ AKM Mag Bottom Left Windowed BL
    - ▪ AKM Ten Round Mag Body Bottom Left BL
  - ○ **AKM Mag Bottom Right BL**
    - ▪ AKM Mag Bottom Right Windowed BL
    - ▪ AKM Ten Round Mag Body Bottom Right BL
  - ○ **Pin 6mm - AKM**
    - ▪ **Pin Lock 6mm**
  - ○ **Pin 5mm - AKM**
    - ▪ **Pin Lock 5mm**

- **Glock 9mm Magazine - Standard**
  - ○ **Glock Mag Frame Supported**
  - ○ **Glock Mag Extension Frame**
  - ○ **Glock Mag Extension Sleeve**
  - ○ **Glock Mag Spring Base**
  - ○ **Glock Mag Baseplate**
    - ▪ Glock Mag QuickDraw Baseplate
  - ○ **Glock Mag Follower**

- **Glock 9mm Magazine – BoltLess [BL]**
  - ○ **Glock Mag Extension Frame BL**
  - ○ **Glock Mag Extension Sleeve BL**
  - ○ **Pin 5mm - Glock**
    - ▪ **Pin Lock 5mm**

Printing Orientation

Preface

There's a lot of you in this community that like to "Think Different™" and fly by the seat of your pants when you print my projects. Maybe you want to assemble the magazine in some CAD software and print it as one piece or print it upside down with tree supports 40mm above the build plate. Regardless, I feel the need to express that the orientation these parts import with is **optimized for durability and reliability.** I cannot guarantee proper function nor longevity if you choose to print these parts in a different manner.

Mag Body Tops and Ten Round Frames

The top piece needs to be printed as imported at an angle resting on the back feet to give the feed lips the necessary strength. The part will require supports, however you can waive support on the leading edge by using the Supported models. The following figures demonstrate an example method of supporting the part. Figure 4 shows how one could position support blockers in Cura to remove unnecessary supports. If you have trouble getting the print to stick to the bed, use a large brim.
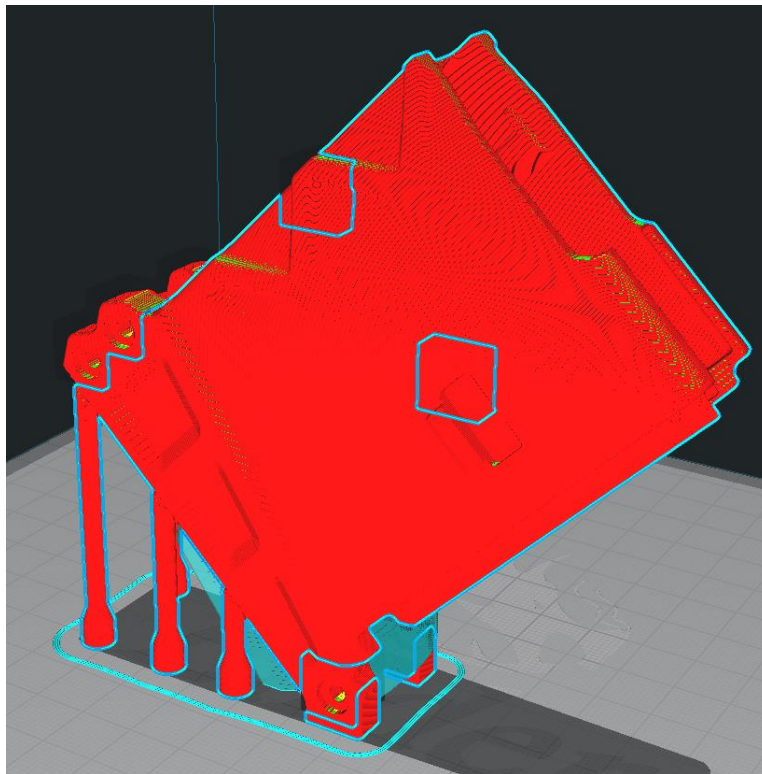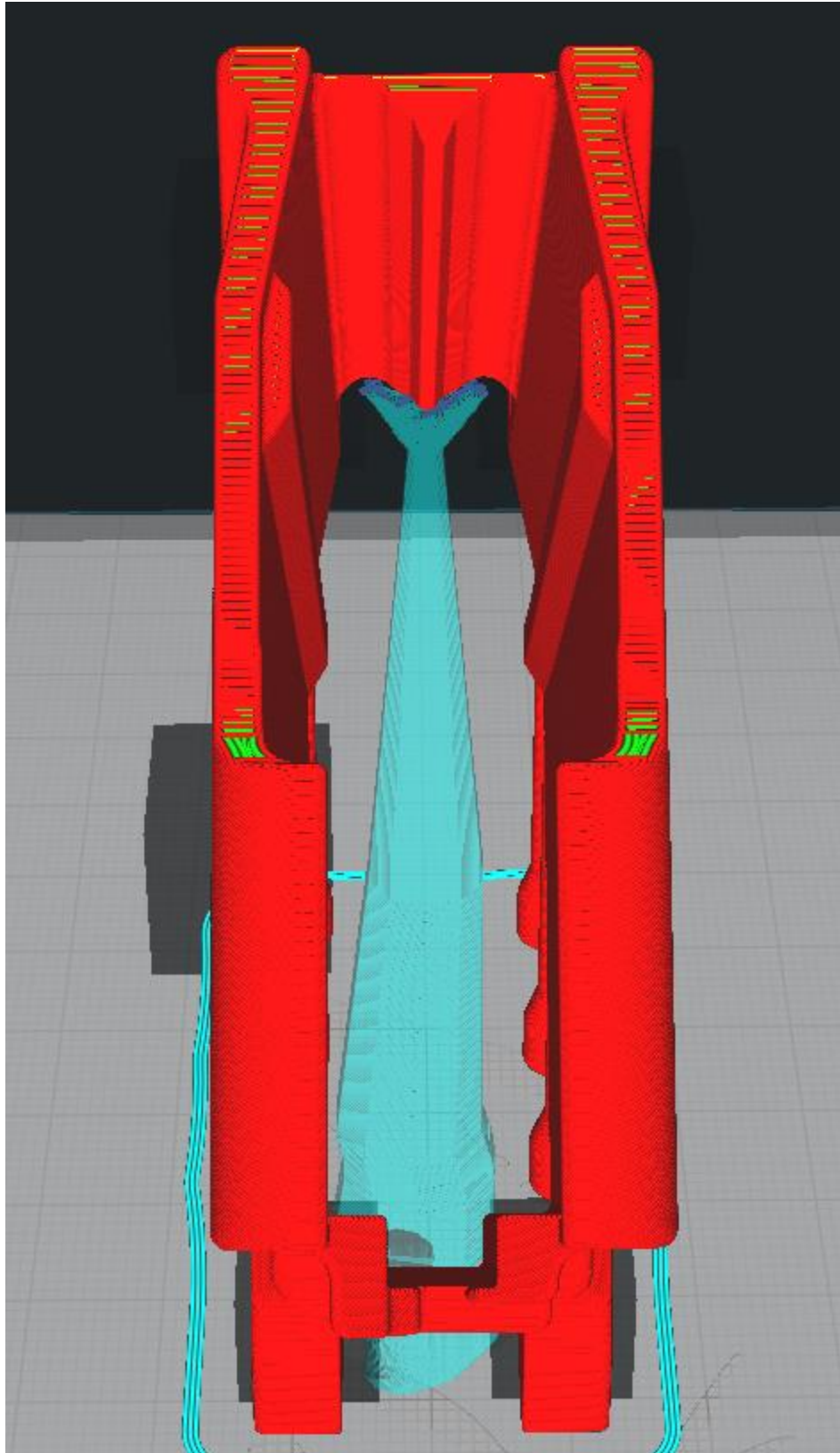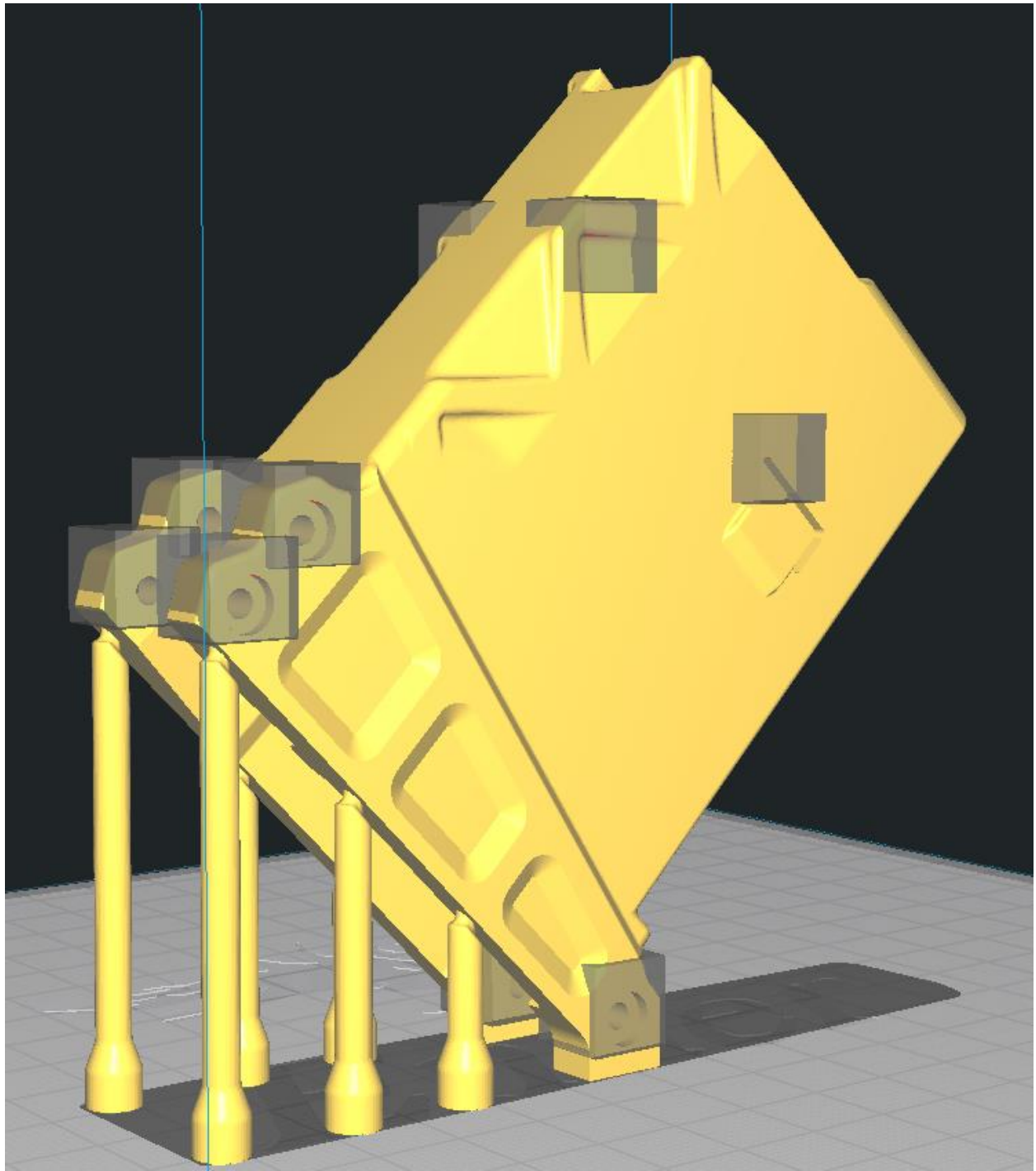

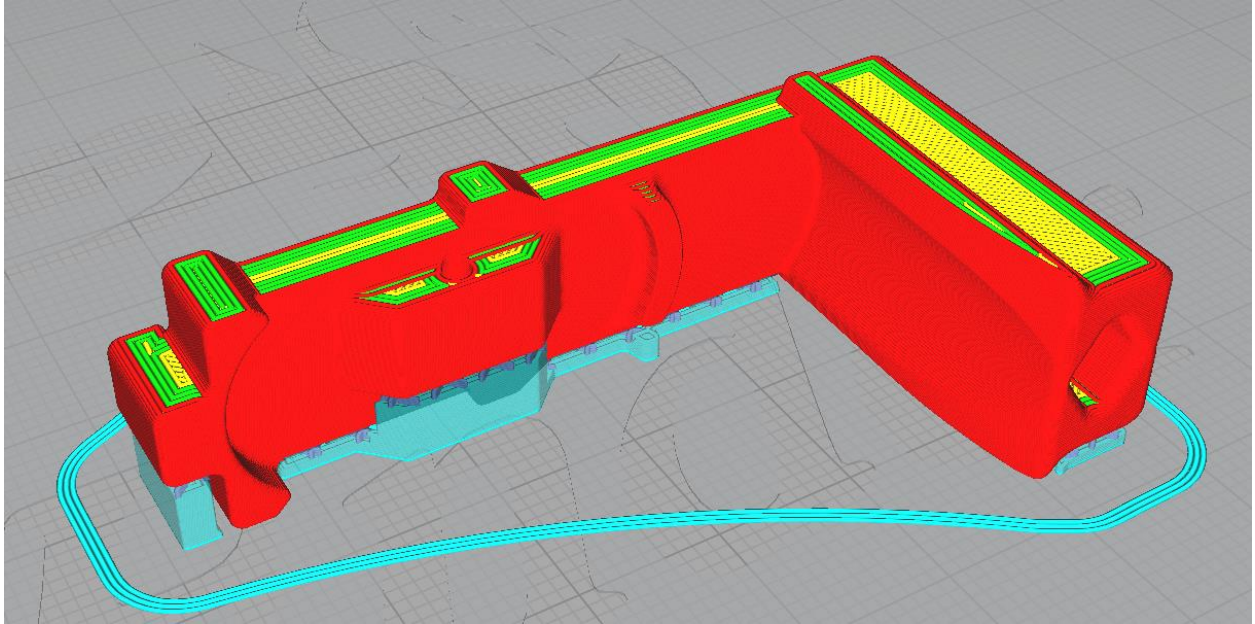**Figure 1**
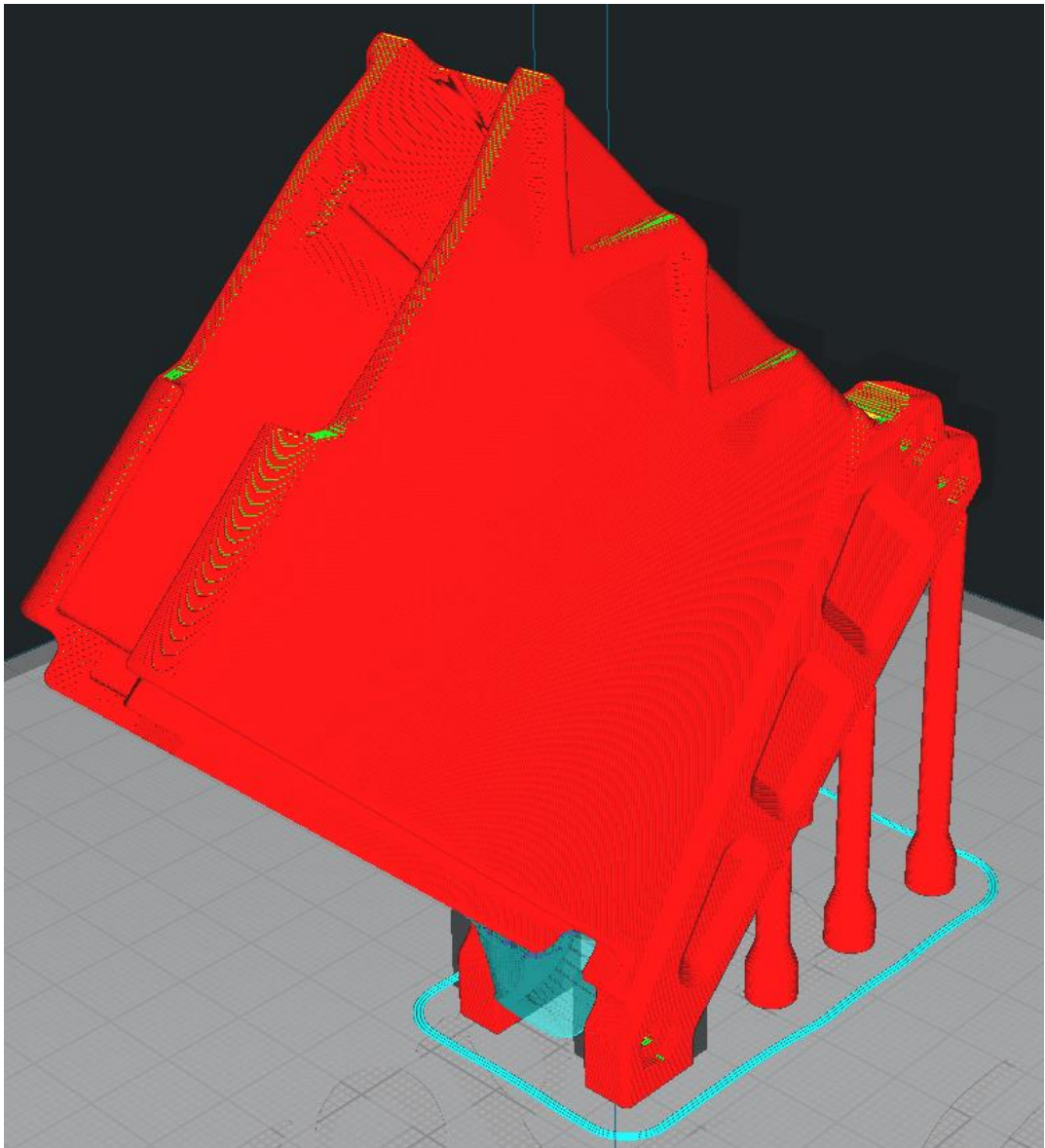
Figure 2

Figure 3

**Figure 4: Example Support Blockers**

Mag Followers

For AR-15: follower should be printed on its side with supports to produce the cleanest faces on the sides, reducing friction. A support blocker can be used inside of the front leg to prevent unnecessary supports. Print other followers as imported (generally upright with supports.)
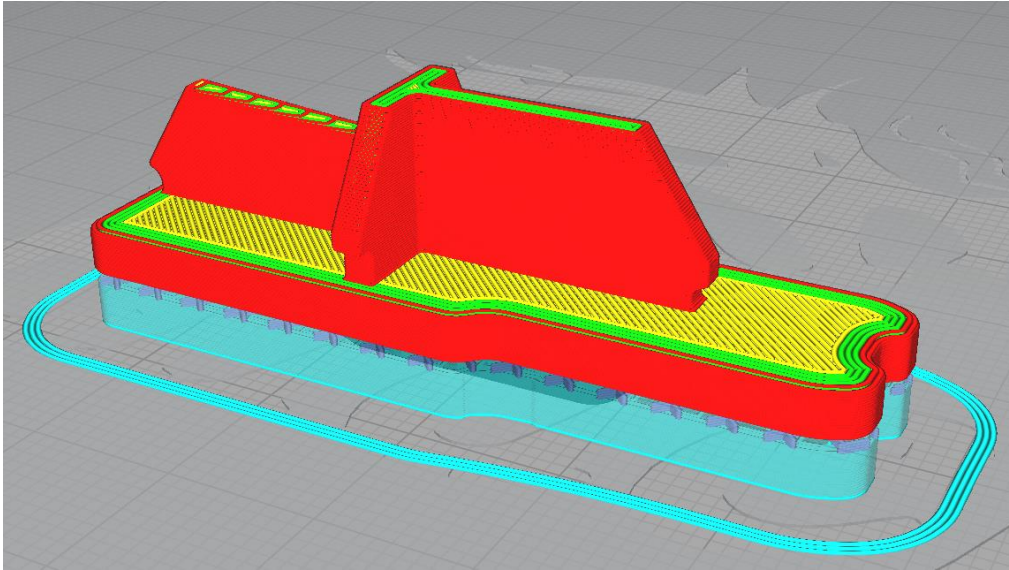

Figure 5

Mag Bodies Bottom Left and Right

The magazine bottom parts should be printed on the outside face. Supports must be used to support the magazine connection points, but support blockers **can** be used to block supports in the waffle pattern, the baseplate channels, and windows if printing those versions. Do not block supports in the bolt holes.
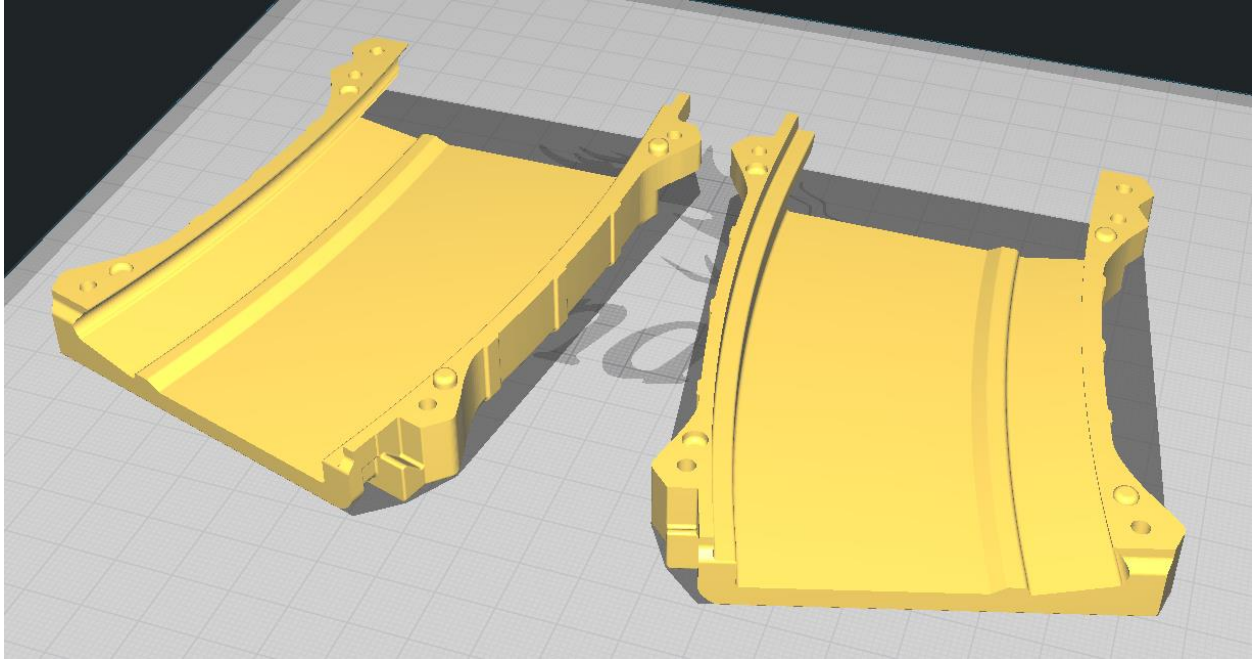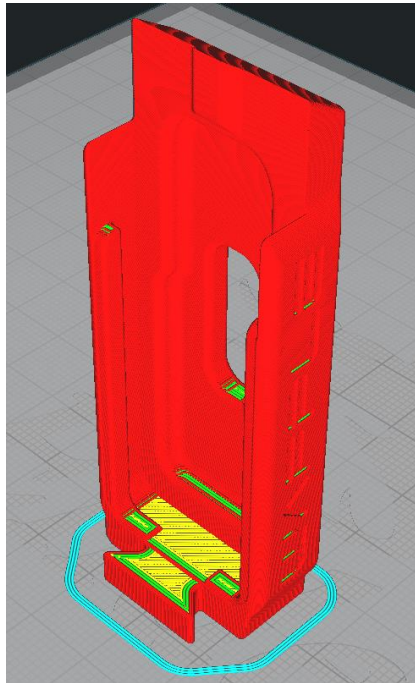

Figure 6

Spring Bases

The Spring Base should be printed on its bottom with supports.

Figure 7

Baseplates

The Baseplate(s) should be printed on its back without supports. Printing them flat could cause failure at the locking guides.
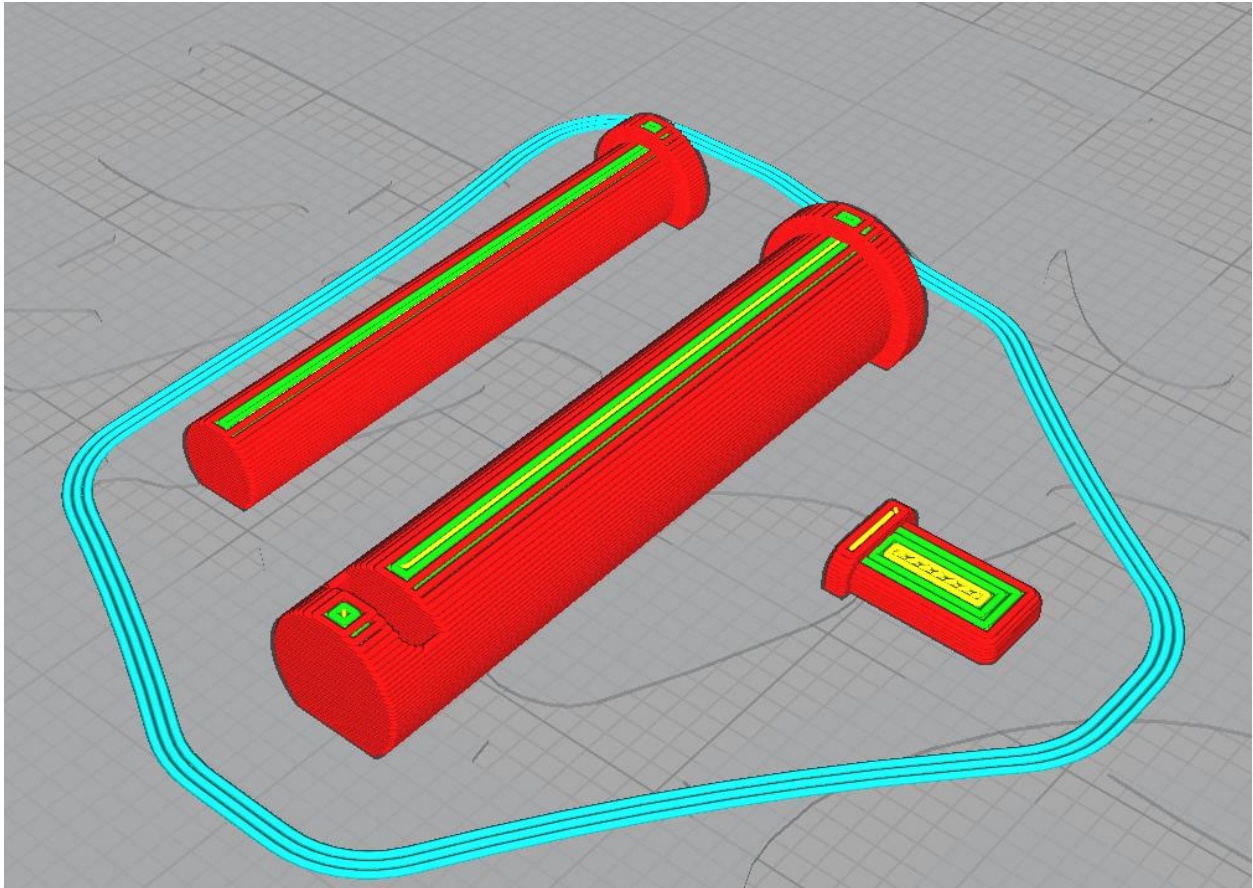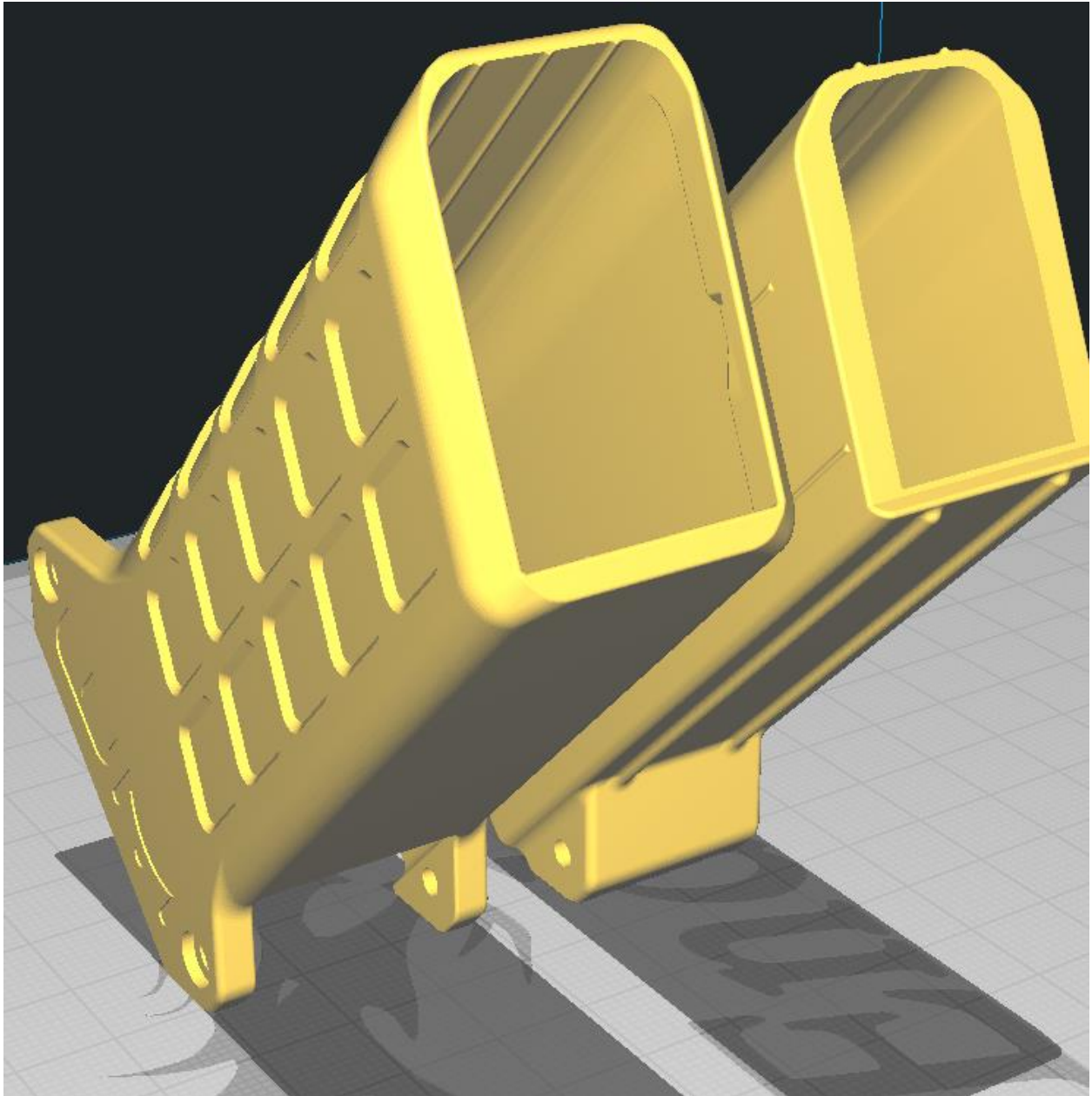

Figure 8

BoltLess Pins / Pin Locks

The pins for the boltless frames should be printed on their flat face, not upright. Printing them upright **will** cause your magazine to explode in a shower of bullets and plastic. Suggest being more liberal with infill and walls for longevity.

Figure 9

(Glock only) Extension Assembly

The extension frame and sleeve should be printed like the Mag Body Top parts print: at an angle on the feet. The Sleeve does not require supports but the Frame will for the overhanging edges.
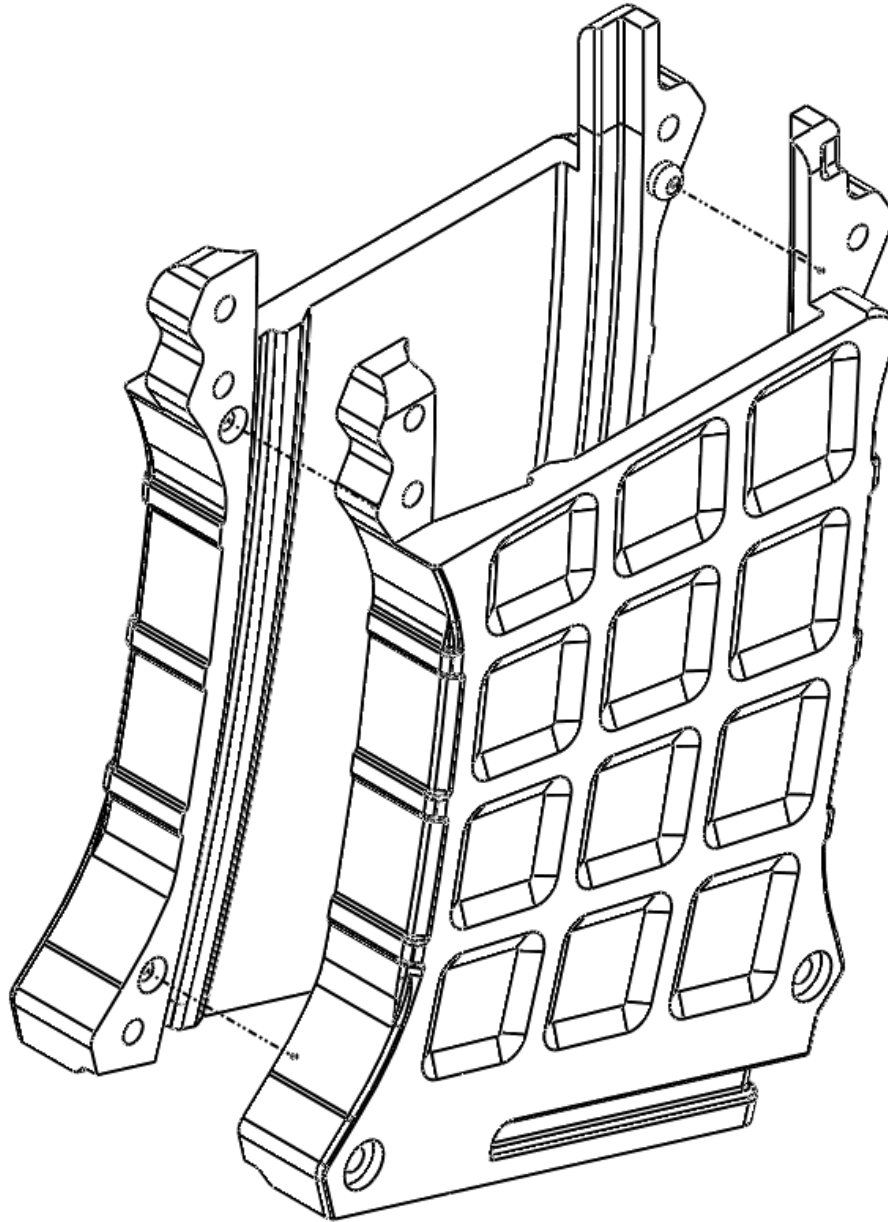

Figure 10

Assembly

NOTE: Assembly instructions will only display the standard capacity magazine assembly. Other frame styles follow similar assembly instructions.

Rifle Magazine Assembly

1. Using the printed guide pegs, combine the two bottom parts.

Figure 11: Standard Magazine Bottom Parts Assembly

2. Using two 25mm/30mm M3 screws and nuts, bolt together the bottom parts of the magazine. **BOLTLESS:** Drive a 6mm pin through the rear slot and a 4mm pin through the front. Lock in the 6mm pin with the Pin Lock. (**Note:** If the pin is too hard to drive through the frame, either drill out the holes with the appropriate drill bit or reduce the scale of the pins and reprint. Pins should be **snug** but not too tight, as this could damage the frame.)
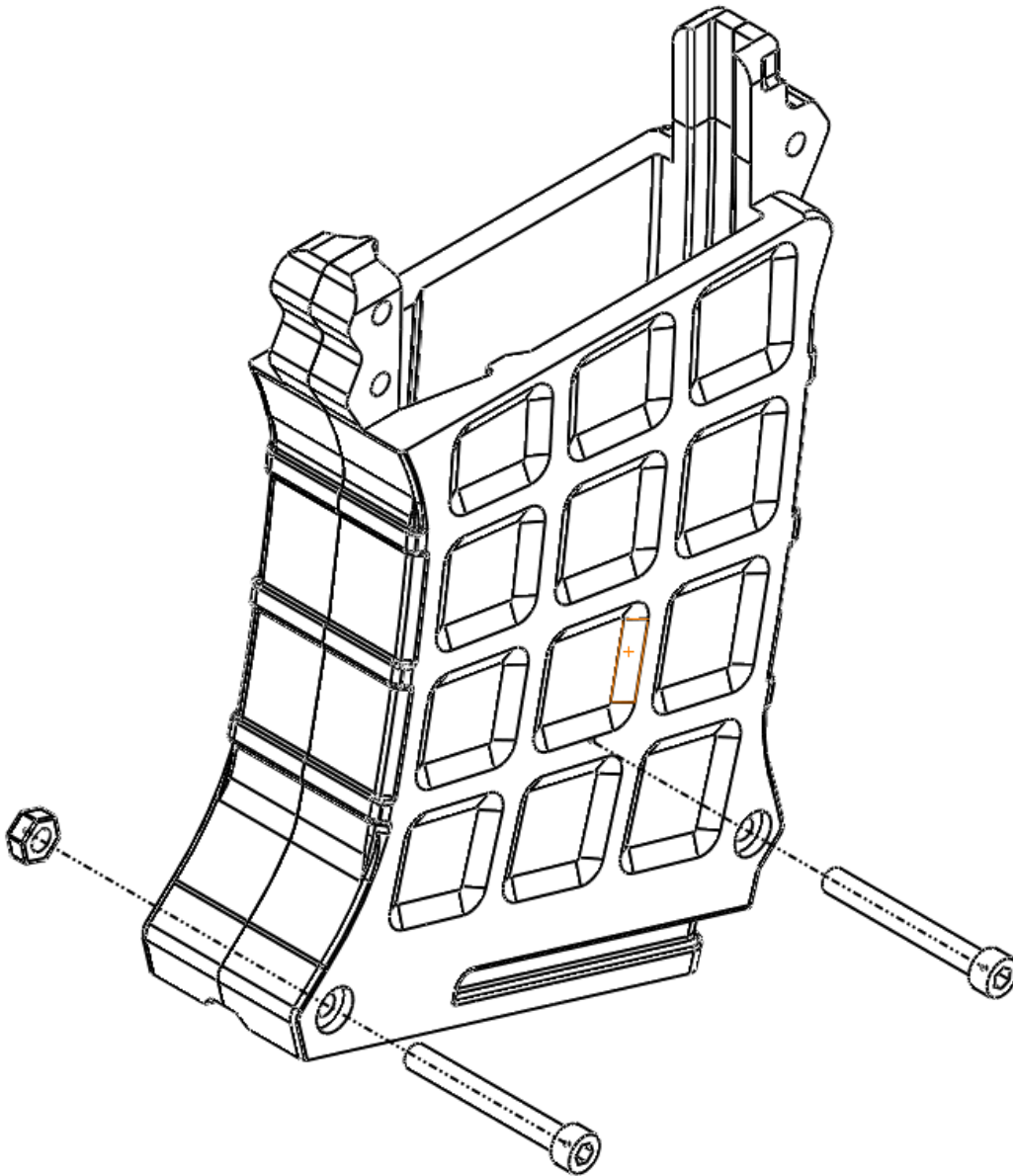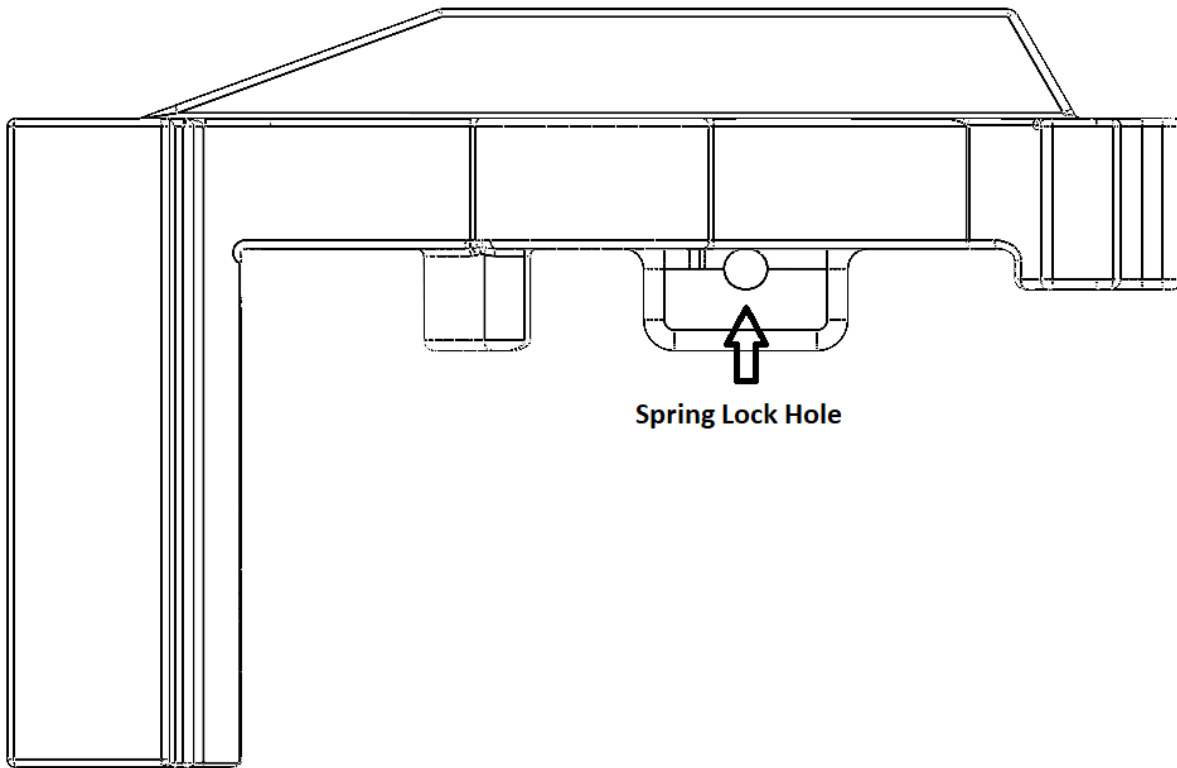
Figure 12

3. Connect the follower end of the spring to the magazine Follower via the Spring lock hole and insert the other end of the spring over the Spring Base.

Ensure both the follower and the spring base are oriented in the same direction.


Figure 13: Magazine Spring Locking Hole

4. If you printed the <u>windowed</u> version of the bottom parts, mark on your 1/16" clear plastic sheet a 10mm x 60mm rectangle (20mm x 40mm for AR-10 Windowed Magazine). Score the shape using a sharp object then snap off the piece or use some sharp snips or scissors. Alternatively, you can use a cutting tool like a Dremel, as the window channel will hide any imperfections to your edges up to 1mm from the edge.
5. Slide the clear plastic strip into the channel. The channels are shaped to allow for easier printing, so they might be tight on the strip. It may be prudent to sand the rear long edges of the strip.

6. Bolt the entire magazine together using three 25mm/30mm M3 screws and nuts. **BOLTLESS:** Drive a 6mm pin through the rear slot and two 4mm pins through the front slots. Lock in the 6mm pin with the Pin Lock. (**Note:** 4mm pins are meant to be interference fit, they should not be loose to the point that they can be removed by hand.)
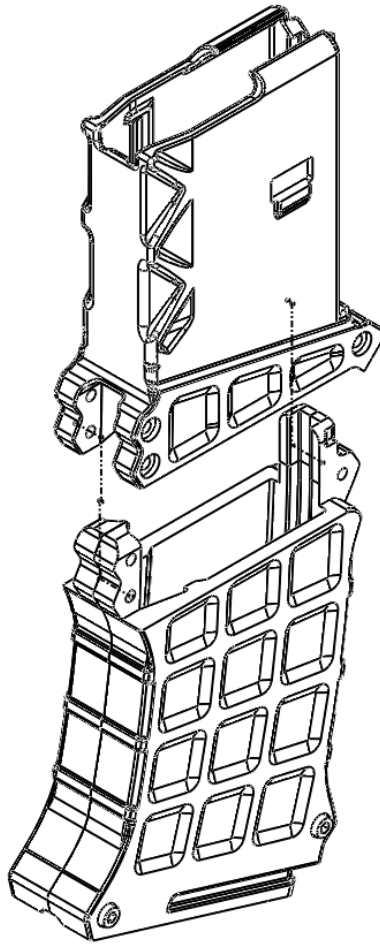

Figure 14: Magazine Bottom-to-Top Connection
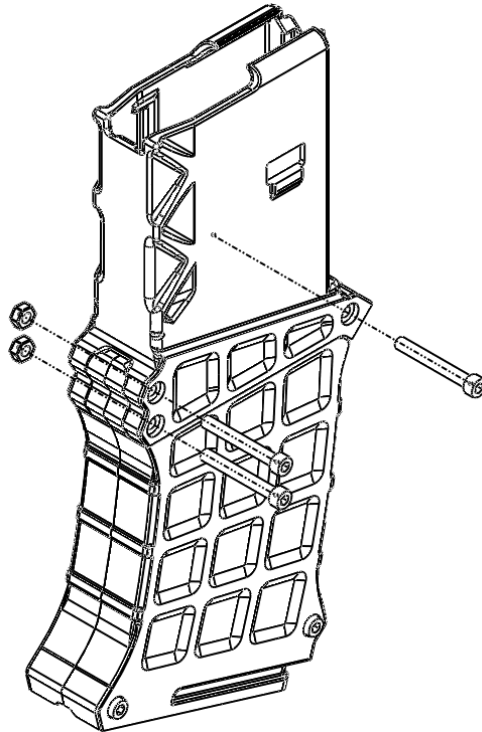
Figure 15: Magazine Frame Assembly

7. Insert the spring and follower into the bottom of the magazine through to the top of the magazine.

8. While retaining the spring base within the magazine, slide the baseplate into the guide cuts and over the spring base until the spring base clicks into position and locks the baseplate. (**Note:** Because the bottom half of the magazine is split, the installation of the baseplate could be tight at first due to tolerances in the assembly. If you find it difficult to slide the baseplate into place, consider sanding the grooves and locking guides on the baseplate prior to installation.)
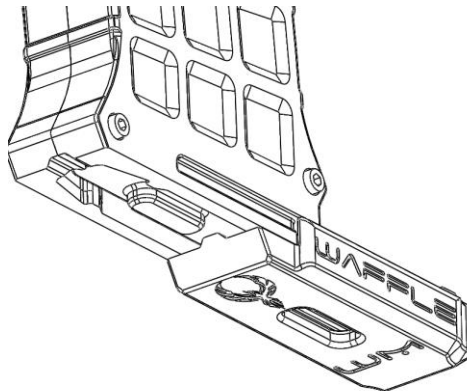

Figure 16: Baseplate Installation

Glock Magazine Assembly

Note: This instruction is specific to the extended magazine assembly.

1. If you are extending a previously completed Glock Waffle magazine, be sure to remove the baseplate, spring base, and 17-rnd spring. Remove the follower from the previous spring and install it onto the 33-rnd spring.
2. Slide the Extension Frame over the Glock Frame until it rests on the lip at the bottom of the magazine.
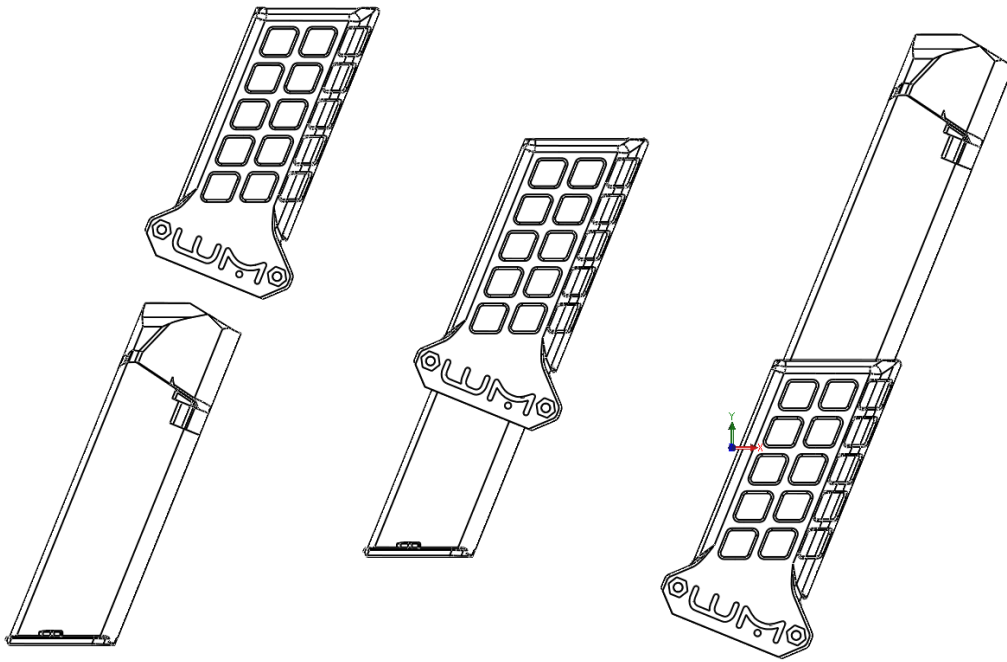
Figure 17: Extension Frame Installation

3. Insert the follower-end of the spring into the bottom of the magazine assembly until the follower rests at the feed lips. Slide the Extension Sleeve into the bottom of the assembly, ensuring to nest the base of the spring into the sleeve. Slide the Sleeve all the way into place until the bolt holes align.
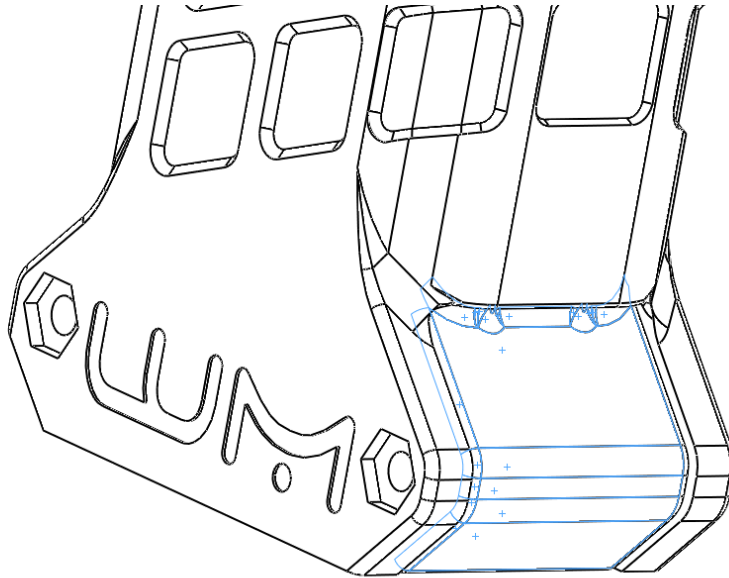
Figure 18: Extension Sleeve Installation

4. Using two 30mm M3 screws and nuts, bolt together the Extension Sleeve and Frame of the magazine. **BOLTLESS:** Drive a 5mm pin through the front and rear slots of the magazine. Lock in the 5mm pin with the Pin Lock. (**Note:** If the pin is too hard to drive through the frame, either drill out the holes with the appropriate drill bit or reduce the scale of the pins and reprint. Pins should be **snug** but not too tight, as this could damage the frame.)

Final Notes:

- Tolerances on the external dimensions of the magazine frames are very tight with respect to their corresponding magazine wells. It may be necessary to sand down the outer faces should you find it difficult to install the magazine.
- The inside of the magazine needs to be as smooth as possible, thus printer calibration is crucial. It is highly recommended to calibrate both dimensional accuracy and flow of your printer.
- After assembly, you should perform multiple load/unloads of your magazine to wear it in.
- Though the feed lips can handle the pressure of 30-40 rounds pressing up into them, they can still crack during loading if the rounds jam inside of the magazine. It is **highly** recommended in the case of difficult loading that the magazine be loaded by pressing in the loaded rounds and sliding the next round in under the feed lips. This method will ensure greater longevity.
- Occasionally the rounds can jam inside the mag while loading; negate this by tapping the magazine's rear against a hard surface to seat the rounds properly while loading.
- Even if your frame or feed lips crack, they can be quickly repaired with a solder iron.
- **UNLOADING TIP:** Pinch the very top of the magazine, then slide out each round.

If you find any problems with the files or have any further questions, please contact me either on Twitter at @Spooky3DPG or on the DetDisp RocketChat @spooky.spectre