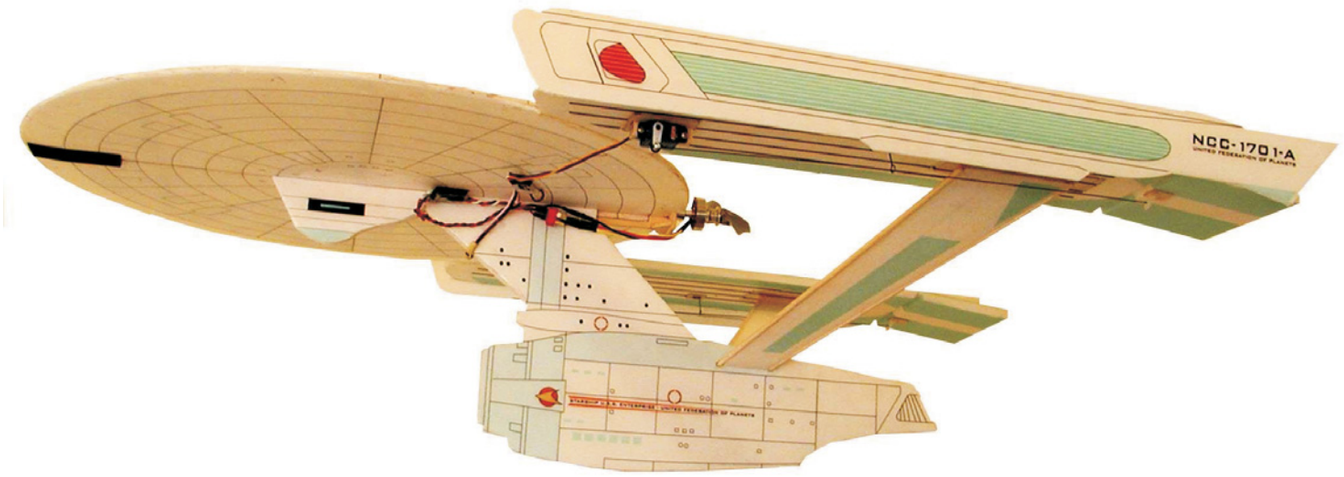
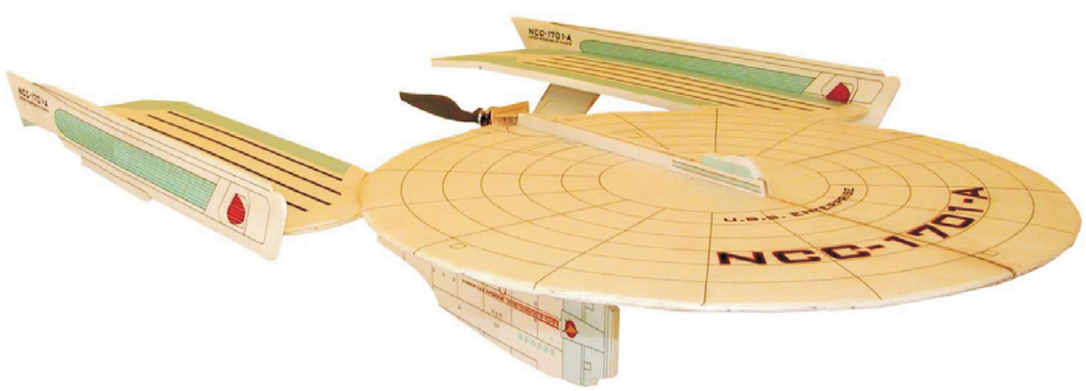
Starship Enterprise



A Radio Control Model

This package is a revised construction plan for a representation of the Starship Enterprise as developed by Michael Blott and originally published in the December 2001 issue of RC MicroFlight.



By Paul Bradley

June 2009

Starship Enterprise Assembly Guide

The model presented in this package is representation of the Starship Enterprise. It is not intended to be an exact replica of the models used in the movies and television programs but rather a flying model that is easy to recognize. The general layout and markings represent the starship as it appeared in Star Trek IV “The Voyage Home”. The general layout for the model was conceived by Michael Blott. Michael’s approach achieves a good flying platform that solves structural issues associated with an accurate representation of the actual starship models. He first published his design in the December 2001 issue of RC Microflght. That publication no longer exists and the plan that was presented is no longer available. As a result and with Michael’s permission the original plan has been redrawn. The new plan uses a revised structural layout to take advantage of the sheet foam that has become more common for model aircraft builders.

As presented in this package, the Starship Enterprise model is intended to be constructed from 3mm sheet foam. Depron is recommended. Cellfoam 88 can also be used but it is about 30 percent heavier than Depron. A small amount of 1/32” plywood is also used along with some bass wood and wood dowel.

Two configurations are presented. One has the motor set up as a pusher. That arrangement does a better job of hiding the motor and prop while the model is in flight. Due to the location of the mass of the motor in a pusher configuration, more weight is needed on the nose of the disk. That results in a higher total flying weight. A tractor motor arrangement is also shown. That arrangement gives the lightest overall flying weight. The tractor arrangement also shows the motor and prop more and may be less appealing. The only difference between the two configurations is the center disk keel. As a result the assembly instructions are the same for both configurations.

Graphics on the prototype model are ink jet printed tissue. This allows for more detailed markings to be used. The process used for printing the graphics on tissue is described in this package. The ink jet printed tissue added less that one ounce to the model flying weight. The graphics layouts are provided in this package. Traditional pen and ink graphics can be used if you don’t want to deal with ink jet printed tissue, or the graphics can be eliminated all together.

The prototype model uses a HexTronik 24 gram 1300 kv brushless outrunner motor turning an APC 7x5 electric prop. You can use any motor that will produce at least 60 watts of power.

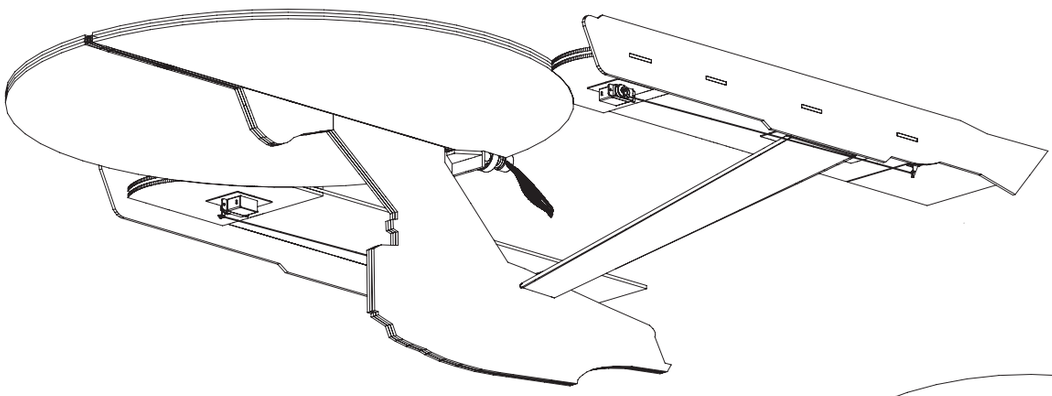
The prototype, pusher layout, used a three cell lithium polymer (Lipo) battery pack weighing 4 ounces. It required an additional 2 ounces of ballast to achieve the Center of Gravity (CG) location. The Starship Enterprise built from this plan will need a fairly heavy battery pack to achieve the proper CG location, or some nose ballast if a lighter battery pack is used.

The materials needed to build a model from this plan are listed below:

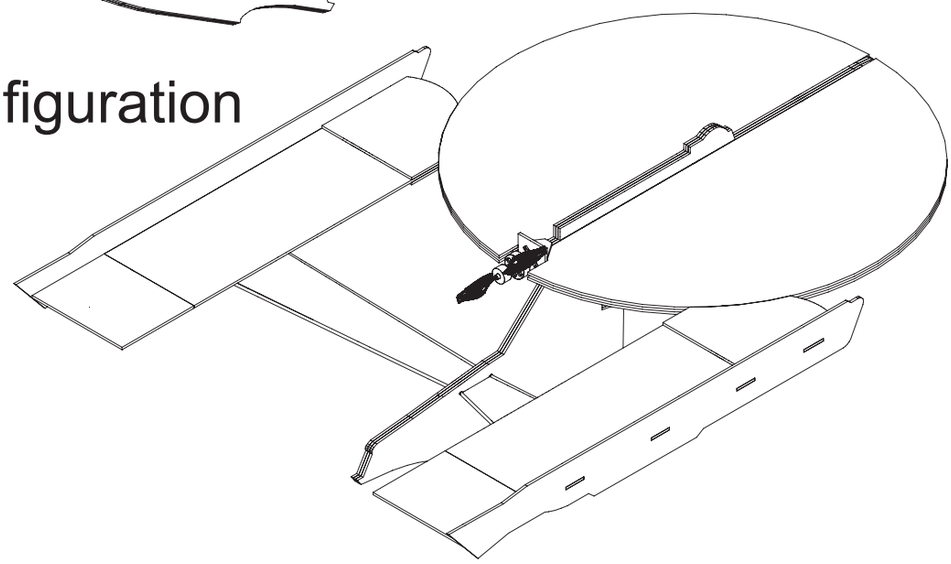
1. 3mm foam sheets - Five 13” x 1 meter sheets are suggested
2. 1/8” diameter dowel - Three 36” lengths
3. 1/32” plywood
4. Basswood - Two 1/8” x 1” x 24” strips, two 1/8” x 1/2” x 24” strips, and two 1/8” x 3/8” x 24” strips
5. Spray adhesive
6. White glue or similar product
7. Motor - A brushless outrunner motor is suggested that can produce at least 60 watts of power
8. Prop - 7x5 electric prop
9. Prop adapter for the motor
10. At least a three channel radio system capable of elevon mixing (delta wing). A micro receiver is recommended.
11. Micro servos - two
12. Electronic Speed Control (ESC) with a Battery Eliminator Circuit (BEC) capable of 10 amps
13. Micro control horns - two
14. 3/32” x 12” aluminum tubing - two
14. Optional Items
    a. Low cost white tissue paper like that sold for gift wrapping - About 13 sheets
    b. Glue stick - the colored type that turns clear when dry
    c. Clear acrylic spray

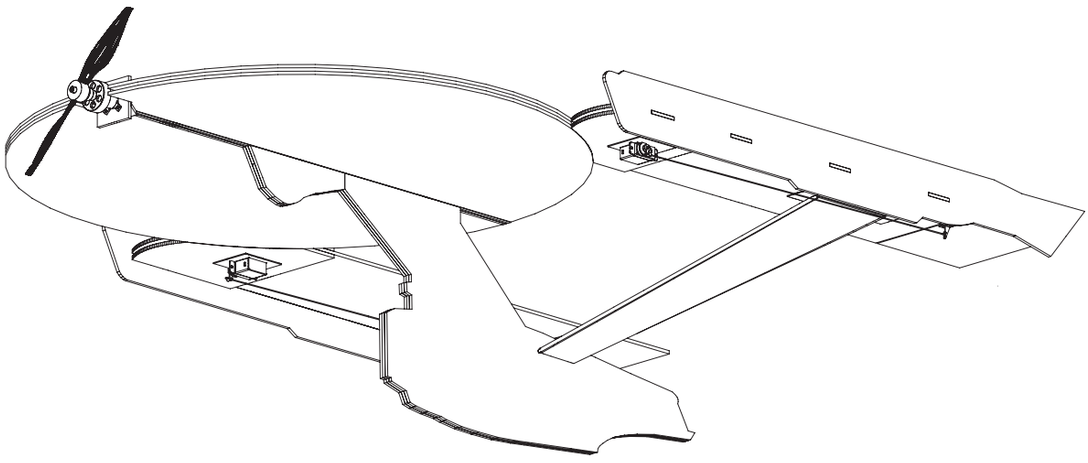
One good source for 3mm foam sheets and the motor used on the prototype is RC Foam. You will find them at http://www.rcfoam.com.

A model built from this plan package has a disk diameter of 20 inches with an overall length of 36 inches. The total flying surface area is 515 square inches. The total flying weight will depend on the materials used, the selected motor, battery pack, and the motor configuration (tractor or pusher). The total flying weight should be in the range of 14 to 17 ounces.

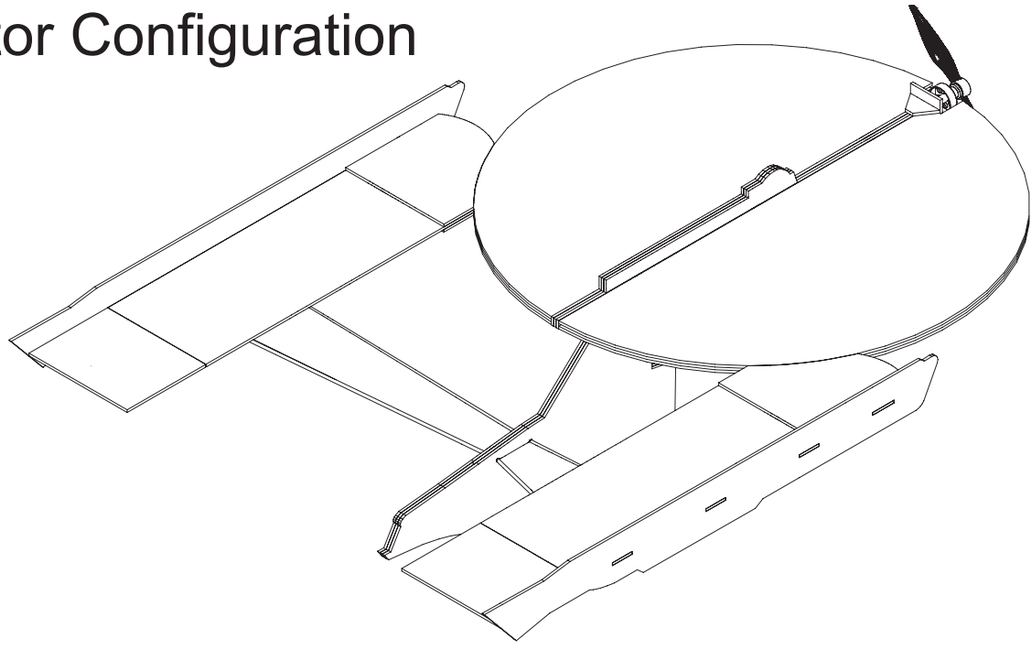


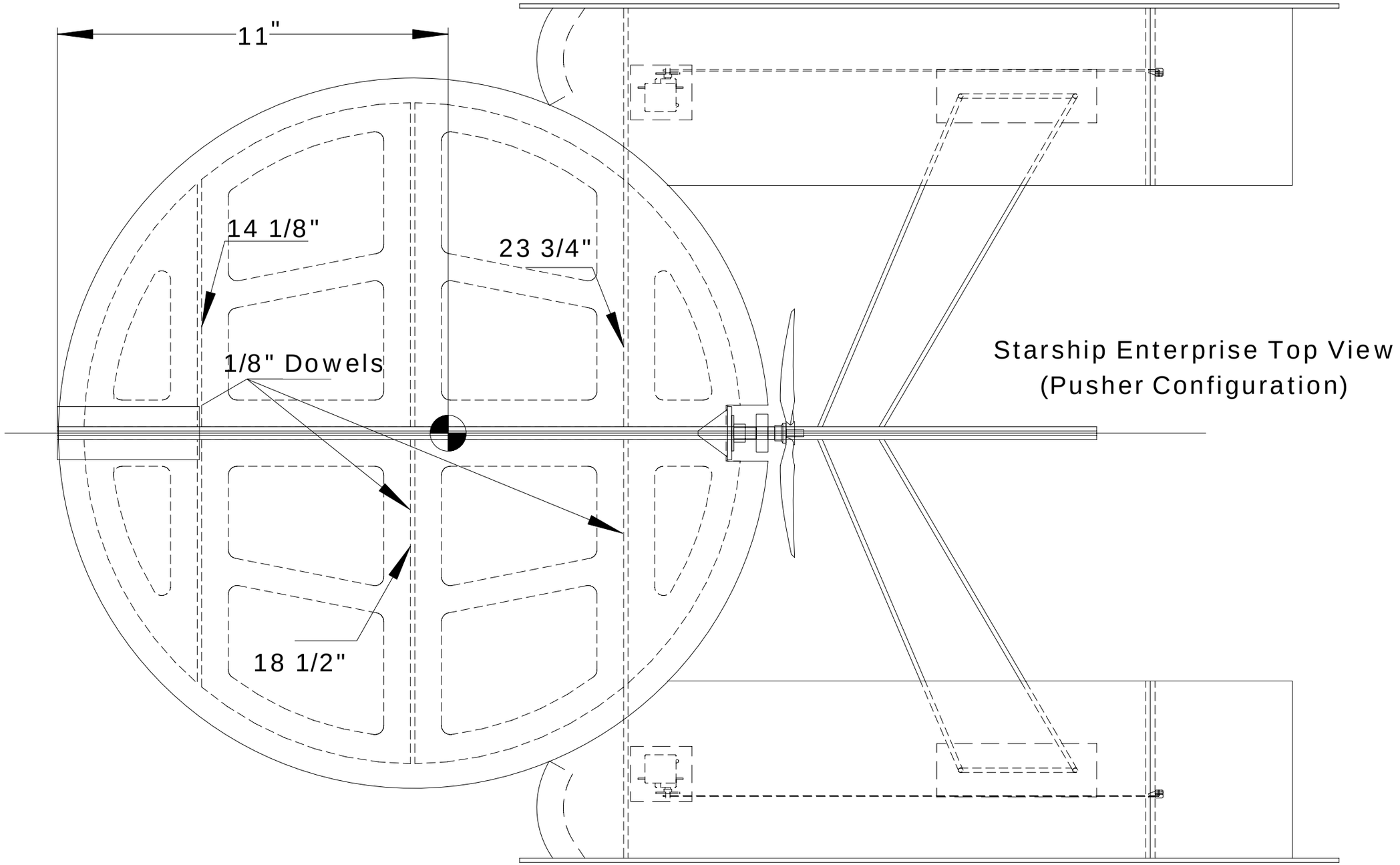
Pusher Configuration

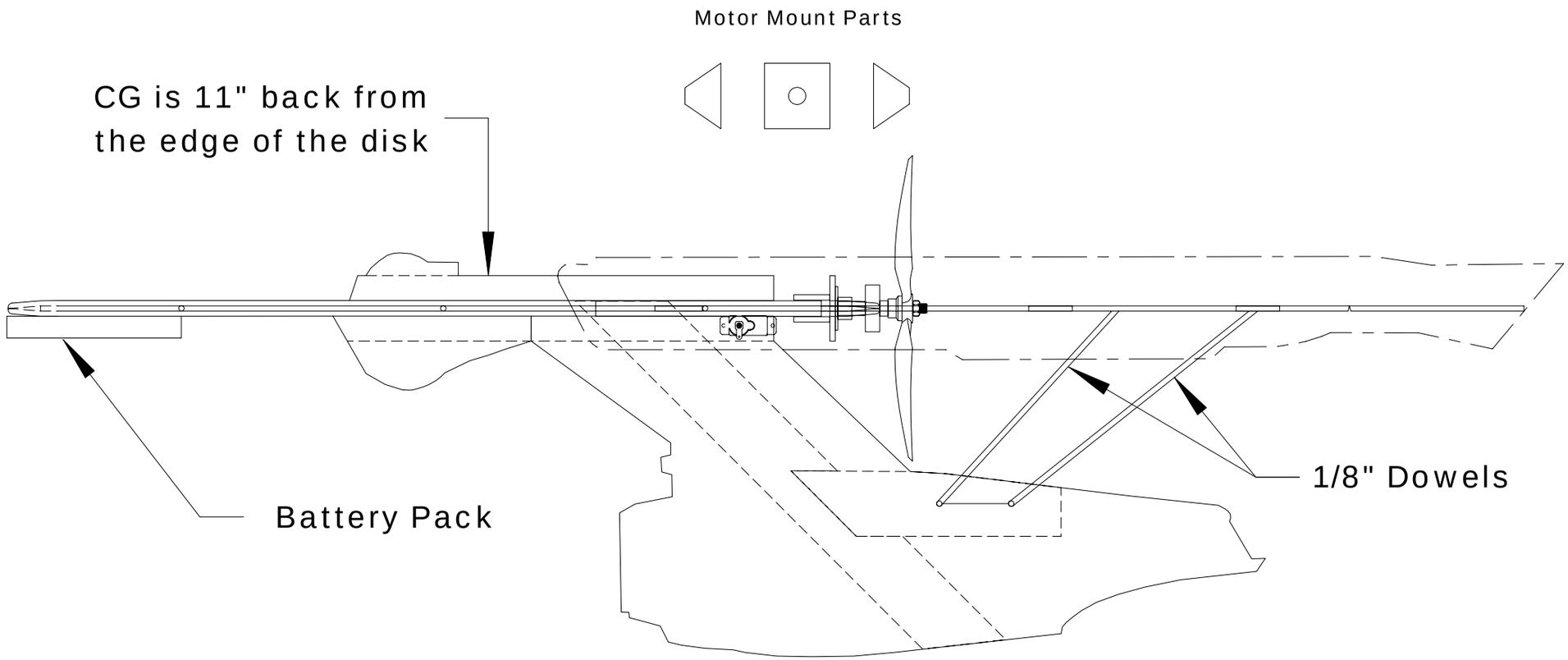




Tractor Configuration




11"
14 1/8"
23 3/4"
1/8" Dowels
18 1/2"
Starship Enterprise Top View
(Pusher Configuration)



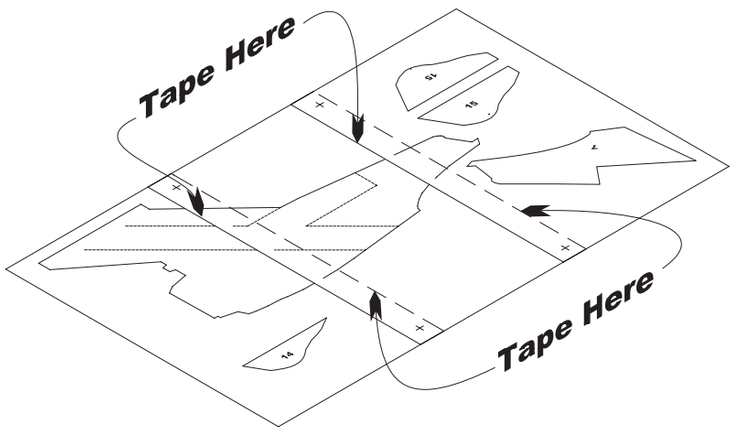
Starship Enterprise Profile View
(Pusher Configuration)

General Assembly Notes

1. Printing and assembling the part templates.

Many of the part templates had to be printed on individual sheets of paper to make sure all printers could be used to generate the templates. The largest paper size that all printers can handle are sheets 8 1/2”by 14” (Legal size in the U.S.). The pages of this package have been set up to print on that size paper.

For parts that are printed on multiple sheets, sheet alignment marks have been included. Place one sheet on top of another using the alignment marks. Tape the sheets together on each side. Cut the templates from the assembled sheets. An illustration is provided below:



2. Attaching the templates to the foam or wood construction materials.

A very good way to attach the paper templates to the construction material so they can be easily removed (and reused in some cases) is to use a spray adhesive. Please note that spray contact cements should not be used as they form permanent bonds. There are several low cost spray adhesives available. Two that were used for the prototype are Duro All Purpose Spray Adhesive and 3M General Purpose 45 Spray Adhesive. These products are available at home improvement centers, office supply stores, and general department stores.

To form a temporary bond, spray a light coat of the adhesive on the paper template. Let it dry for a half minute or so. The template can then be stuck to the construction material. After the part is cut the template can be easily removed without damage to the template or the cut part.

Some parts need several copies made. The printed paper template can simply be reapplied to the construction material without needing additional spray adhesive. If a given template gets damaged before all the parts have been cut, just print out the page or pages that contain the template and make up a new one.

3. Bonding layers of foam.

The structure of the Starship Enterprise model is made up from several layers of 3 mm foam. To bond the individual layers the same spray adhesive is used that was used to attach the templates for cutting out the parts. The only difference is the spray adhesive is applied to both surfaces of the bond. This makes the bond permanent rather than temporary. Each surface gets a light coat of the spray adhesive. The adhesive is allowed to dry for about a half minute. The parts are then assembled. Care must be taken to be sure the parts are properly aligned as they will not come apart once placed in contact with each other.

4. Ink Jet printed tissue graphics

The prototype model had the markings applied using sheets of light weight tissue that had all the graphics printed via an ink jet printer. Low cost white gift wrap type tissue was used. The graphics for the model have been organized on legal size sheets. The complete graphic is created as the individual parts are applied to the model. Most gift wrap tissue comes in sheet sizes around 20” x 20”. This allows two of the model graphic sheets to be printed from a single sheet of the gift wrap tissue.

The process for printing the graphics on tissue is fairly straight forward and can be accomplished on any ink jet printer. The steps are provided here.

A. Use a piece of legal size paper as a backing sheet.

B. Apply a light coat of spray adhesive to the backing sheet. Let the adhesive dry for several minutes. Stick the backing sheet to a piece of cardboard or other suitable material. Peel it off. Repeat the stick and peel process 5 or 6 times. This will reduce the tack of the adhesive.

C. Place a sheet of tissue over the backing sheet and smooth it down.

D. Cut the tissue so it is the same width as the backing sheet (the 8 1/2” dimension) and slightly longer on one end (about 1/4”).

E. Feed the tissue/backing sheet into your printer. Used the edge that has the tissue even with the backing sheet. Most printers will have the tissue facing down so it will be the printing surface when the paper is pulled around the internal rollers for printing.

F. Print the page of graphics. The normal printer setting is used.

G. Using the edge where the tissue is longer than the backing sheet and carefully peel the tissue away from the backing sheet.

Depending on the ink chemestry of your ink jet printer, the printed images may not be water proof. This is easily resolved. After all the tissue sheets have been printed they can be given a coat of clear acrylic spray. Just lay the tissue on something like a piece of newspaper and apply the spray acrylic. It does not need to be a heavy coat. After the spray has dried for a short while you can remove the tissue from the surface where it was sprayed. It is best to spray the tissue before it is applied to the model as many clear acrylic sprays will attack the foam.

There are a variety of clear acrylic spray products. They are often found in art supply areas of a store including the larger general department stores. Two fairly common brands are Krylon and Patricia Nimocks Plaid.

5. Applying printed tissue graphics to the model.

Since the graphics for the model are broken into parts to allow them to fit on printable size sheets, it is necessary to be able to position them accurately. The process that was used on the prototype is described here.

A. Cut out the individual parts of the graphic to be applied from the printed tissue sheets. It is best to cut the tissue graphic just inside of the printed outline. The only exception to this is the segments that make up the disk top and bottom graphics. They should be cut just outside of the printed outlines.

B. Apply a coat of glue stick, the colored variety, to the surface to receive the tissue graphic.

C. Also apply a coat of glue stick to the tissue graphic. Make sure the glue covers the edges.

D. Turn on your covering iron and set it to the lowest temperature setting.

E. When the glue stick is dry as indicated by it turning clear, the tissue graphic can be placed on the receiving surface. Even if there is some light tack between the tissue and surface, it should be easy to get the tissue piece accurately placed.

F. Use your covering iron to stick down the piece of tissue. The covering iron will reactive the glue and the tissue piece should stick down smoothly on the surface.

G. Place any additional pieces of tissue needed to complete the component graphic and iron them down. The edges of adjoining pieces should touch each other but not overlap.

H. If necessary glue stick can be applied to any edges that do not stick down when ironed.

6. Getting started.

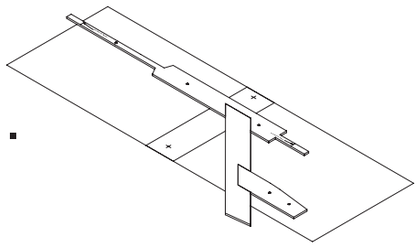
The build of this model begins by cutting out all of the individual parts. The prototype was built from foam sheets purchased from RCFoam.com. The sheets used came in a size of 13” by 1 meter. The part layout that was used with these sheets has been provided for a reference.

The wood keel that forms the backbone of the model is fabricated from 1/8” bass wood stock. Standard hobby shop sizes were used. Two keel strips were made up by gluing a 1/8”x1/2”x24” strip to a 1/8”x1”x24” strip. This made up two pieces that were 1/8”x1.5”x24”. Two strips of 1/8” x 3/8” x 24” are also used on the disk keel. In addition to the keel parts, the motor mount parts were also made from the fabricated keel stock pieces. An alternate material for these components is 1/8” Lite Ply.

The detailed assembly steps are detailed in the pages that follow.

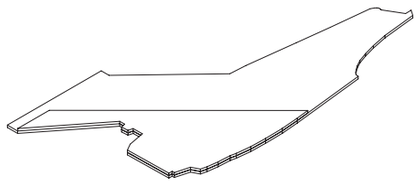
Assembly Steps- Pusher configuration is shown, use same steps for tractor configuration

1.



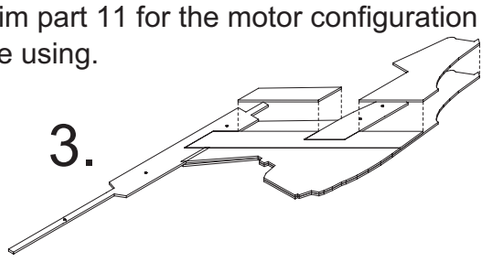
Assemble the keel components 9, 10, and 11 over the supplied layout drawing. Be sure to trim part 11 for the motor configuration you will be using.

2.



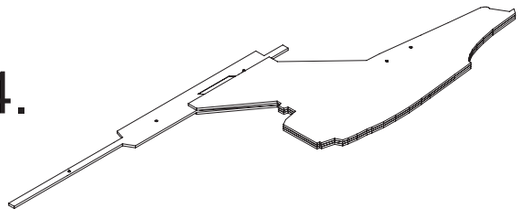
Glue part 5 to one of the outer layers of the engineering hull.

3.



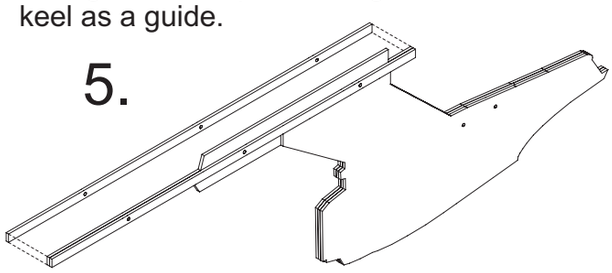
Glue the assembled keel to the engineering hull side using part 5 as an alignment guide. Glue parts 6 and 7 in place. Drill 1/8” holes through the side piece using the holes in the keel as a guide.

4.



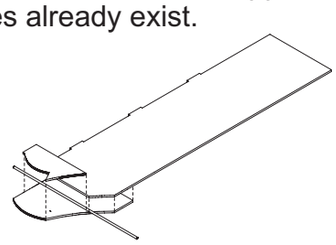
Glue the other side of the engineering hull to the assembly. Drill 1/8” holes in the newly added side. Drill from the opposite side where the holes already exist.

5.



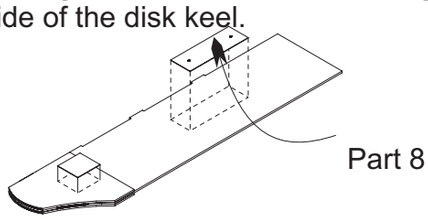
Use the 1/8” x 3/8” x24” basswood strip stock to make doublers for the disk keel. Cut the stock to length, drill the 1/8” holes, and glue to each side of the disk keel.

6.



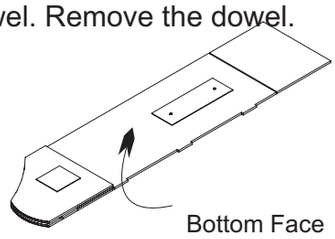
Glue the main piece of the warp engine on the short bottom outer layer of the assembly. Place a length of 1/8” dowel at the forward edge of the main piece. Glue part 16 in place so it is against the dowel. Remove the dowel.

7.



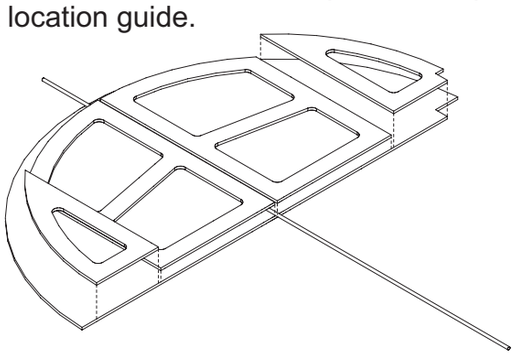
Glue the opposite short outside face in place. The slot at the forward edge will be closed later. Assemble the second warp engine in the same fashion. Glue the 1/32” plywood warp engine support (part 8) and servo mount plates in place on the bottom. Use the printed templates as a location guide.

8.

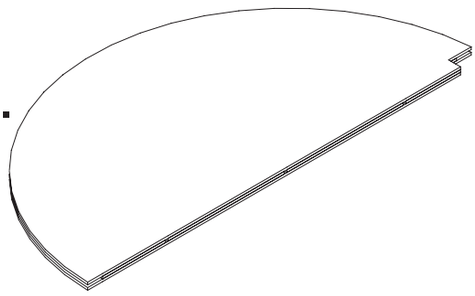


Cut each warp engine 4” from the rear edge. Cut or sand the faces to an angle (at least 15 degrees). Attach each cut piece to the main engine structure using hinge tape on top of the structure.

10.



9.



Use the printed template from the outside disk layer and mark the location of the dowel slots on the root face of a disk surface piece. Use pieces 2 to mark the location of each dowel slot. Place a length of dowel on the center slot. Glue pieces 2 in place so they are touching the dowel. Move the dowel to a slot that is formed by pieces 1 and 2. Glue a piece 1 in place so it is in contact with the dowel. Repeat the process for the piece 3. Remove the dowel and glue the other outer disk surface piece in place. Repeat the process for the other disk half. The slot that is formed around the perimeter of the disk will be closed later.

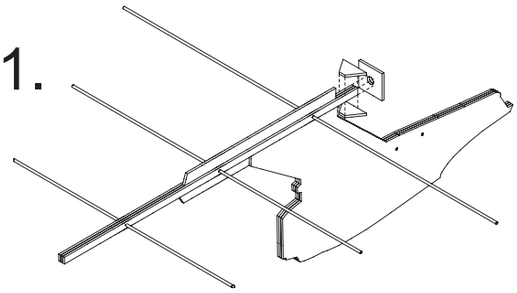
If you are planning to use ink jet printed tissue for markings on the Enterprise, now is the time to add the graphics to the engineering hull and warp engine components.

Before applying the graphics to the main warp engine assemblies, close the slot in the forward edge of each assembly. Apply some glue and use masking tape to hold the slot closed while the glue sets. Sand the forward edge round after the glue sets.

The graphics for the inside face of the warp engine vertical pieces are set up to keep the joint that will be formed with the main warp engine assemblies clear of tissue. Use the upper edge of the warp engine vertical pieces as a location guide for the inside face graphics.

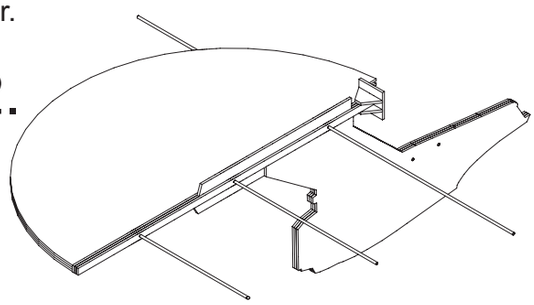
The graphics for the disk components will be added later.

11.



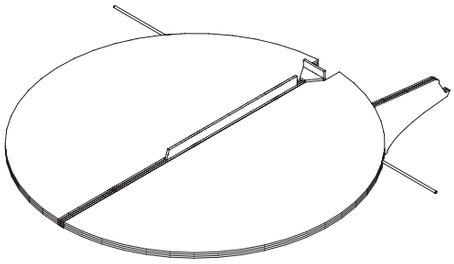
Cut the three dowels that go inside the main disk. Mark their centers. Slide each dowel into the keel and glue them in place with the marked centers in the keel. Also install the motor mount by gluing it to the keel.

12.



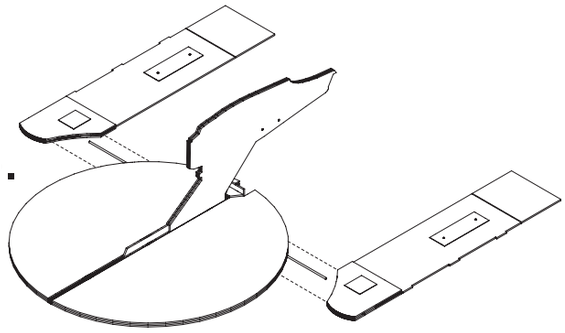
Glue a main disk half to the dowels and keel face. If using the tractor configuration just rotate the disk on the center dowel.

13.



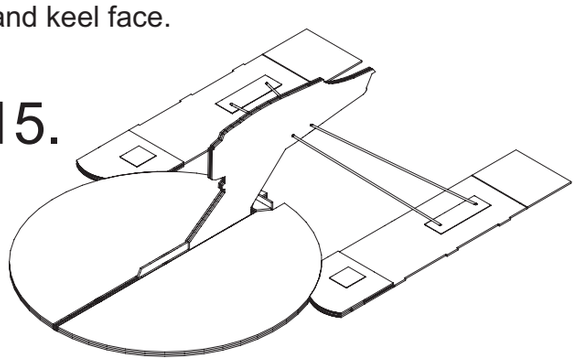
Glue the other main disk half to the dowels and keel face.

14.



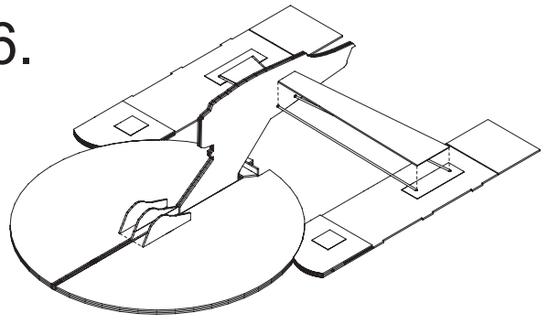
Lay the main disk/engineering hull assembly upside down on the building surface. The disk can be supported by scrap material so the keel will clear the surface. Glue each warp engine in place. Support the warp engines with an extra layer of scrap material so the assembly is flat.

15.



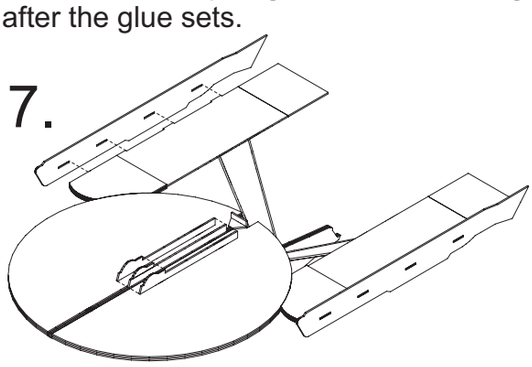
Measure the distances for the warp engine support dowels. Cut 1/8” dowel to the measured lengths. Glue them in place making sure the dowels are in contact with the keel in the engineering hull and warp engine support plates. Close the slot around the disk except where it is in contact with the warp engines. Sand the edge round after the glue sets.

16.



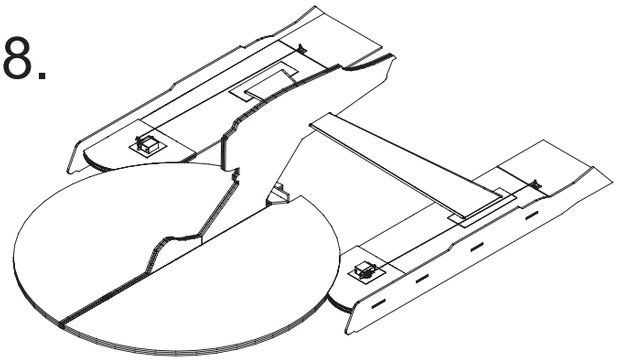
Dry fit the warp engine support filler pieces. Make any necessary adjustments. If you are using ink jet printed tissue for the graphics, make sure the warp enging support filler graphics are in place at this time. Glue the filler pieces in place. If using ink jet printed tissue to apply graphics to the model add the bottom disk graphics at this time. Also add the center and side pieces for the lower disk profile representing the navigation dome and related structure. These are part 14 and two parts 15.

17.



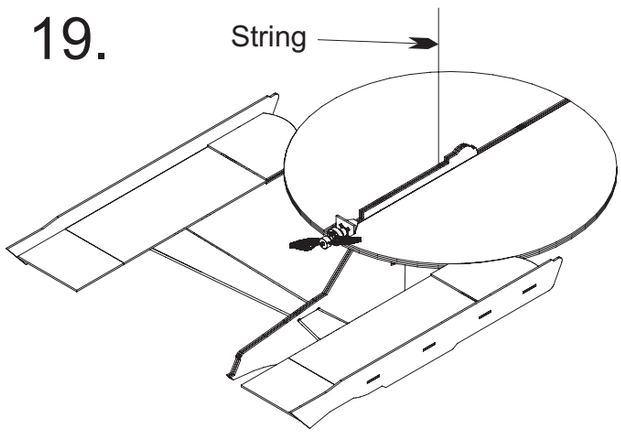
Add the vertical sides to the warp engines. There should not be any tissue at the joint between the warp engine vertical and the warp engine edge where the glue joint is made. If using ink jet printed tissue graphics apply the top disk graphics at this time. Also add the pieces that form the bridge profile structure. These are piece 12 and two pieces 13.

18.



The servos, elevon horns, pushrods, receiver and ESC are installed next. Use .032” music wire for the pushrods. When installing the control horns on the elevons use a piece of 1/32” plywood under the horns to add strength to the joint. Slip a 12” piece of 3/32” aluminum tubing over each push rod before connecting them to the control horns and servos. This will keep the pushrods from flexing under load.

19.

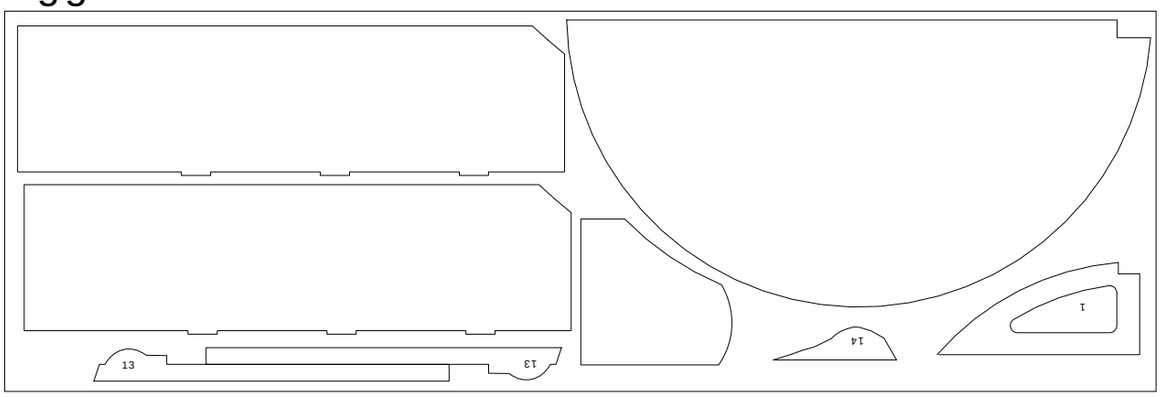


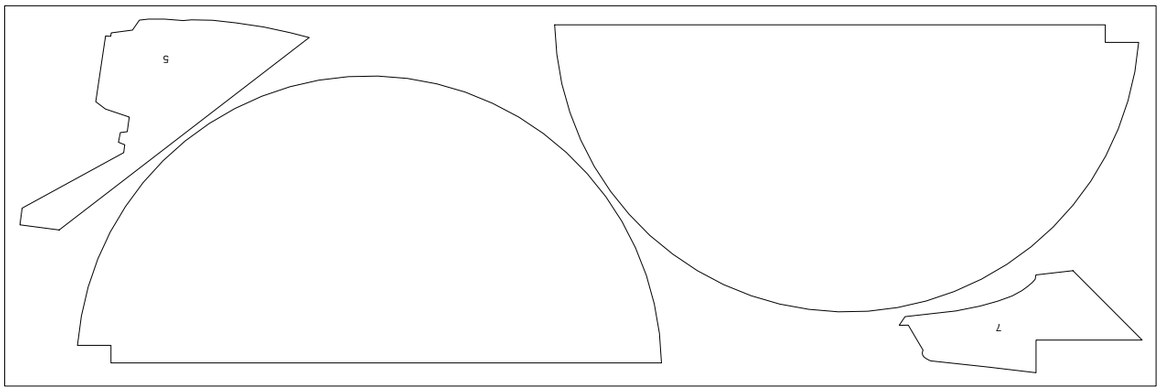
Install the motor. Also apply some hook and loop fastener material (for example Velcro) to the bottom forward portion of the disk. This is used to retain the battery pack. Locate the battery pack to achieve the center of gravity (CG) position shown on the layout drawing. Depending on the weight of your battery pack it may be necessary to add some ballast to the nose of the disk to achieve the correct CG location. One good way to check the balance of the model is to drive a small screw into the top of the disk keel at the CG location. Tie a piece of string to the screw and let the model hang from the string. You will be able to see if the model balances fore and aft as well as laterally. After the correct balance is achieved remove the screw and string.

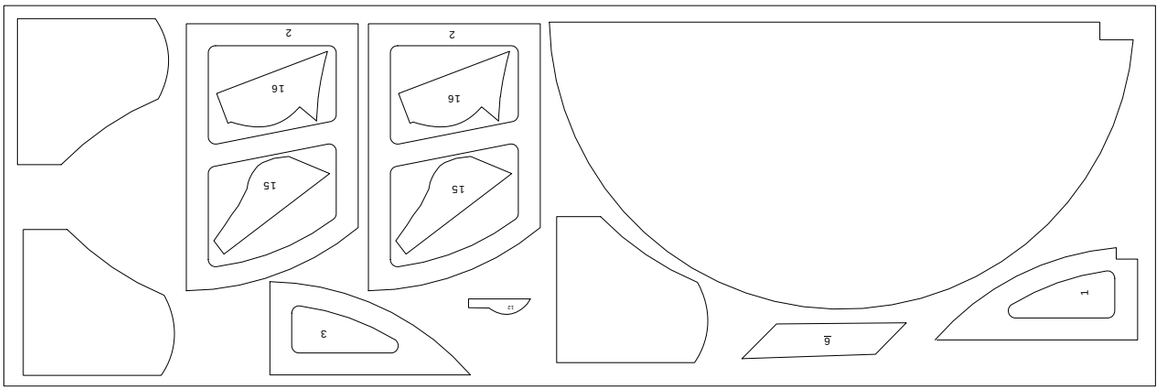
The control surfaces for the Enterprise are not directly in the prop slip stream. As a result they are fairly large so adequate control response can be achieved. It is best to set up the elevon control surfaces for large deflections. Use the bottom hole on the control horns and the outside hole on the servo arms for the pushrods. This will give comfortable control responses with normal movements of the transmitter stick.

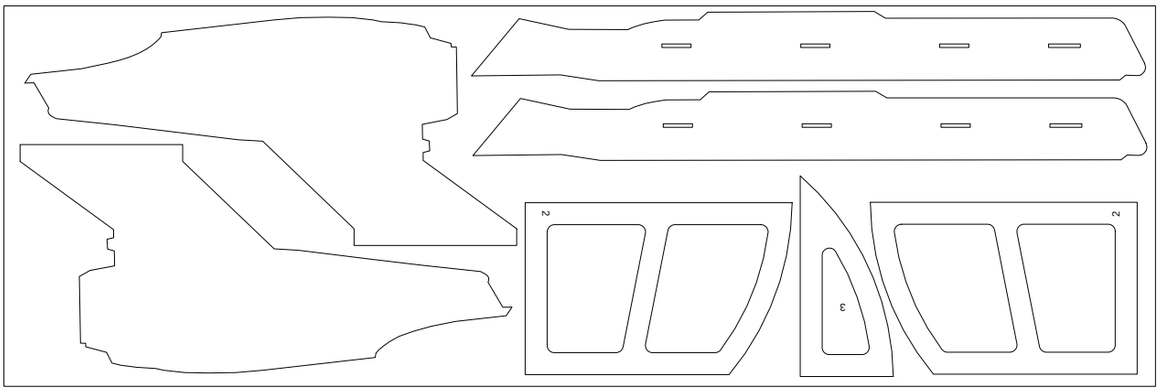
The elevons should be set up so they both move up when the transmitter stick is pulled back and down when the stick is pushed forward. When the stick is moved to the left the left elevon should move up with the right elevon moving down. When the stick is moved to the right the left elevon should move down with the right elevon moving up.

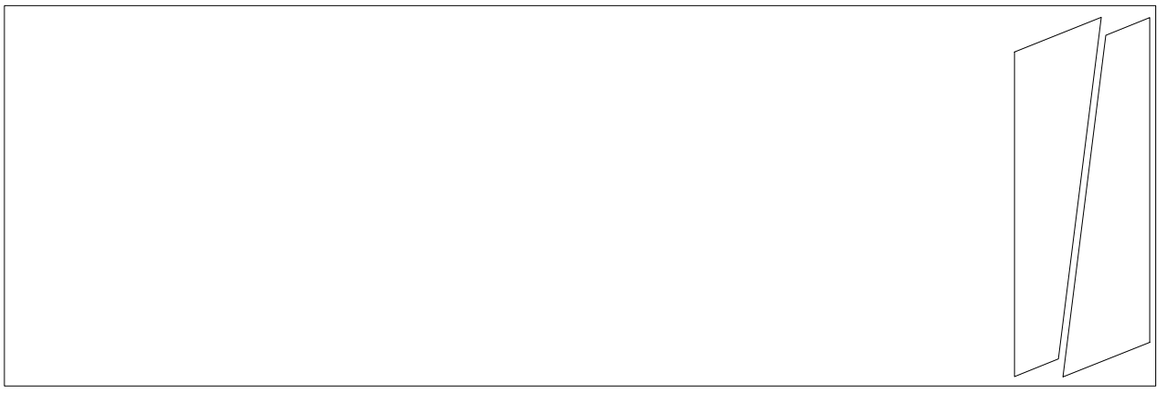
Suggested Part Placement for 13" x 39.4" Foam Sheets

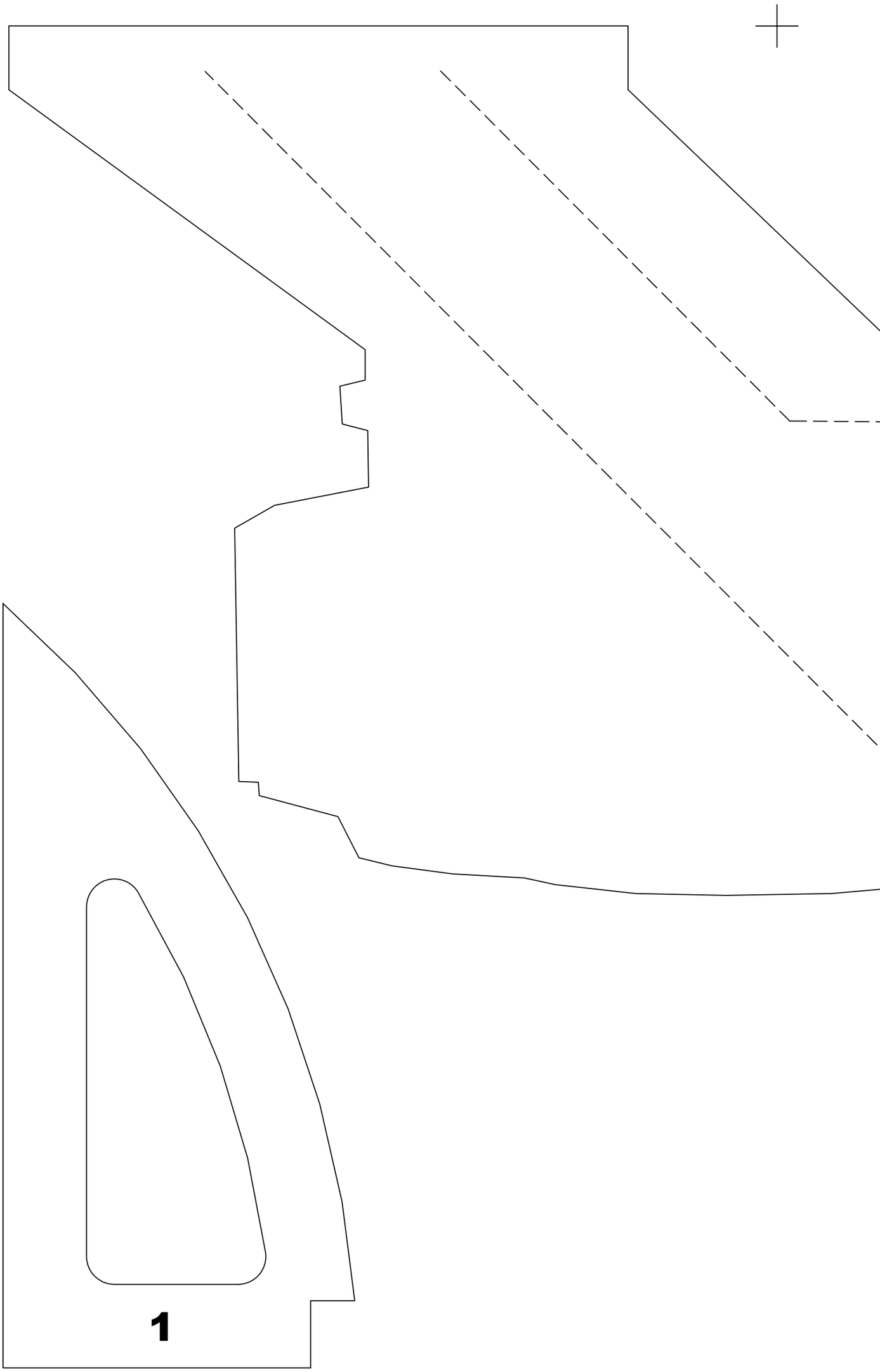








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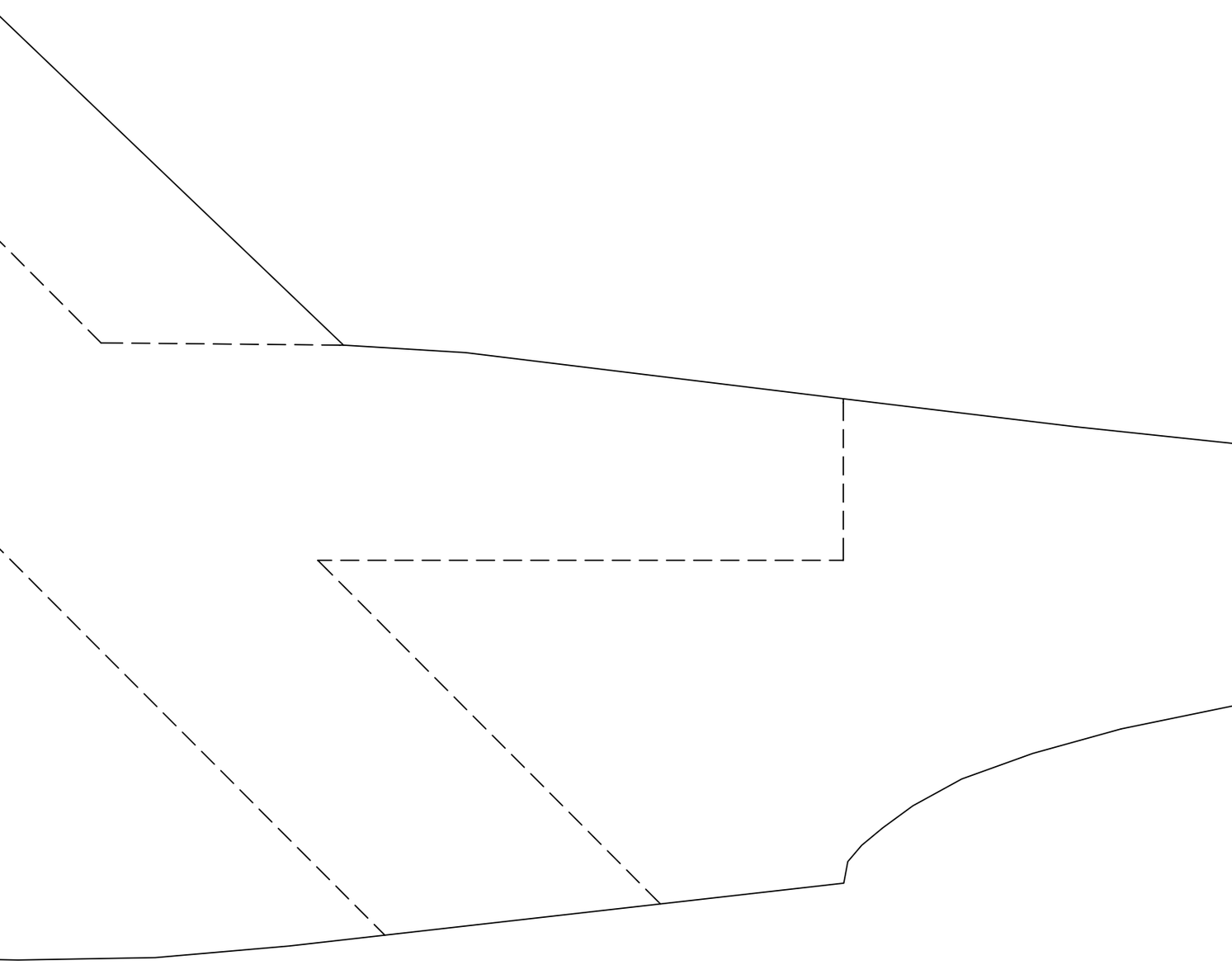
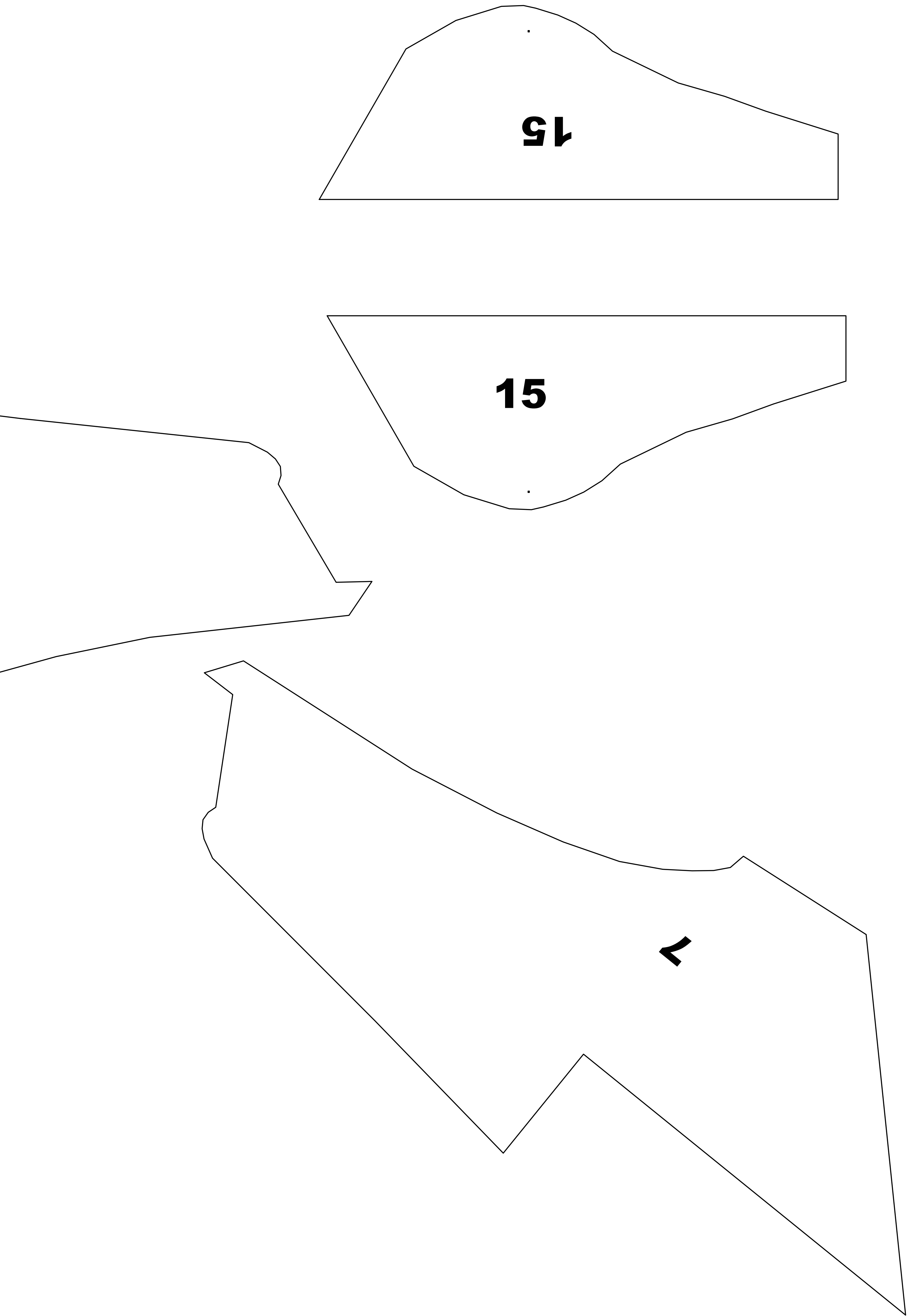
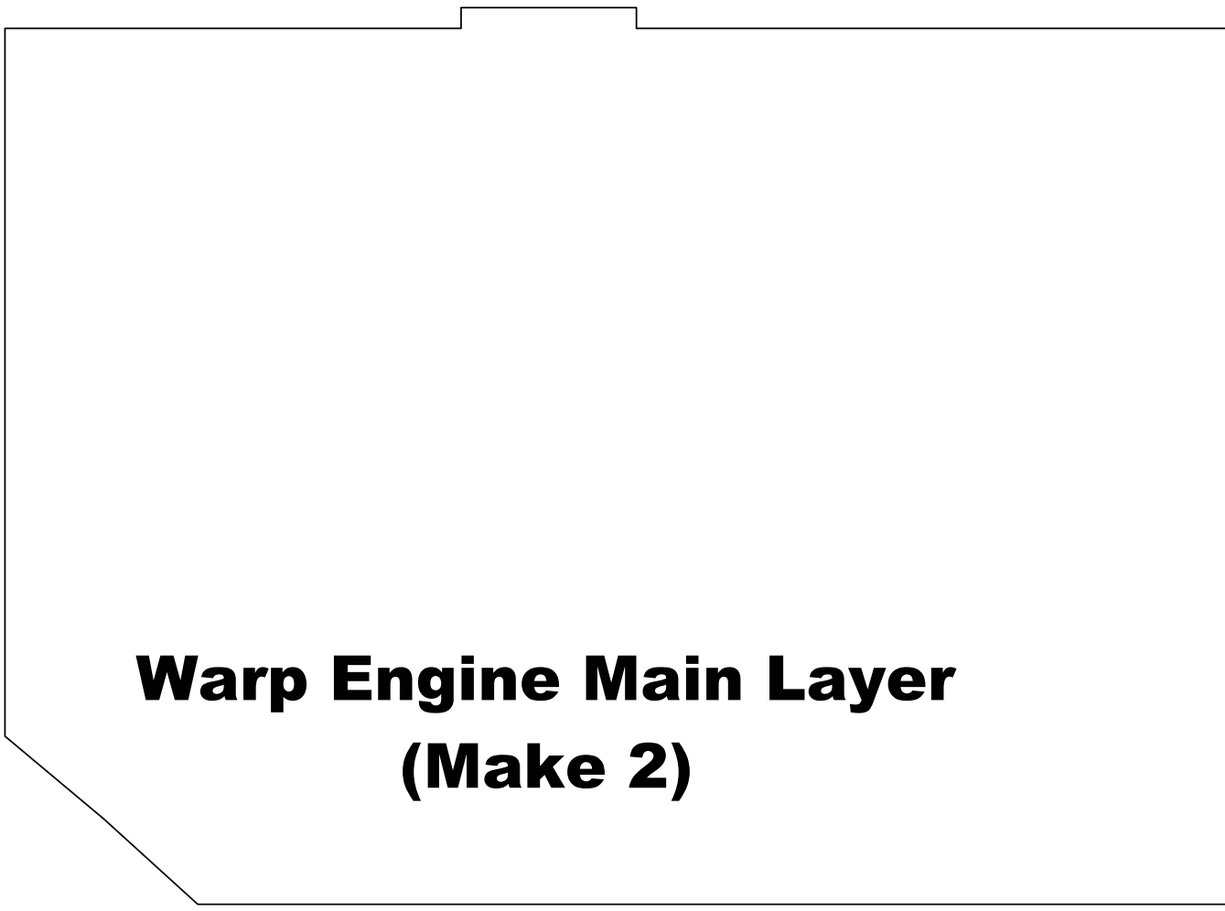
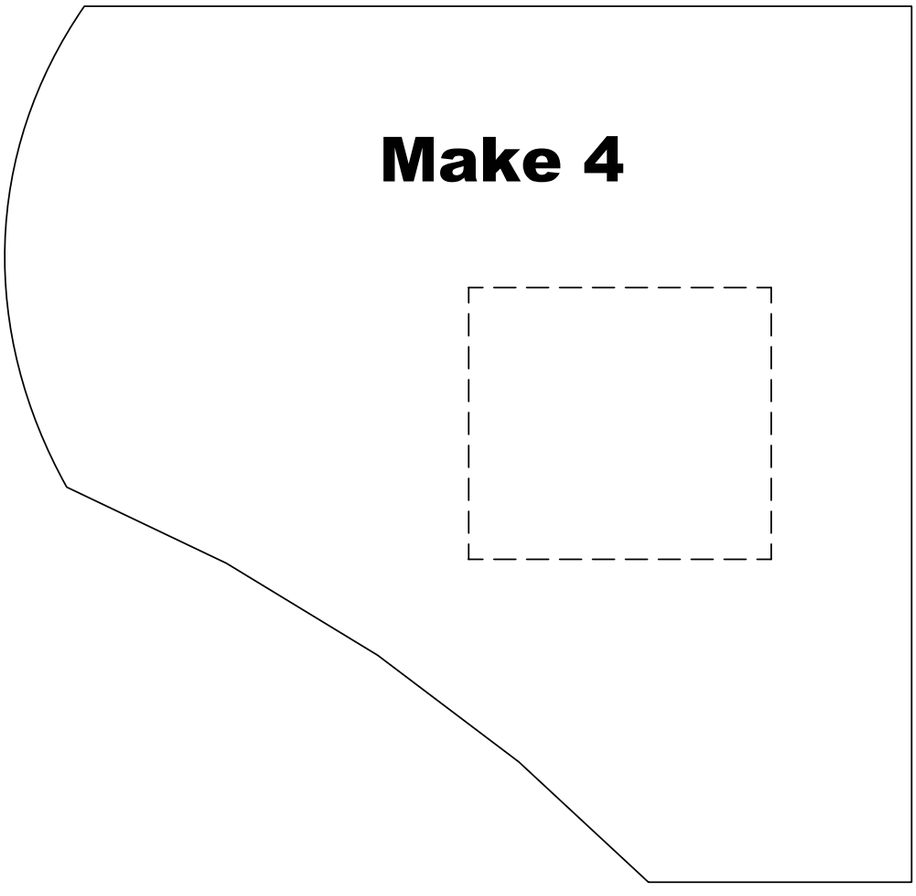



15
15
7


Warp Engine Main Layer
(Make 2)


Make 4

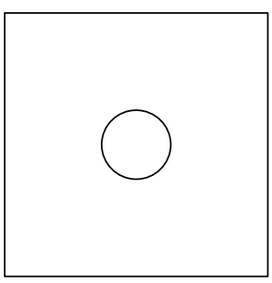
8

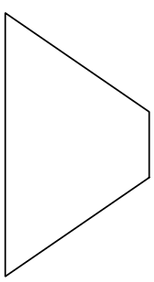
Make 2

(1/32" Plywood)

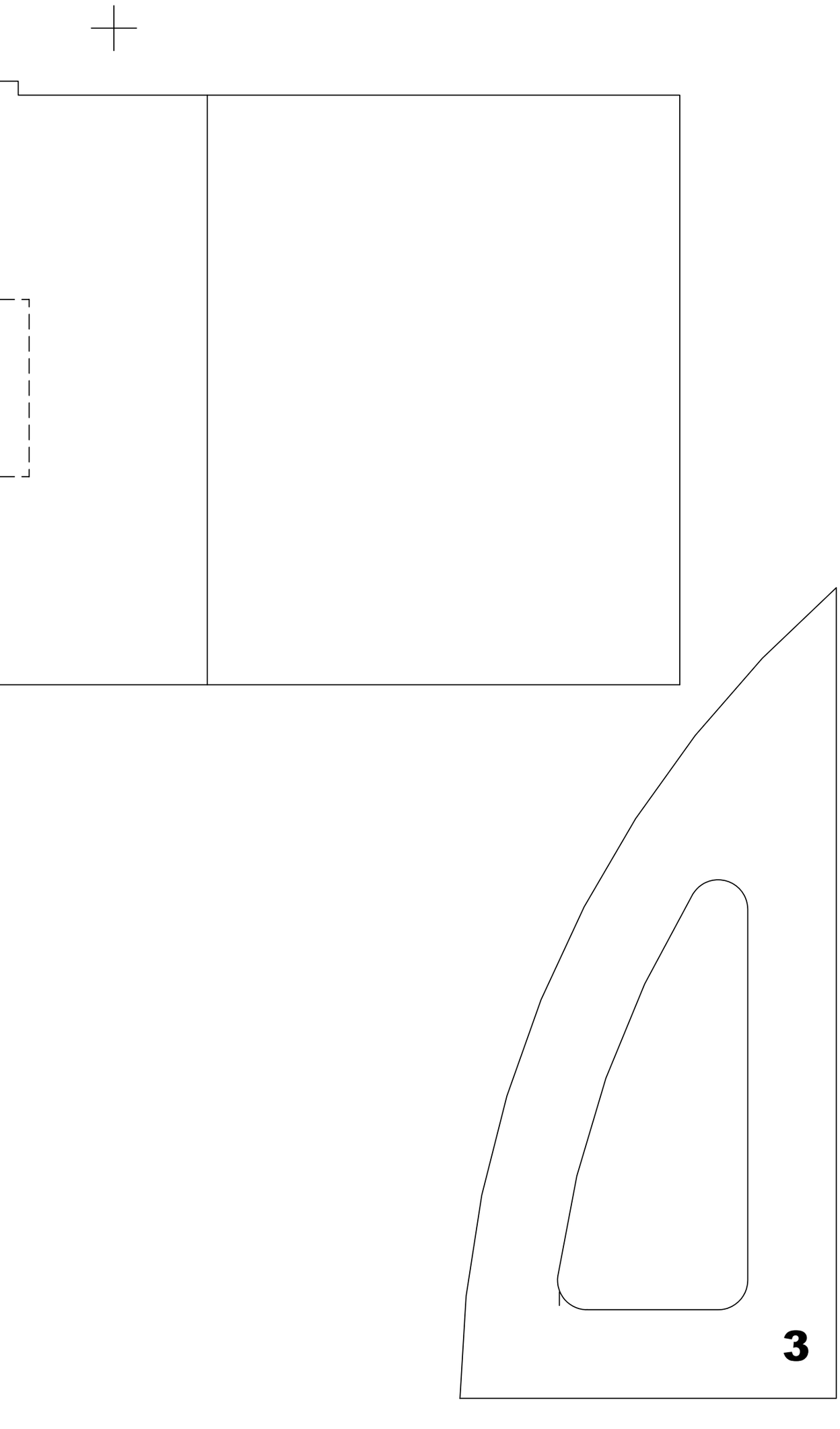
Servo Mount Plate (1/32" Plywood)

Servo Mount Plate (1/32" Plywood)





Motor Mount Components
Make from the same wood
as used for the keel components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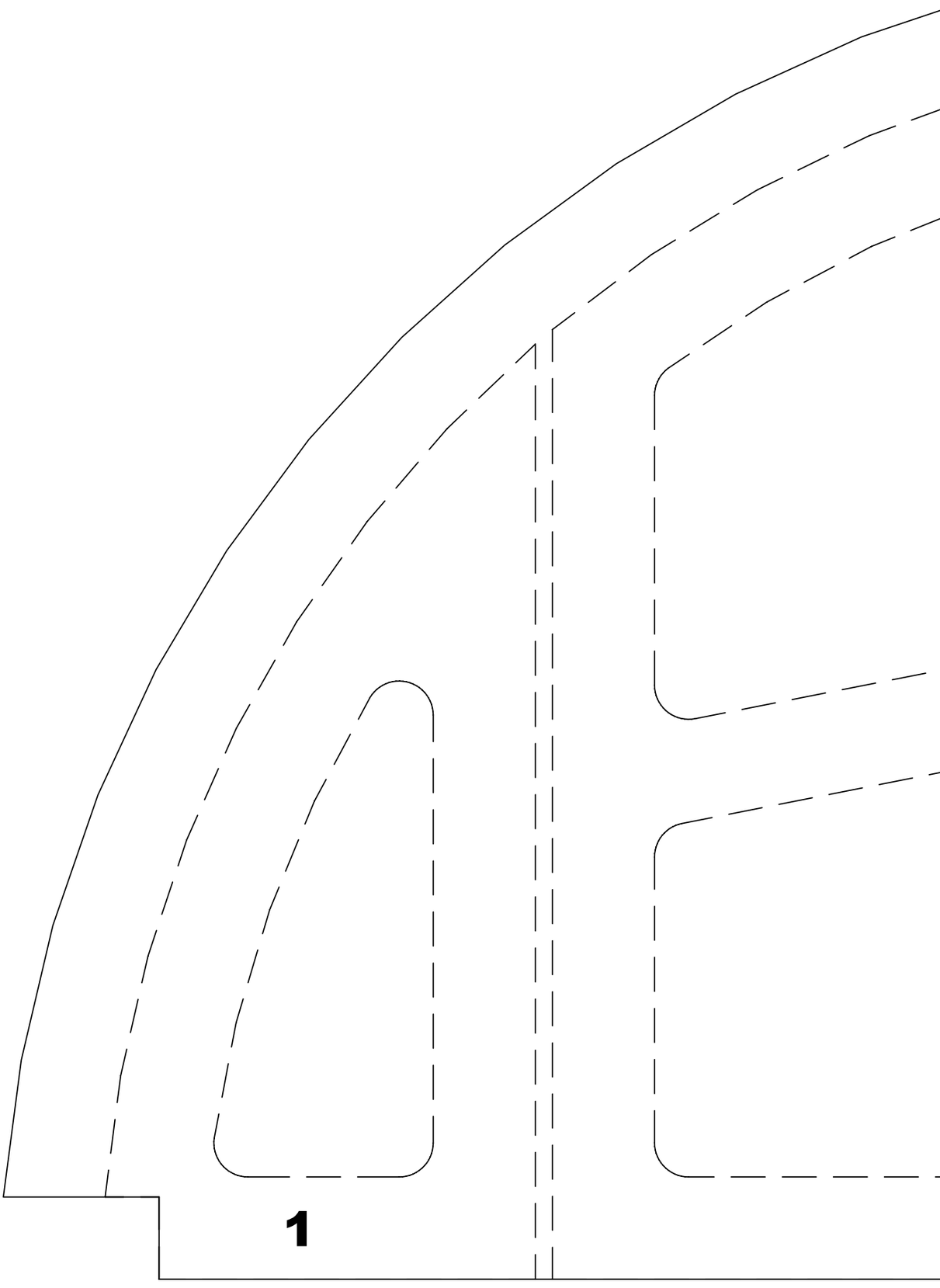
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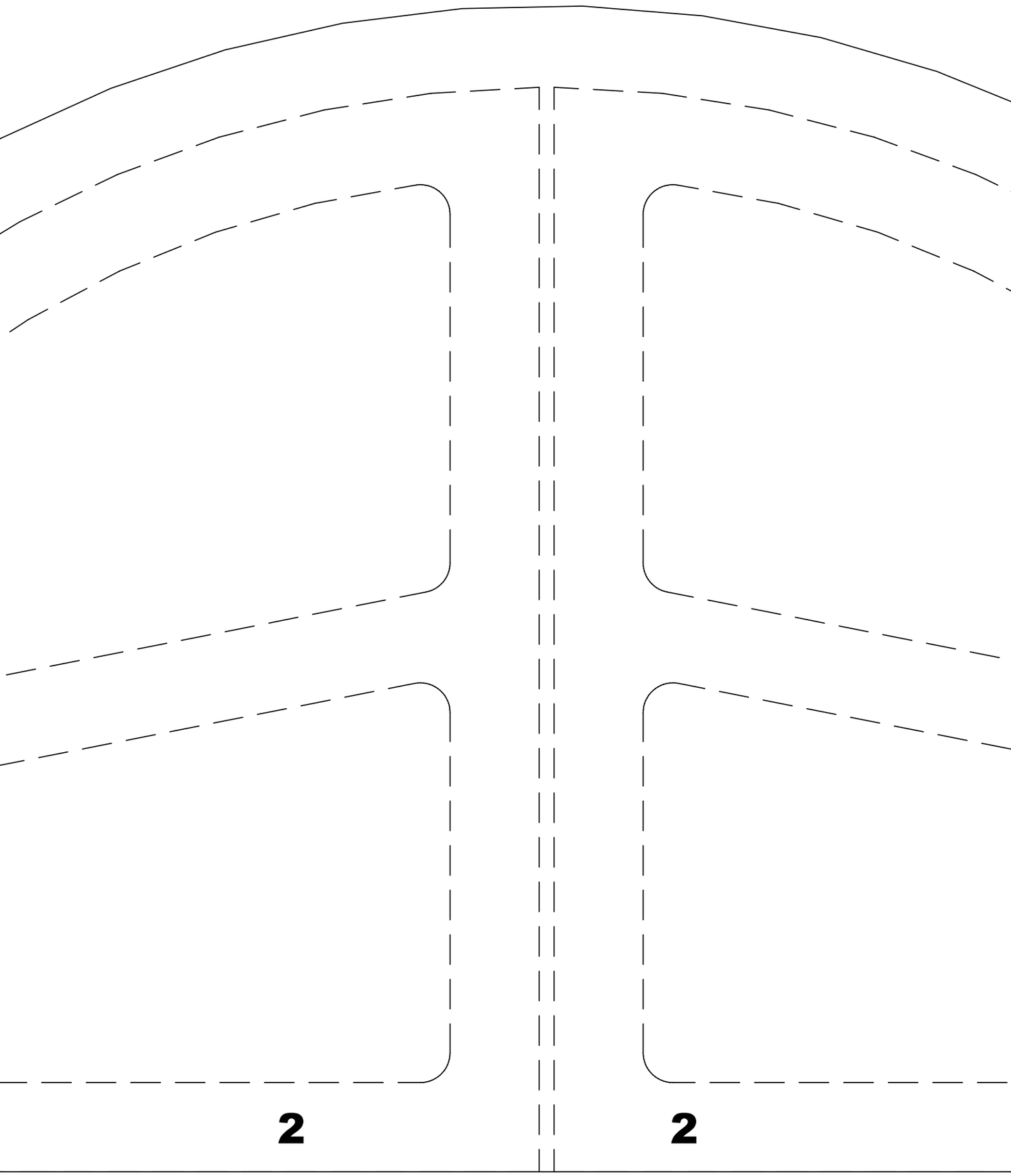
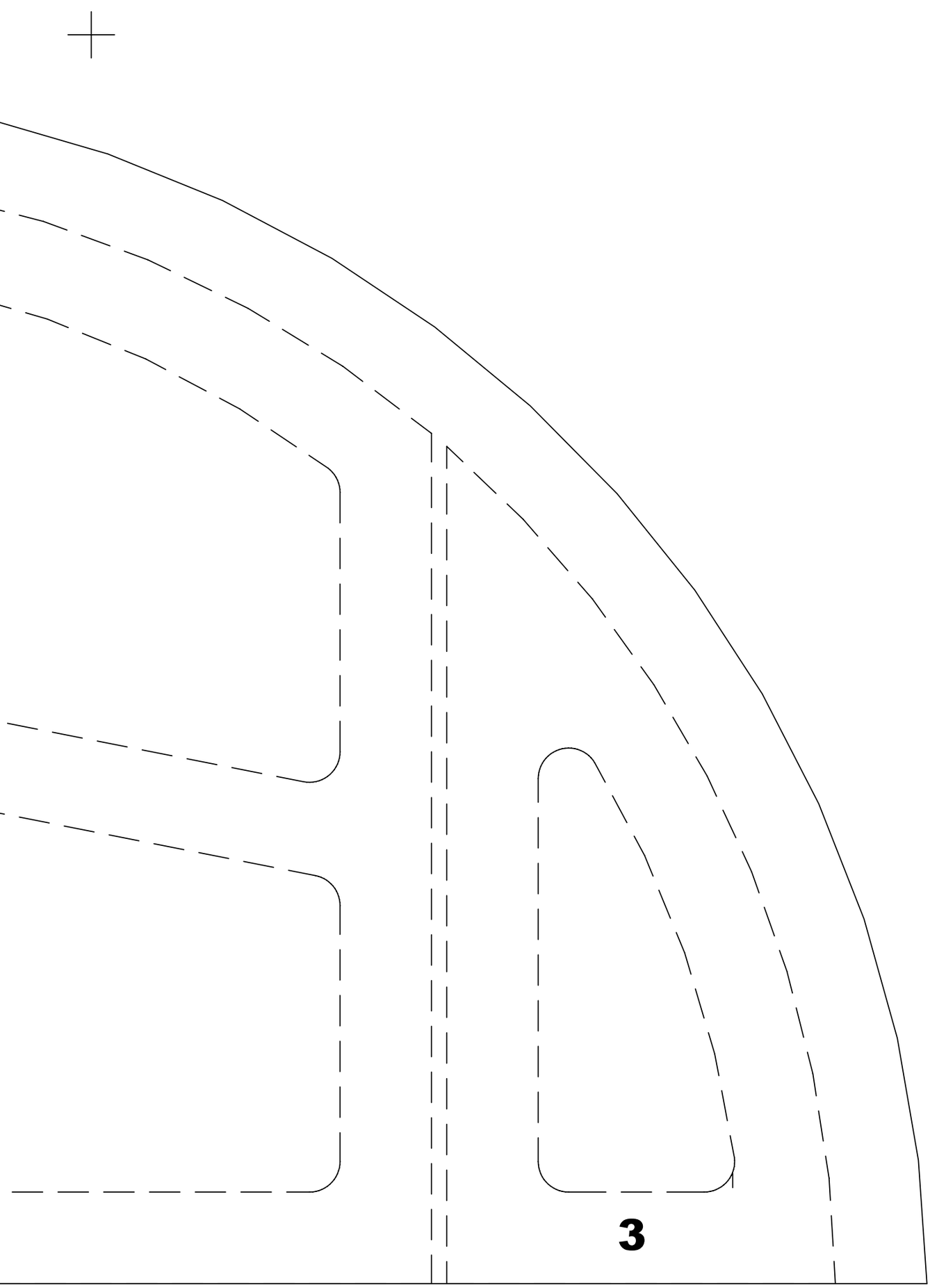


Disk Outer Surface
(Make 4)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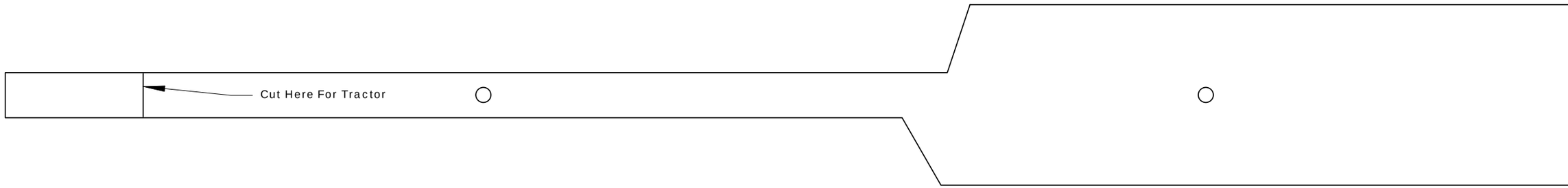
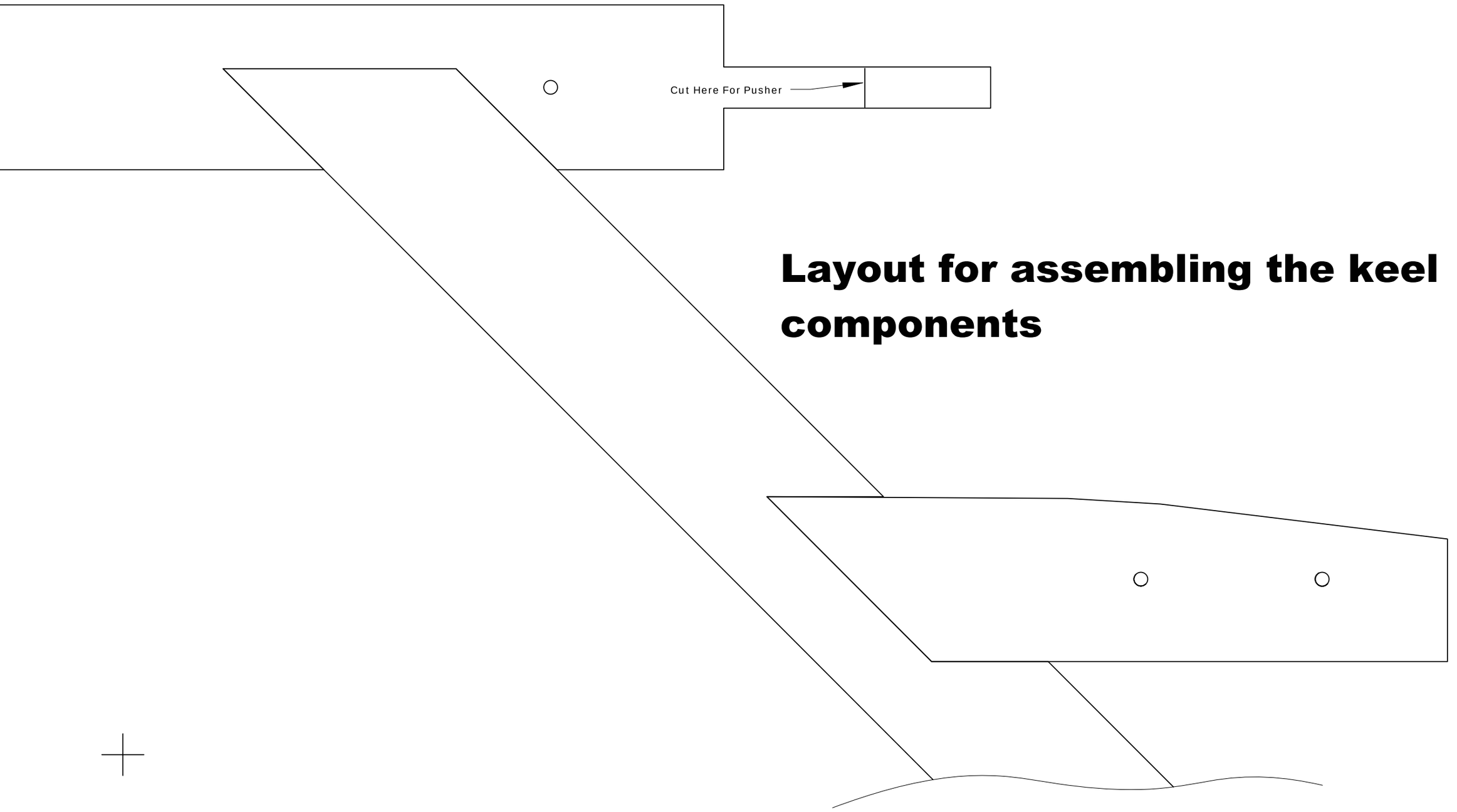
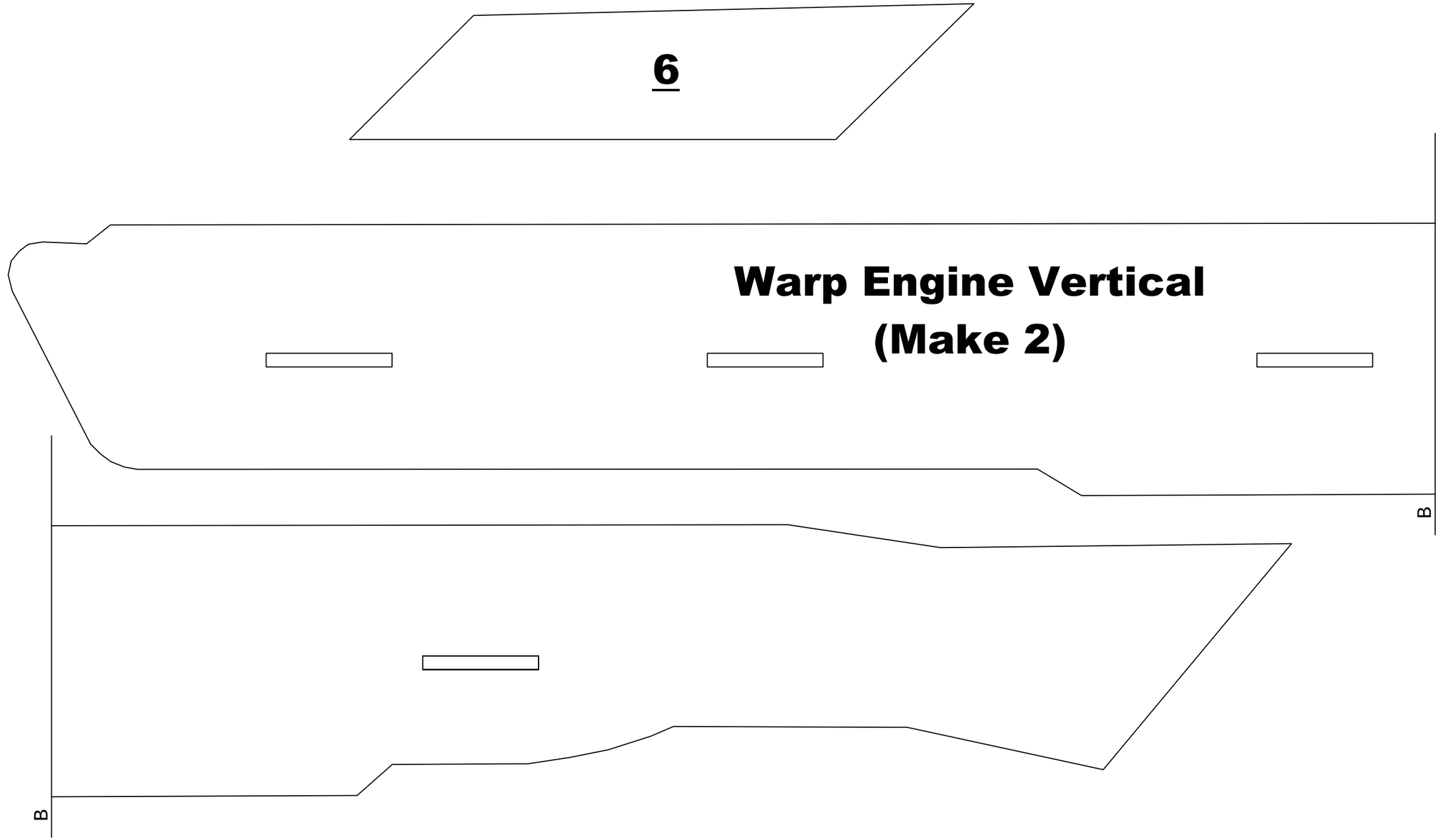
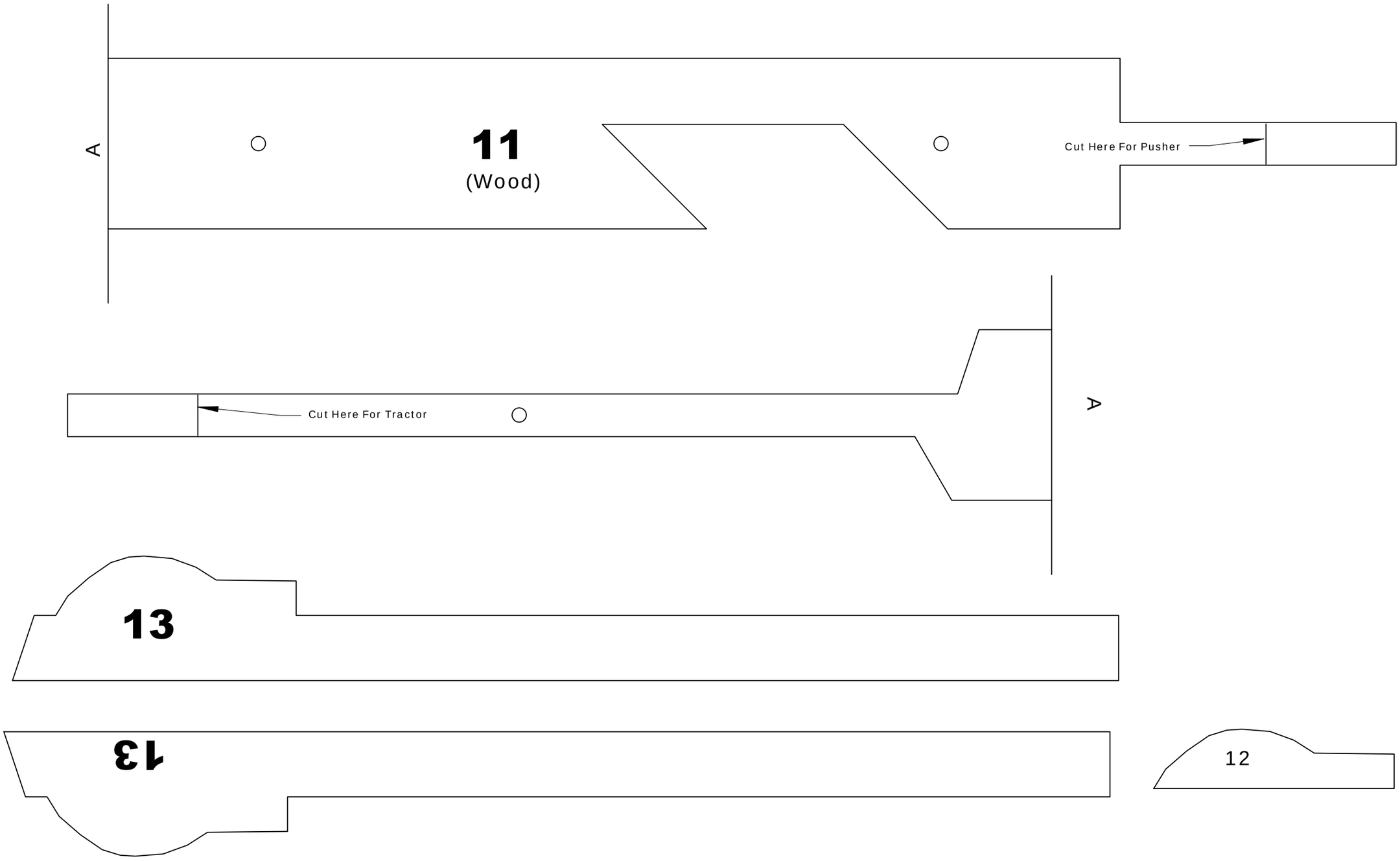


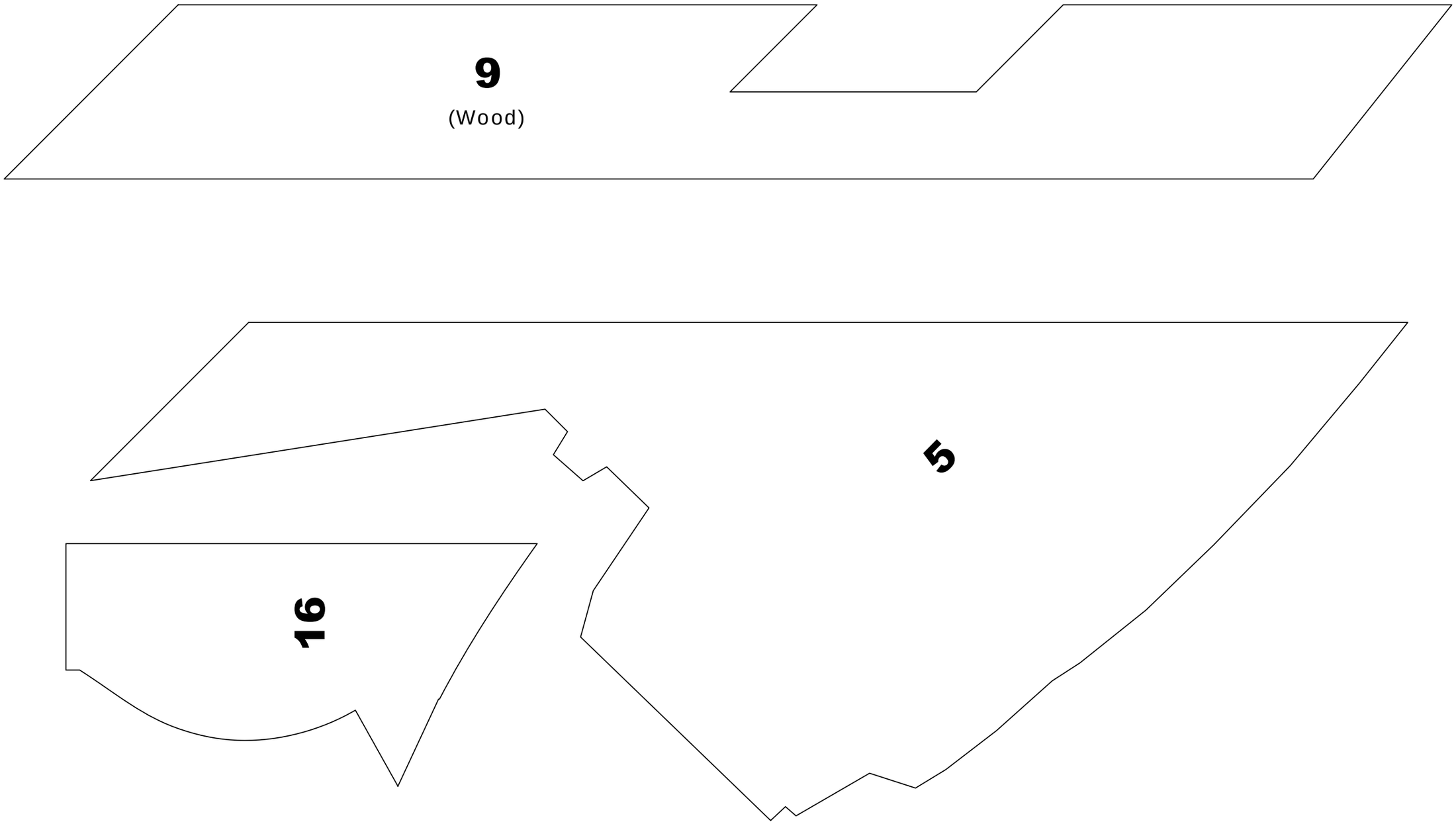
Layout for assembling the keel components

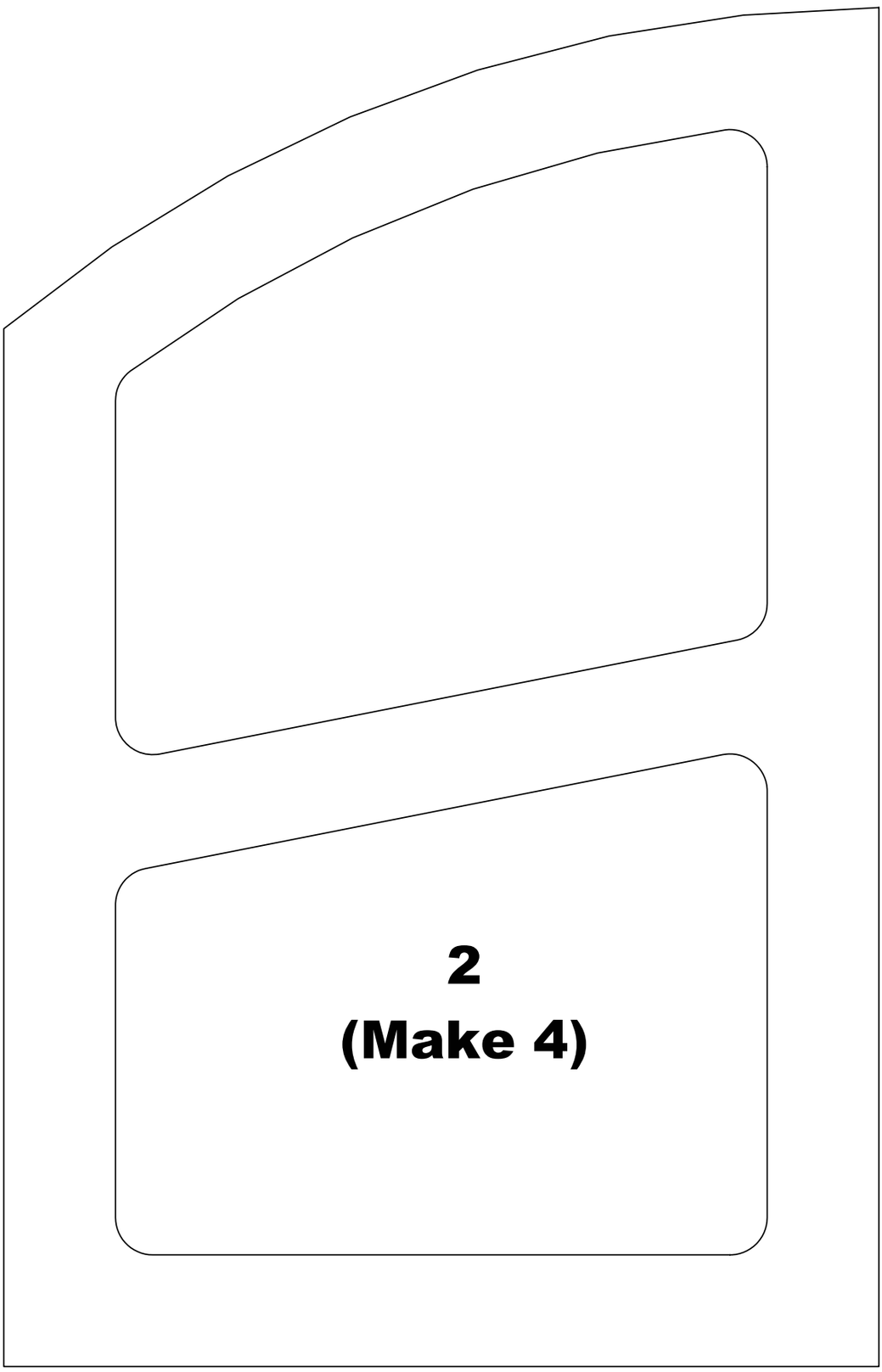
Layout for assembling the keel components

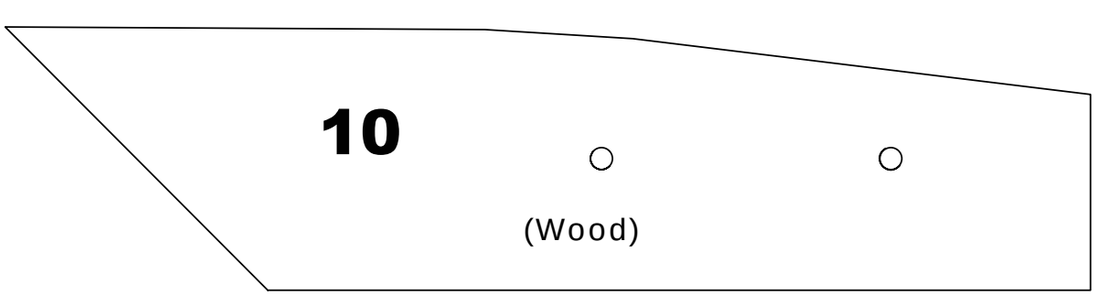



6
Warp Engine Vertical
(Make 2)
B
B

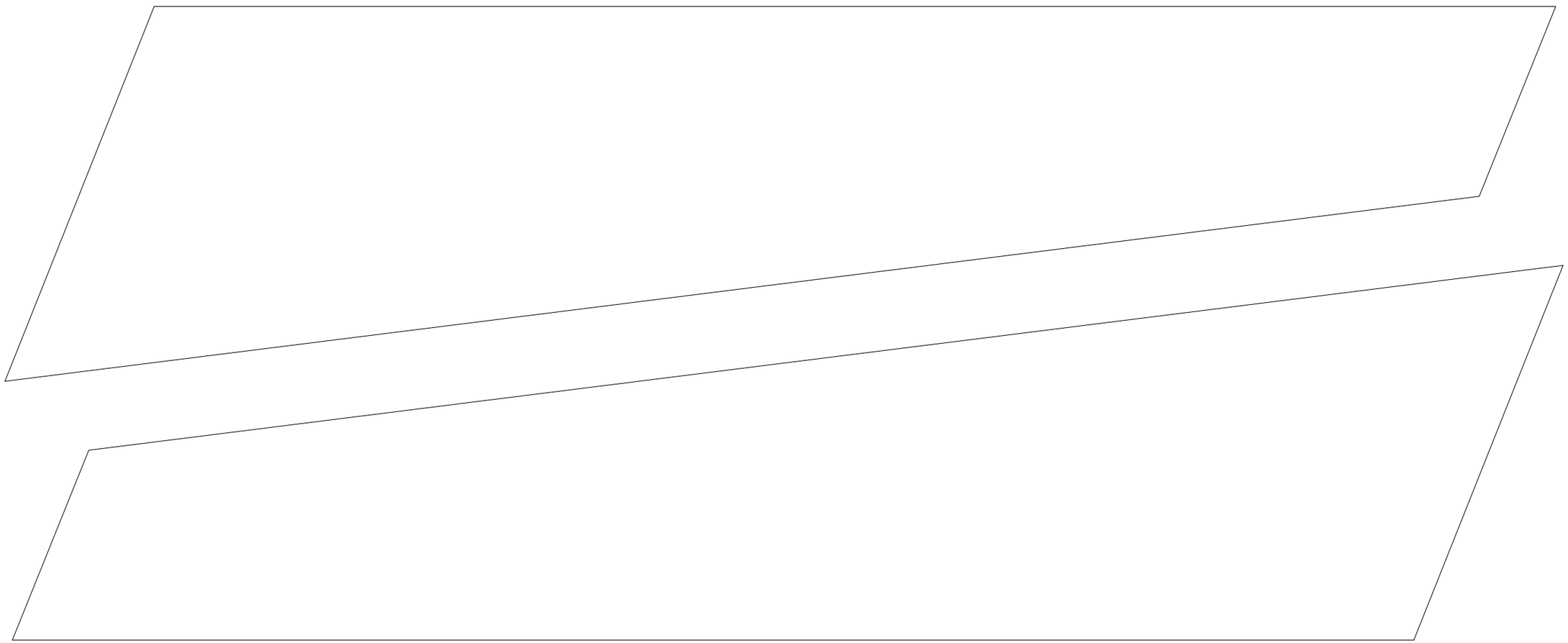

A
11
(Wood)
Cut Here For Pusher
Cut Here For Tractor
A
13
13
12

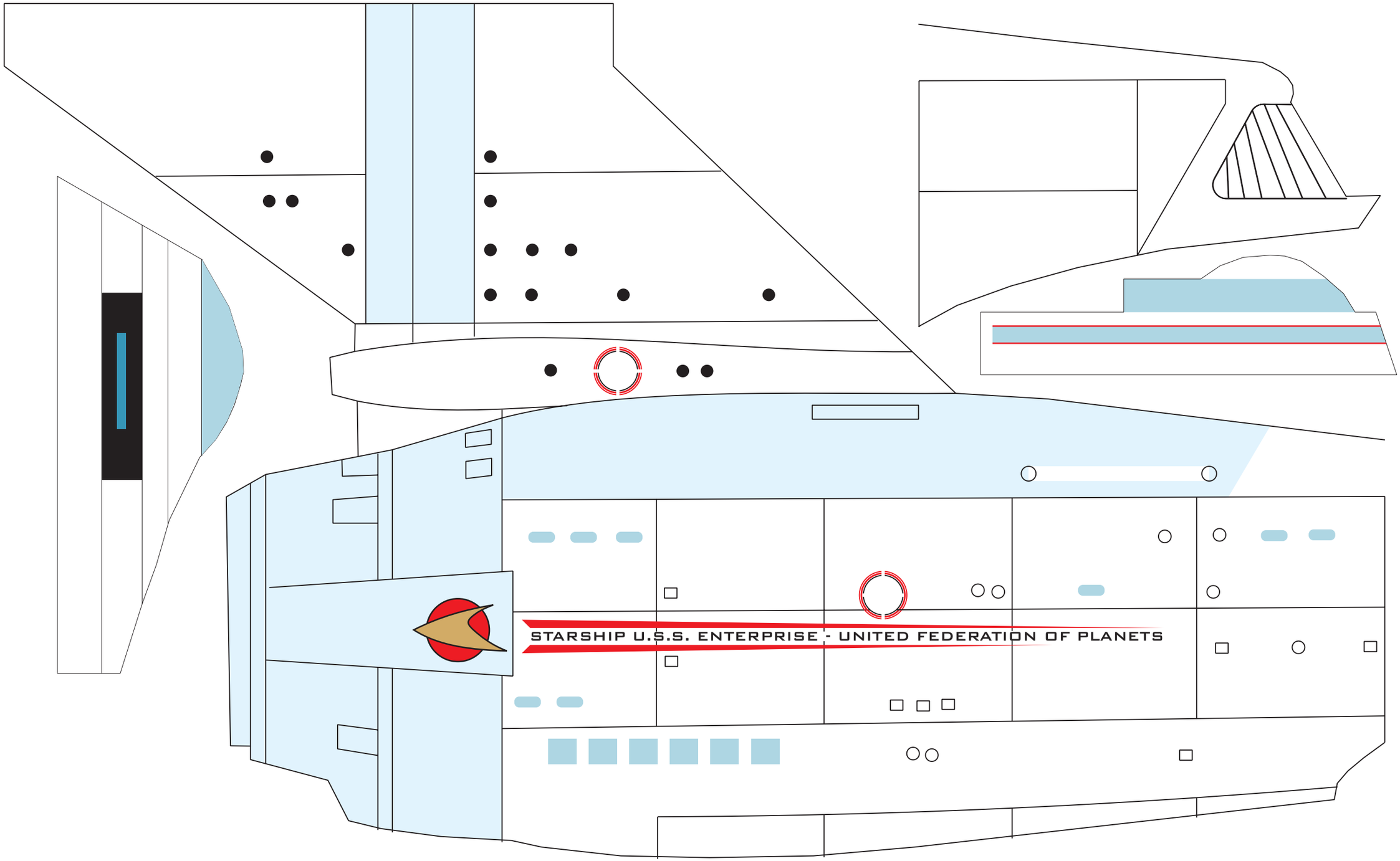

9
(Wood)
5
16

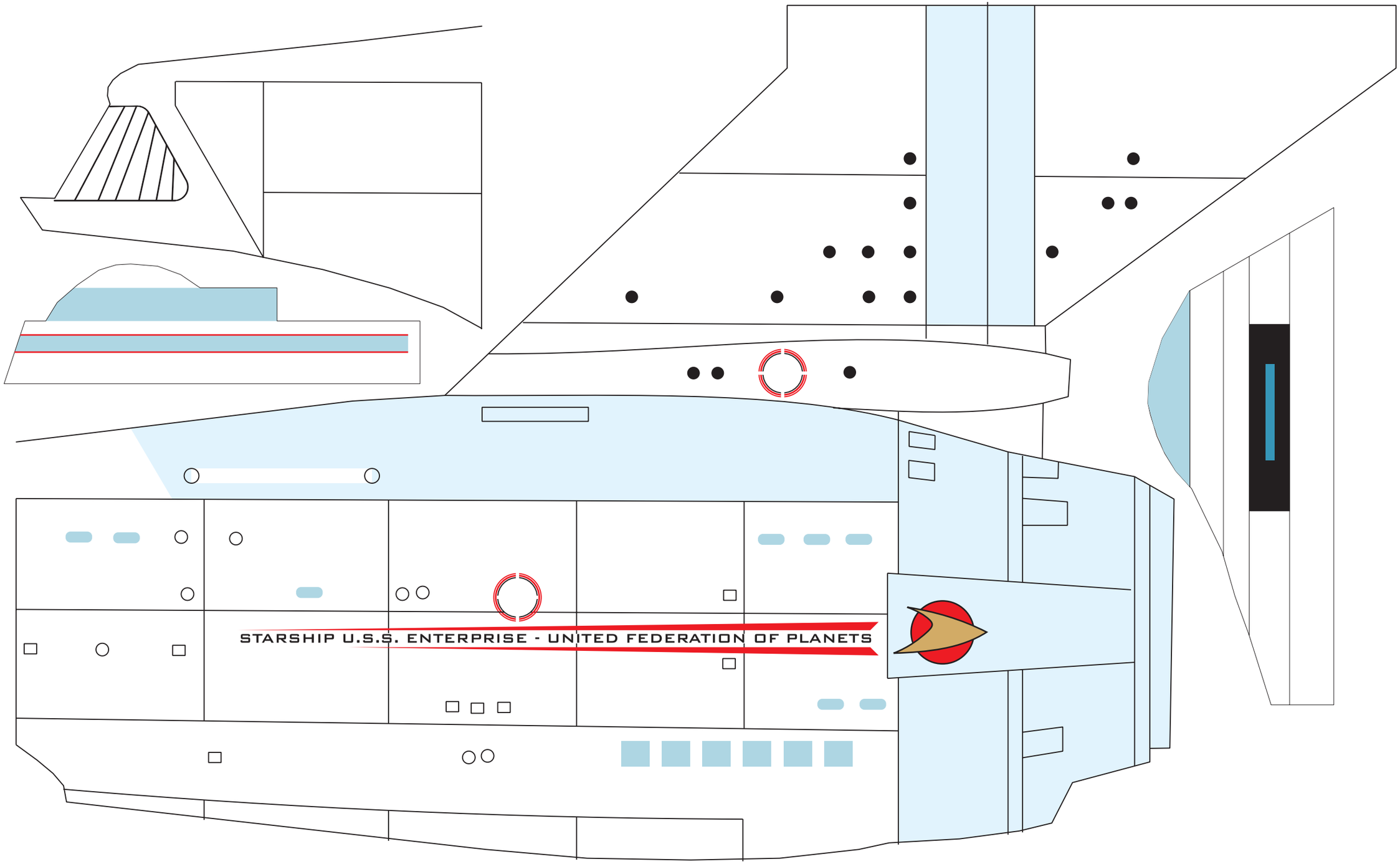

2
(Make 4)


10
(Wood)

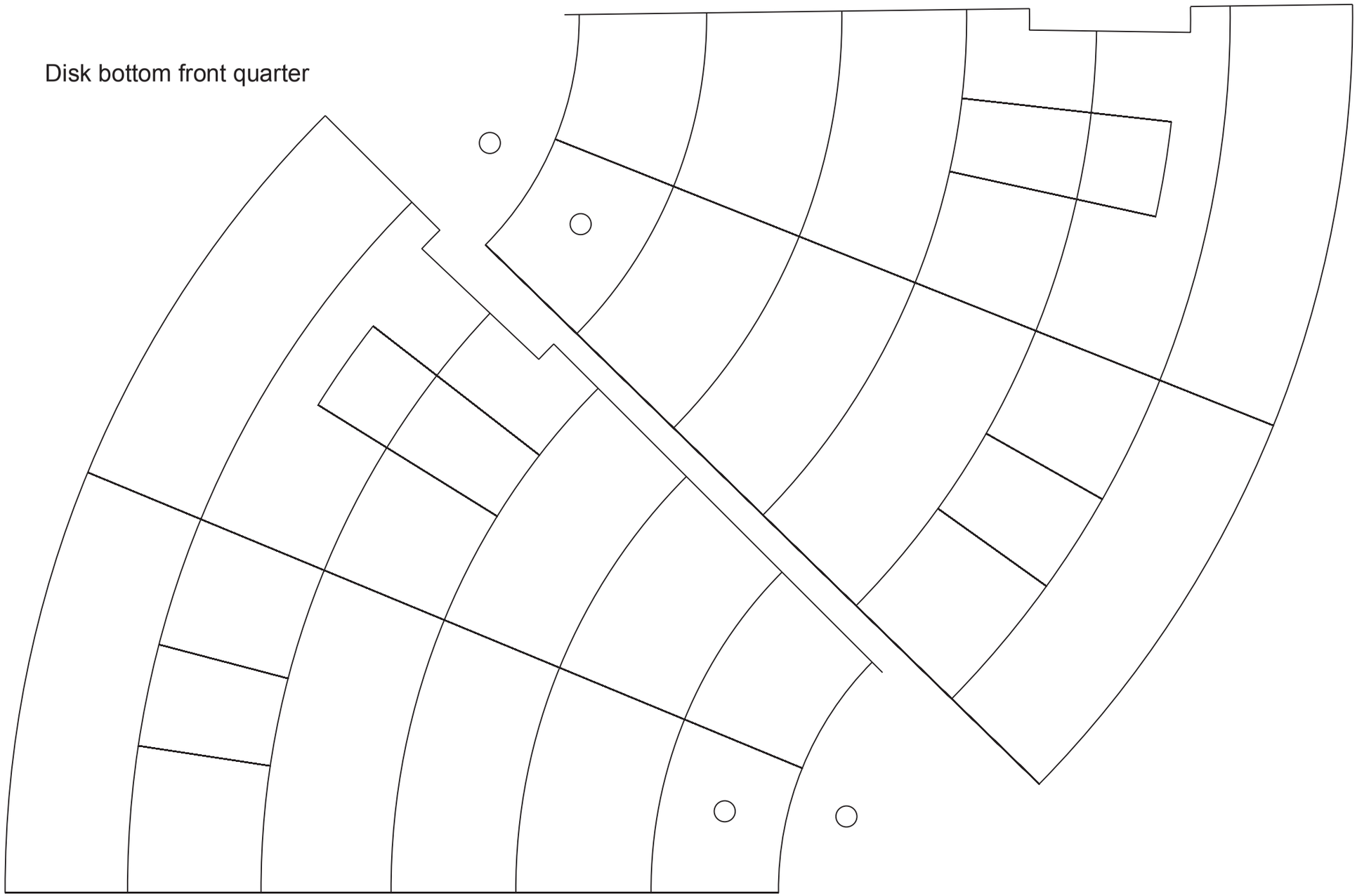
Warp Engine Support Fillers



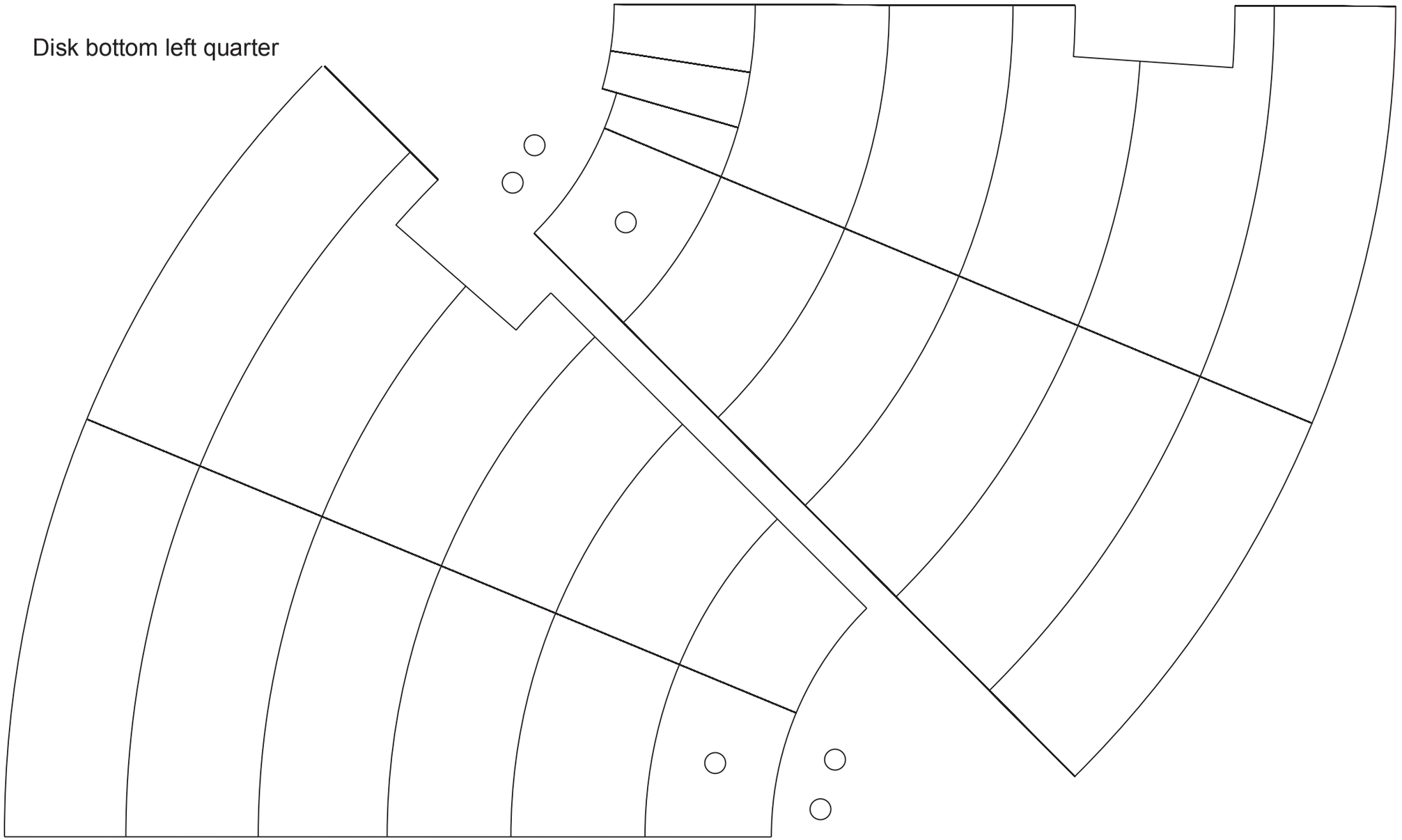

STARSHIP U.S.S. ENTERPRISE - UNITED FEDERATION OF PLANETS


STARSHIP U.S.S. ENTERPRISE - UNITED FEDERATION OF PLANETS

Disk bottom front quarter



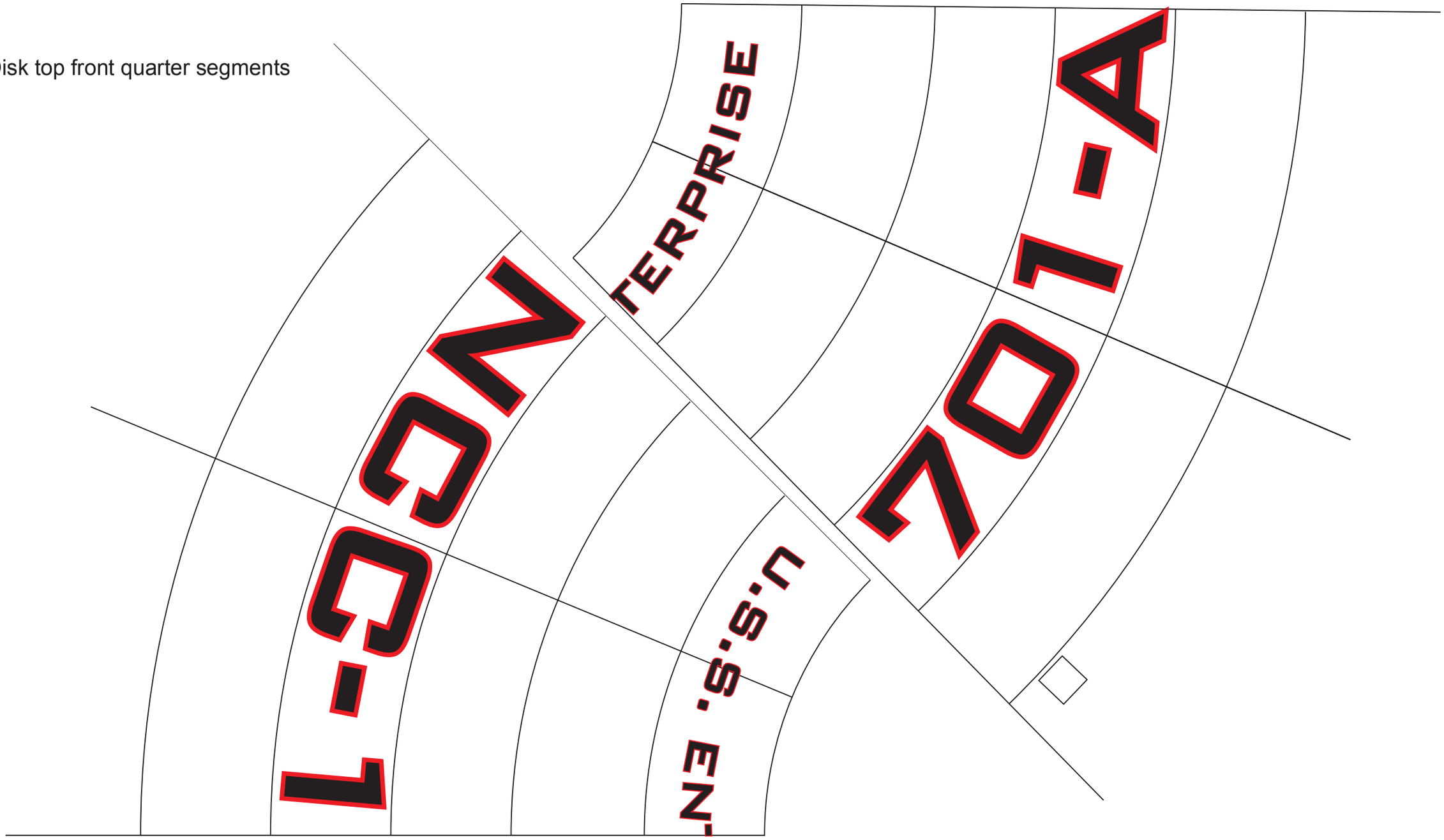
Disk bottom left quarter

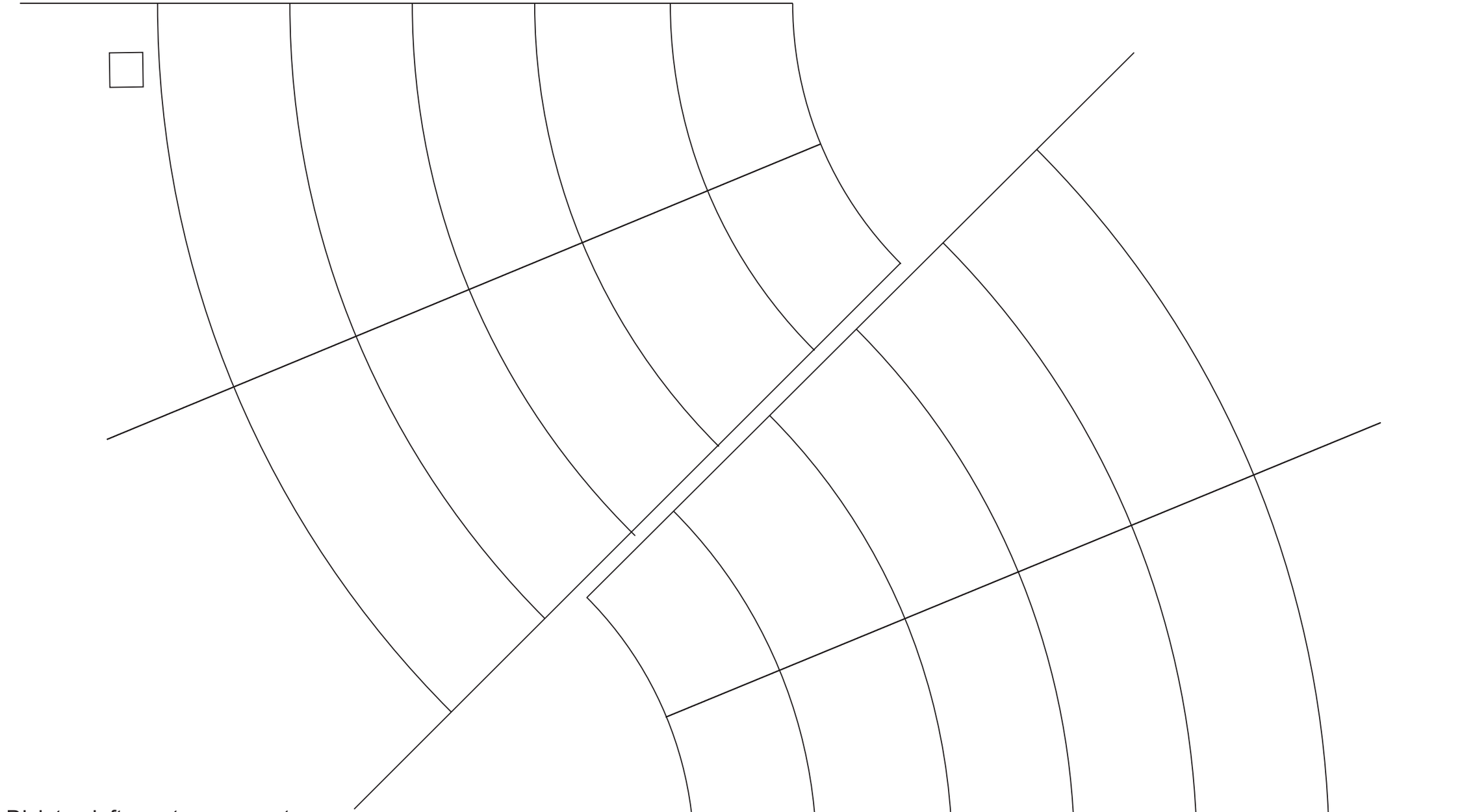


Disk bottom right quarter

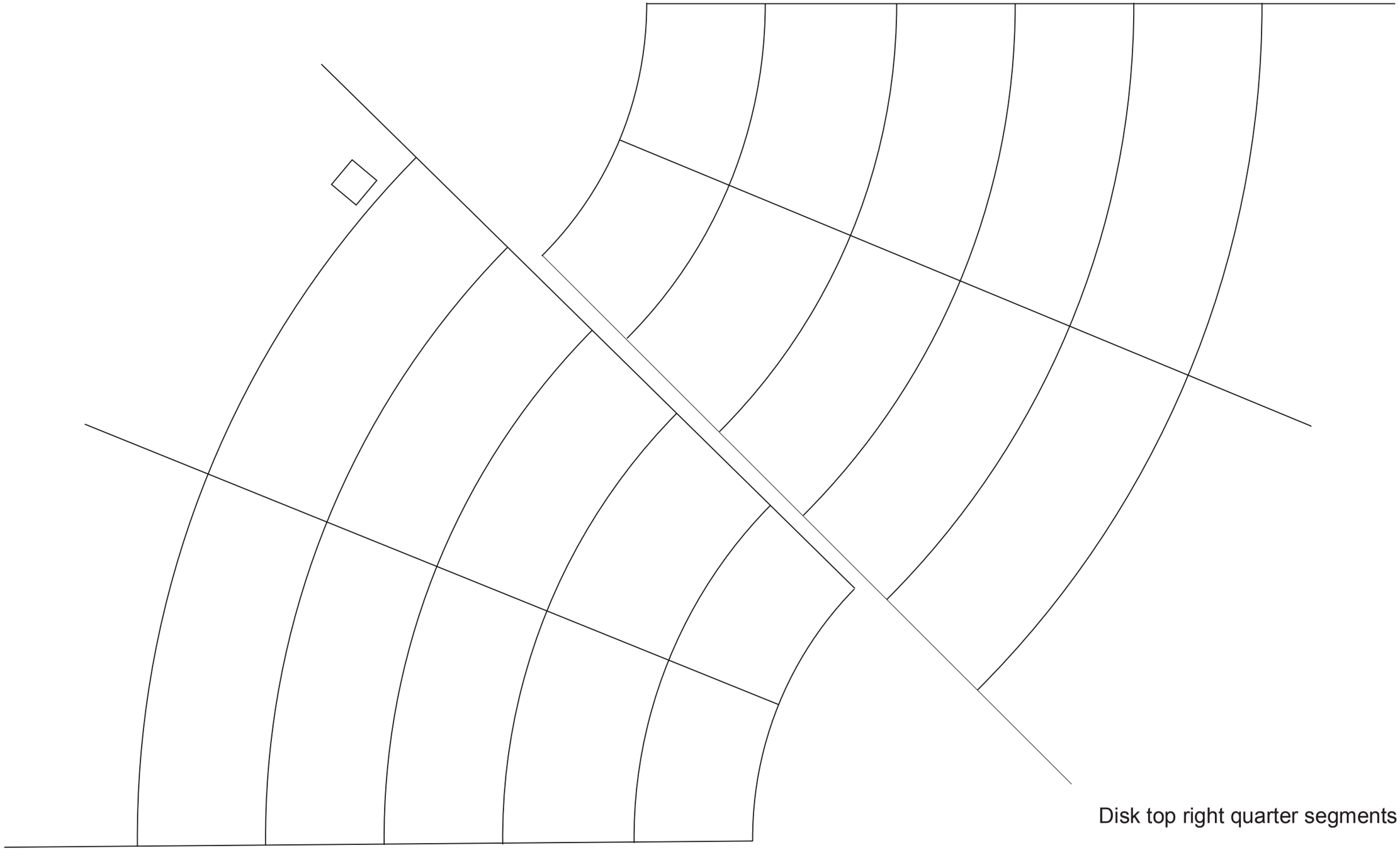
Disk bottom rear quarter

Disk top front quarter segments





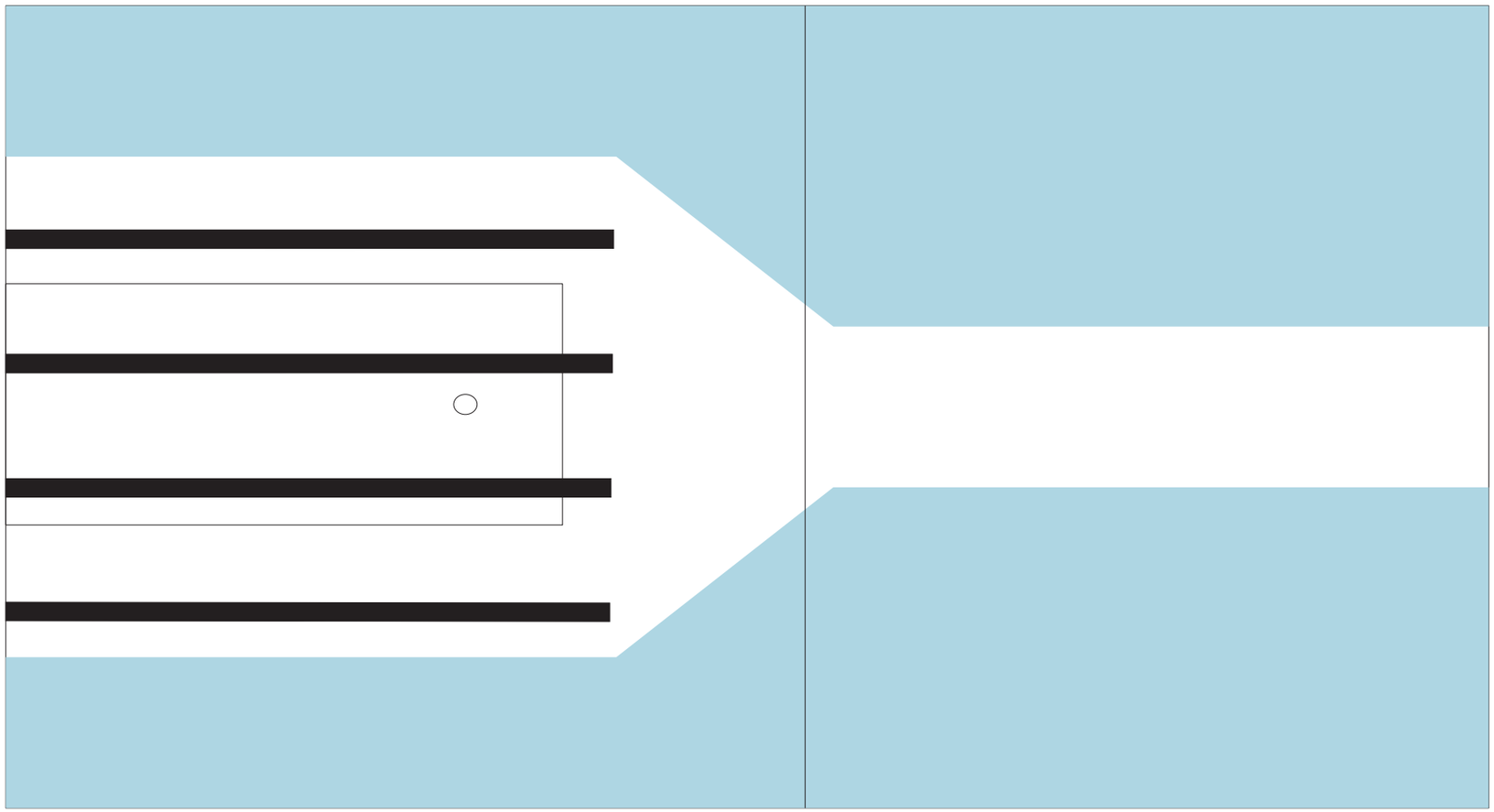
Disk top left quarter segments



Disk top right quarter segments

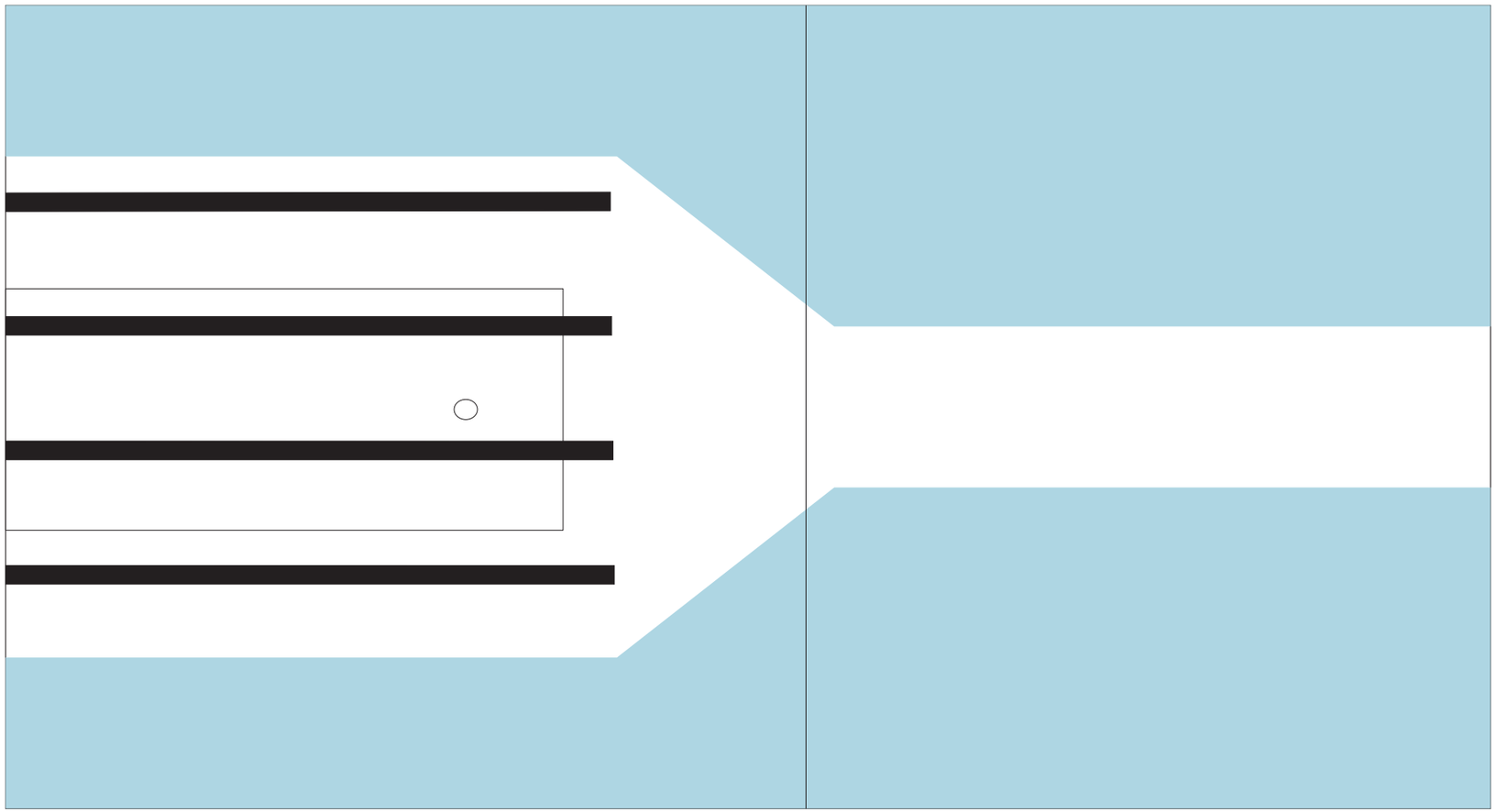
Disk top rear quarter segments

Warp Engine bottom left front



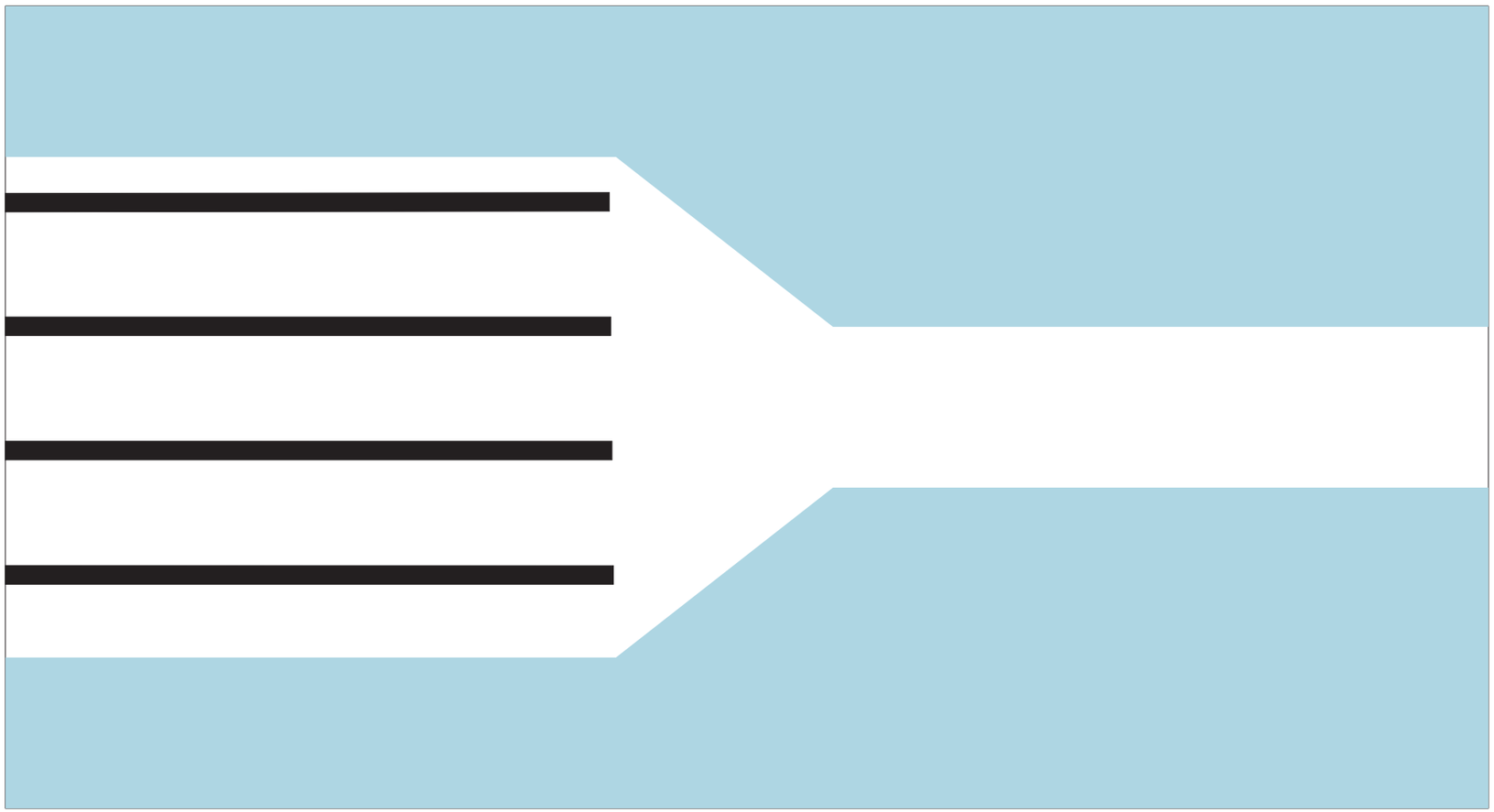
Warp engine bottom left - rear

Warp Engine bottom right front



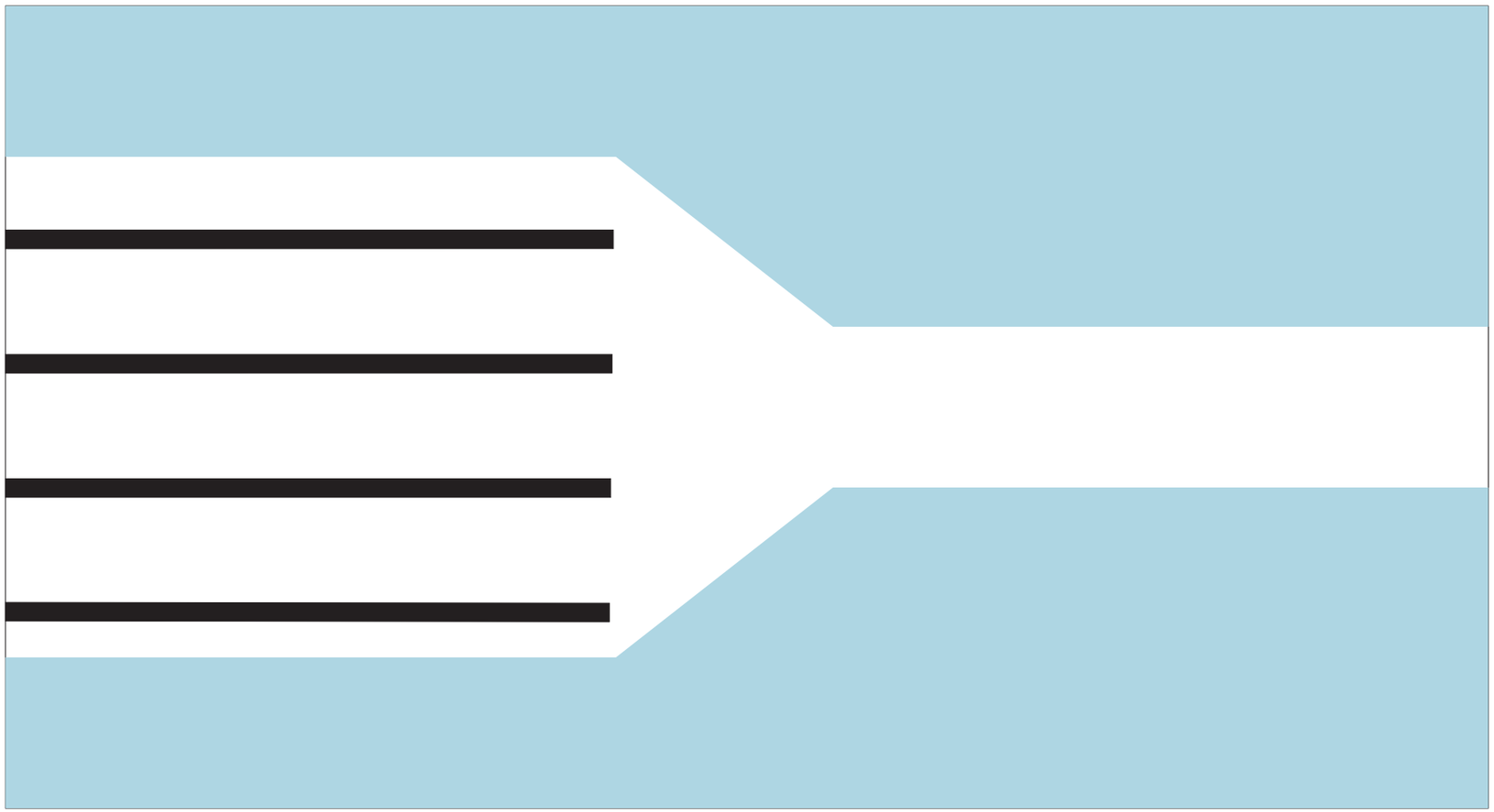
Warp engine bottom right - rear

Warp engine left top front

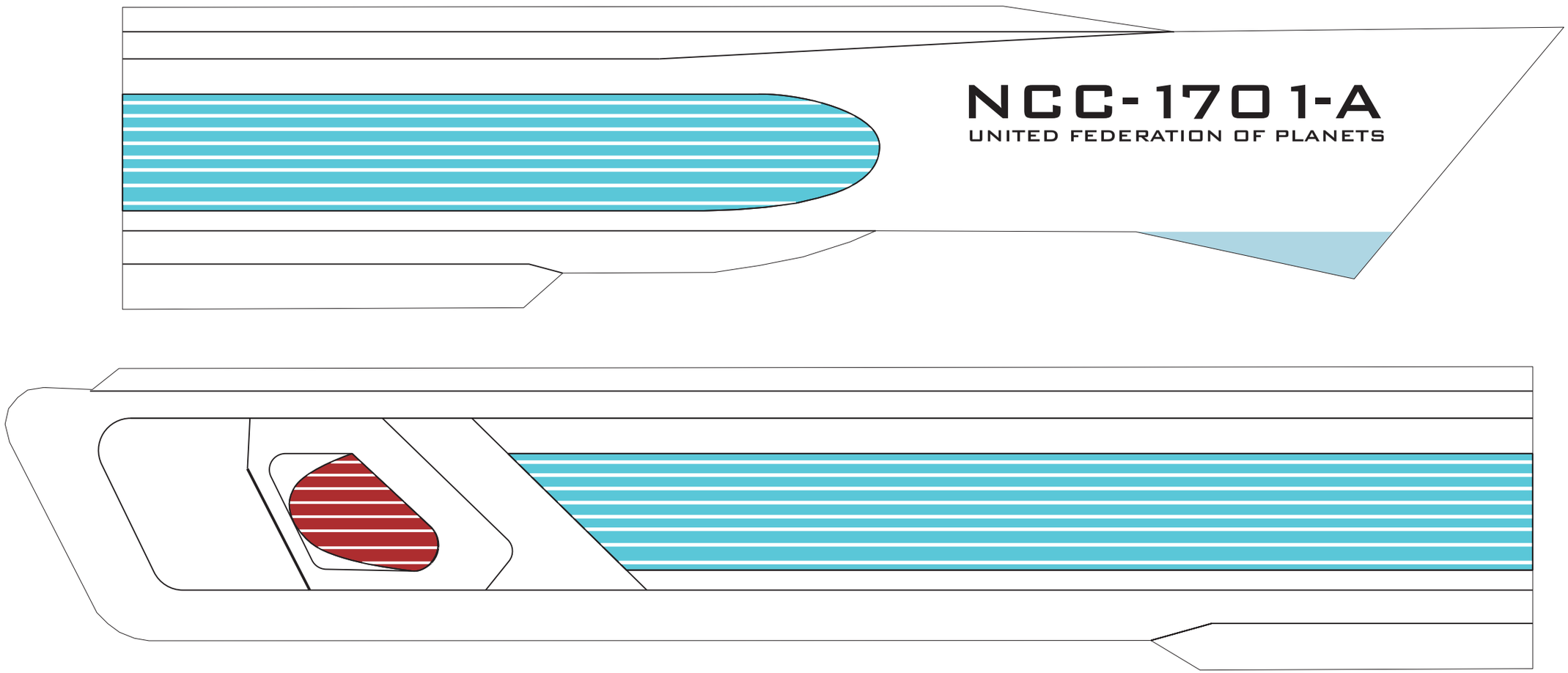


Warp engine left top rear

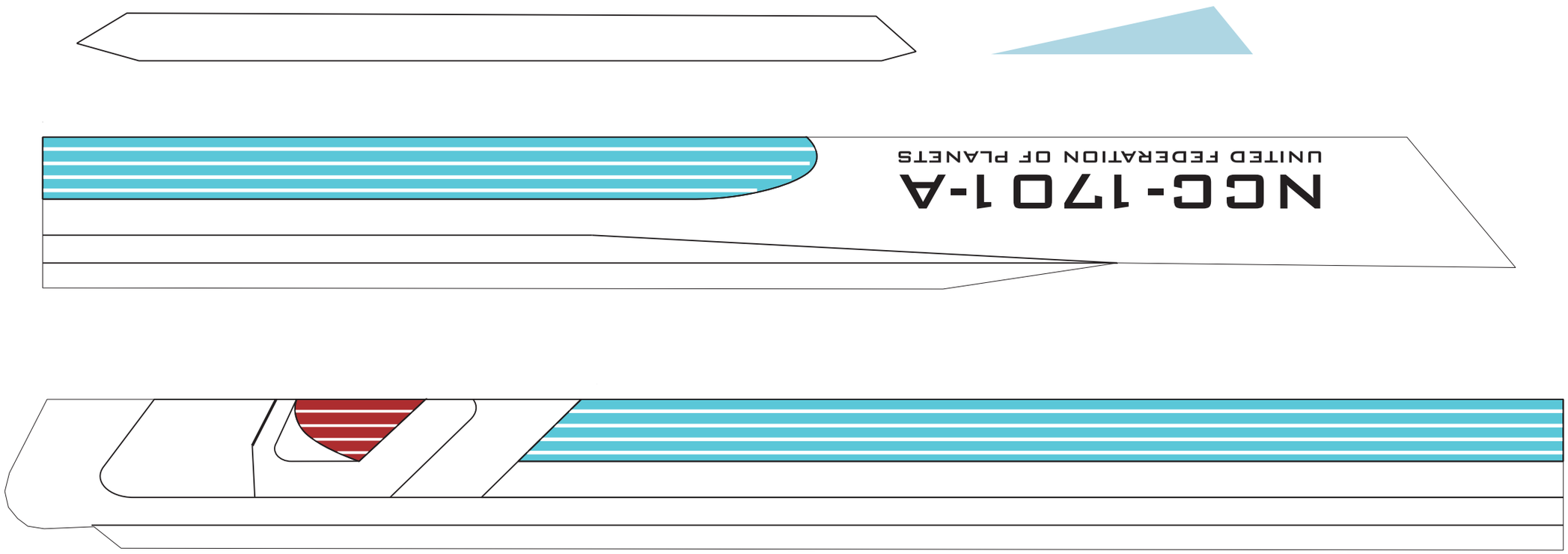
Warp engine right top front



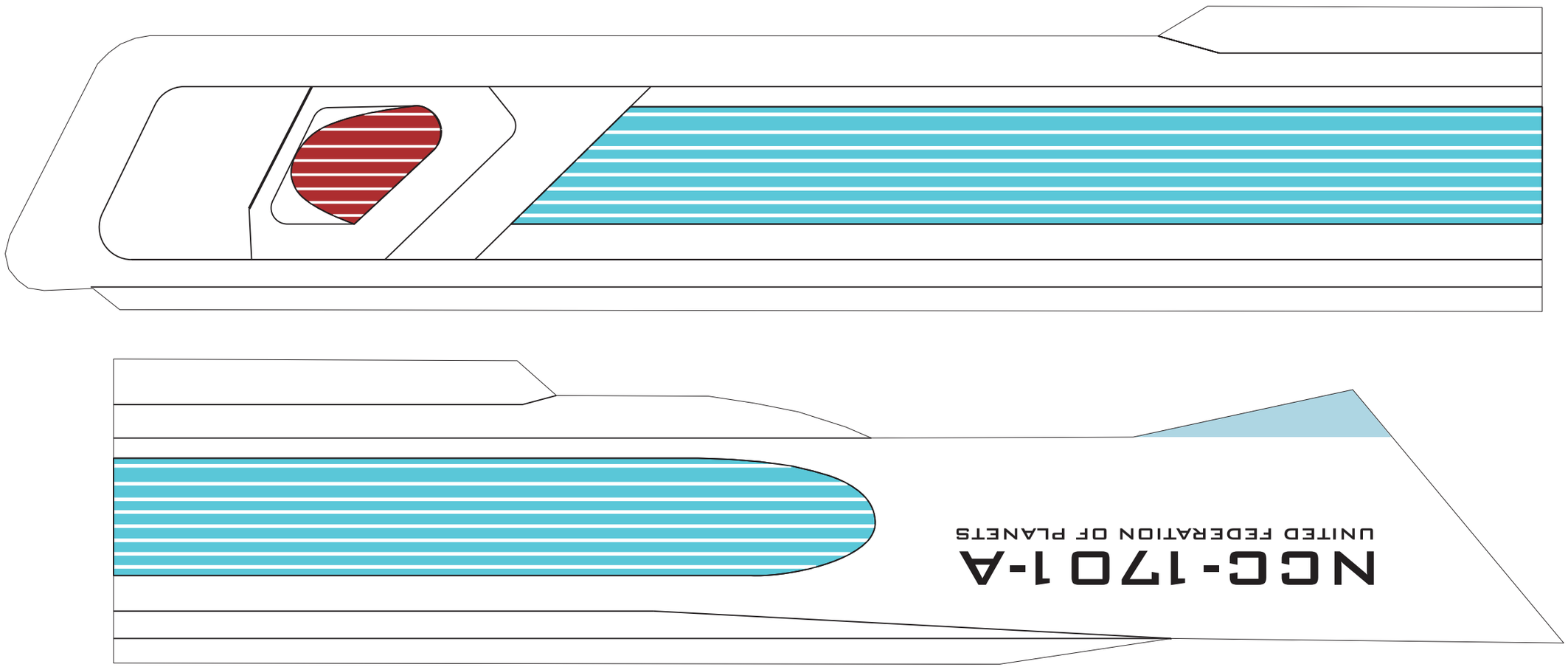
Warp engine right top rear



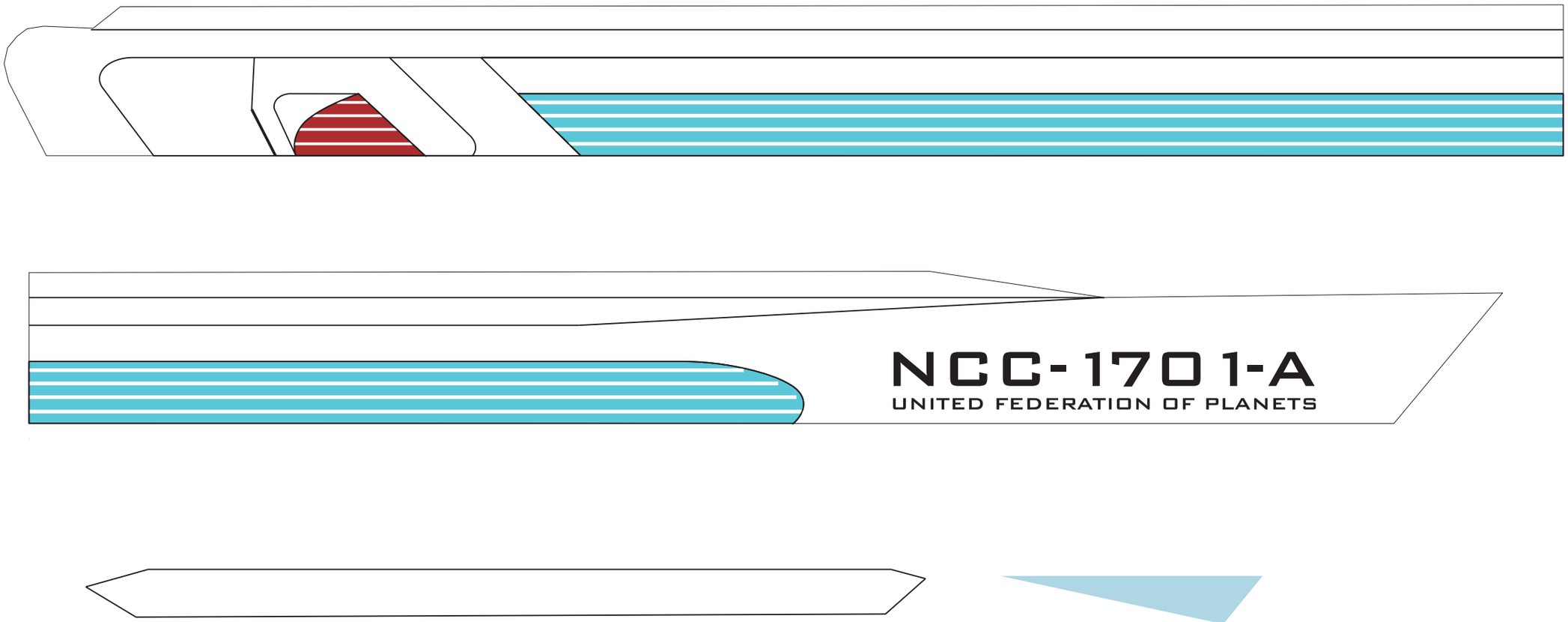
Warp engine left vertical outside face



Warp engine left vertical inside

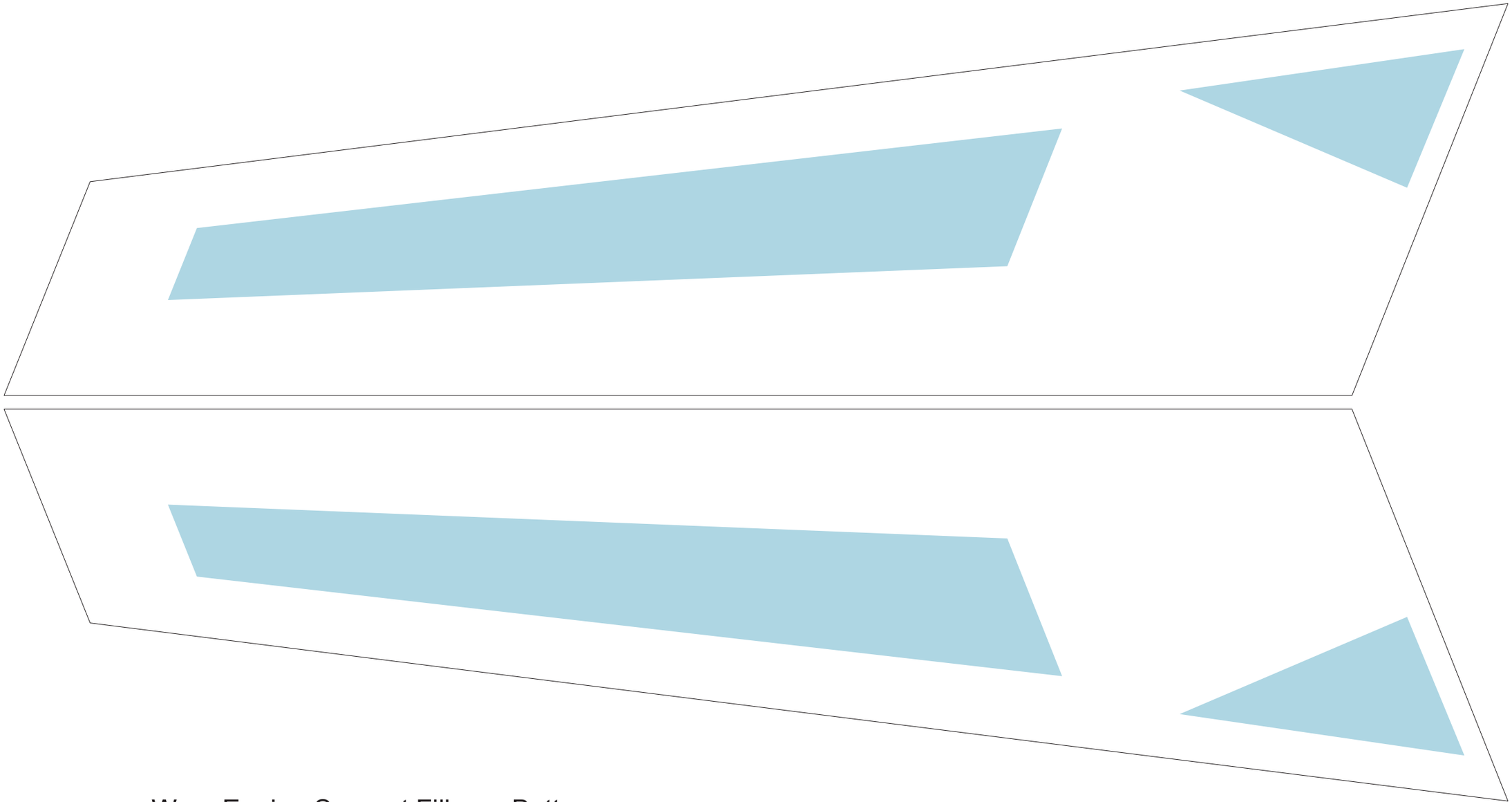


Warp engine right vertical outside face



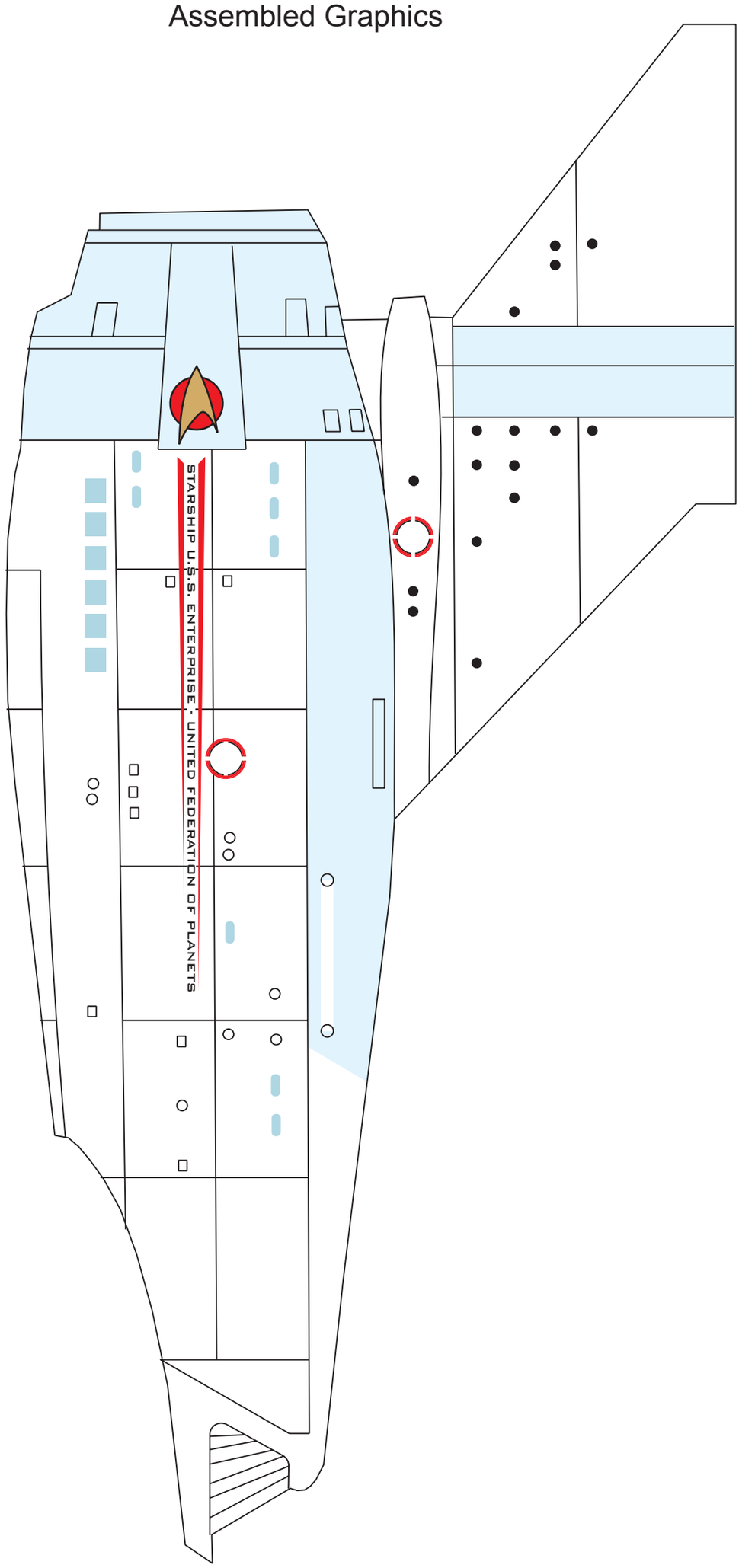
Warp engine right vertical inside

Warp Engine Support Fillers - Top



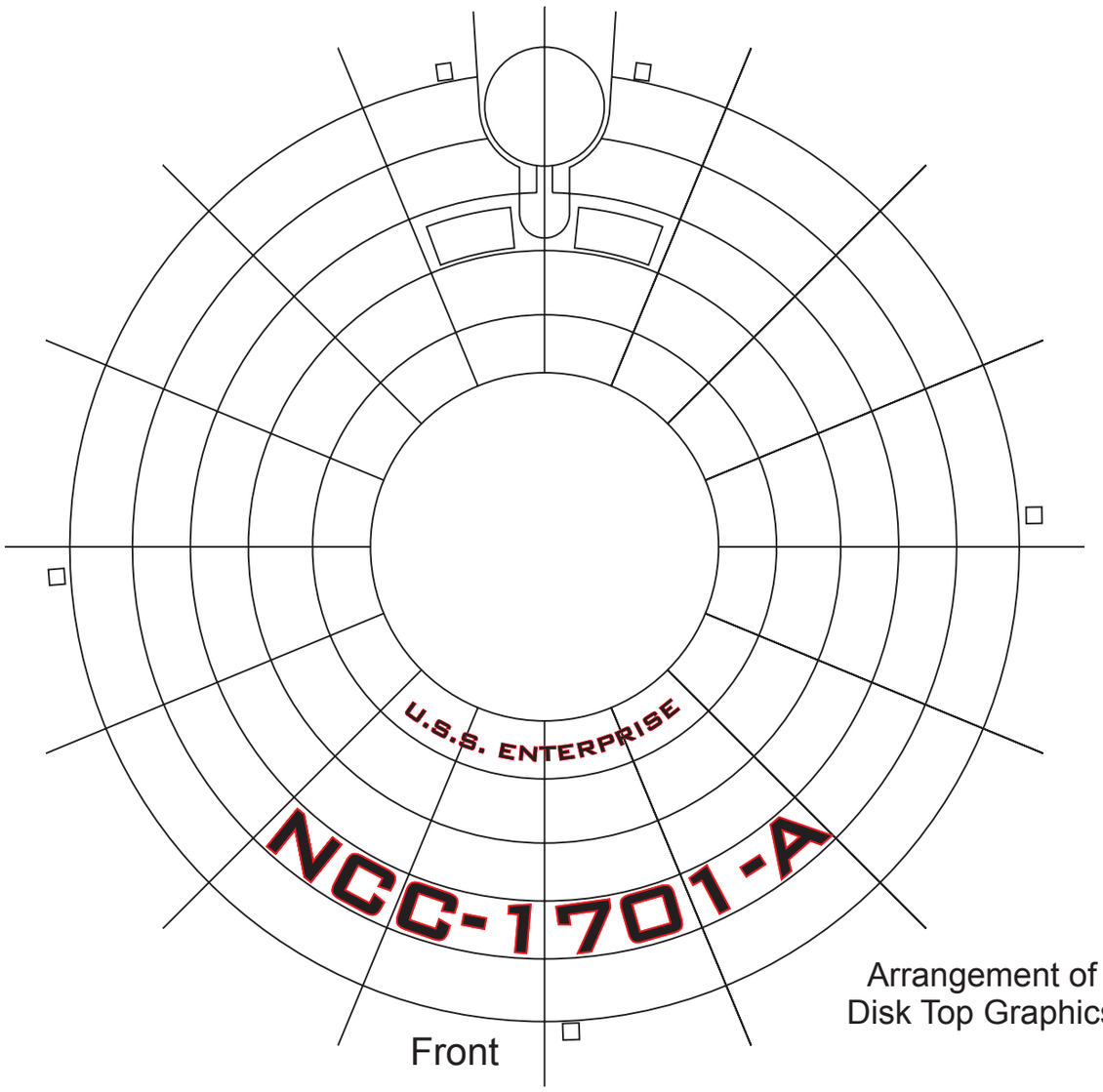
Warp Engine Support Fillers - Bottom

Assembled Graphics



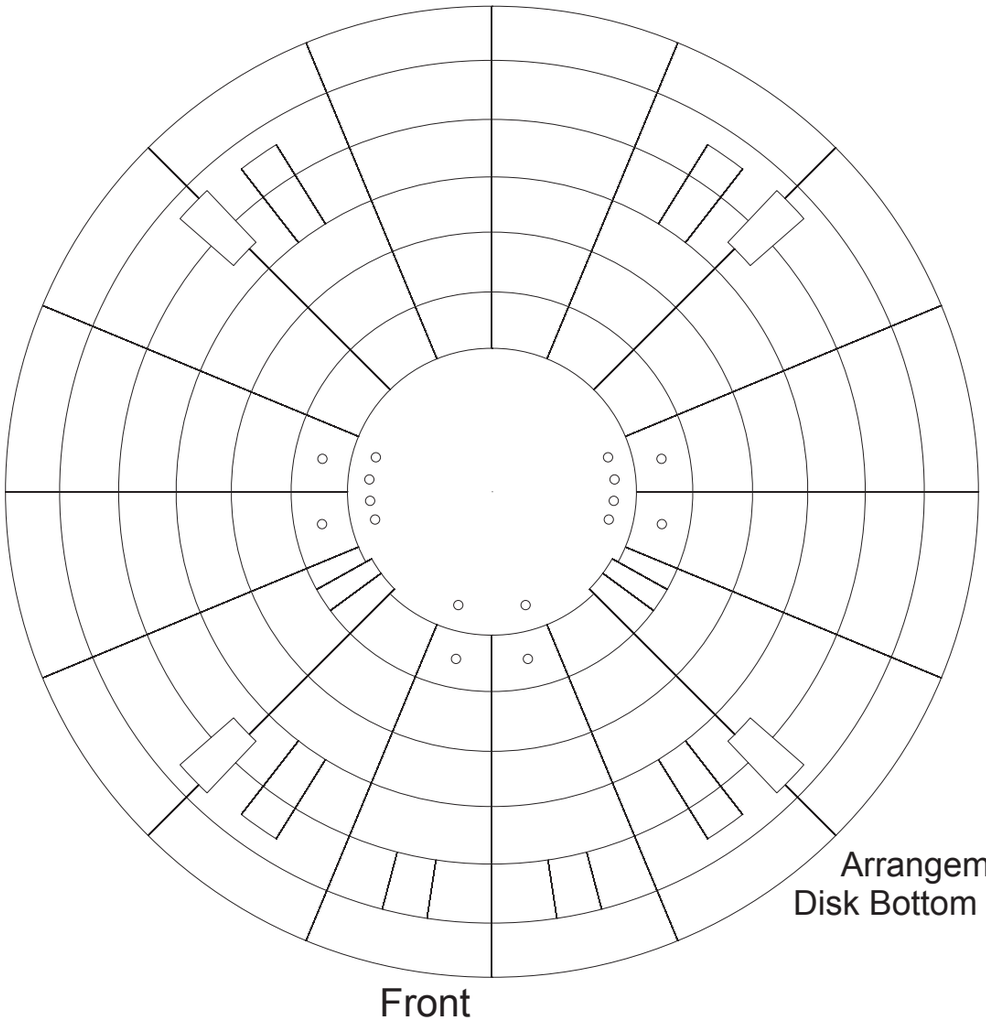
Engineering Hull

Assembled Graphics



Front

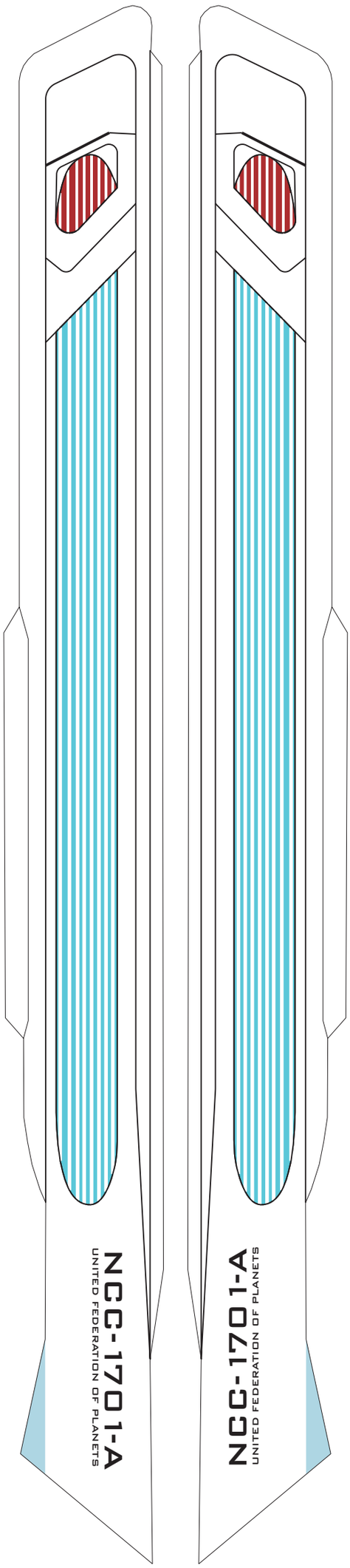
Arrangement of
Disk Top Graphics



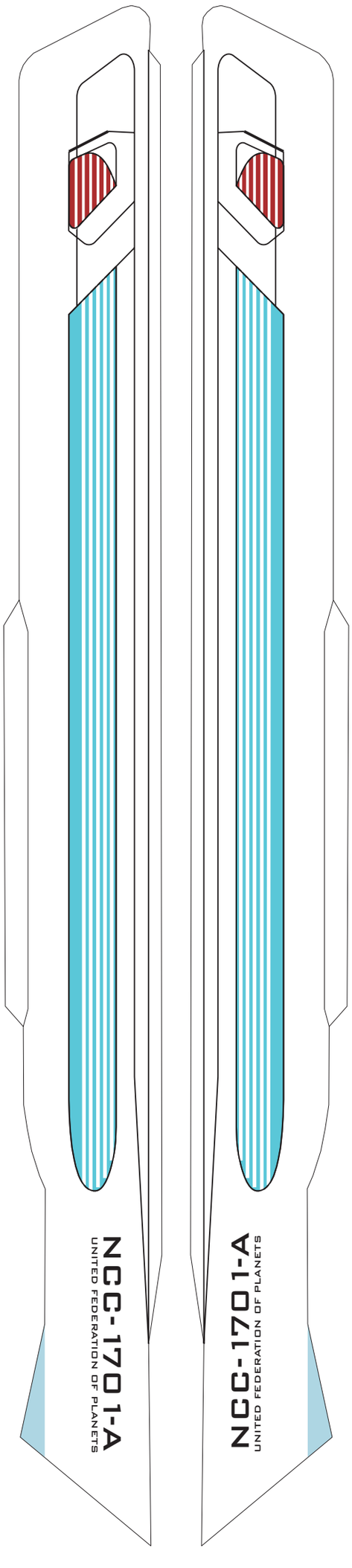
Front

Arrangement of
Disk Bottom Graphics

Assembled Graphics

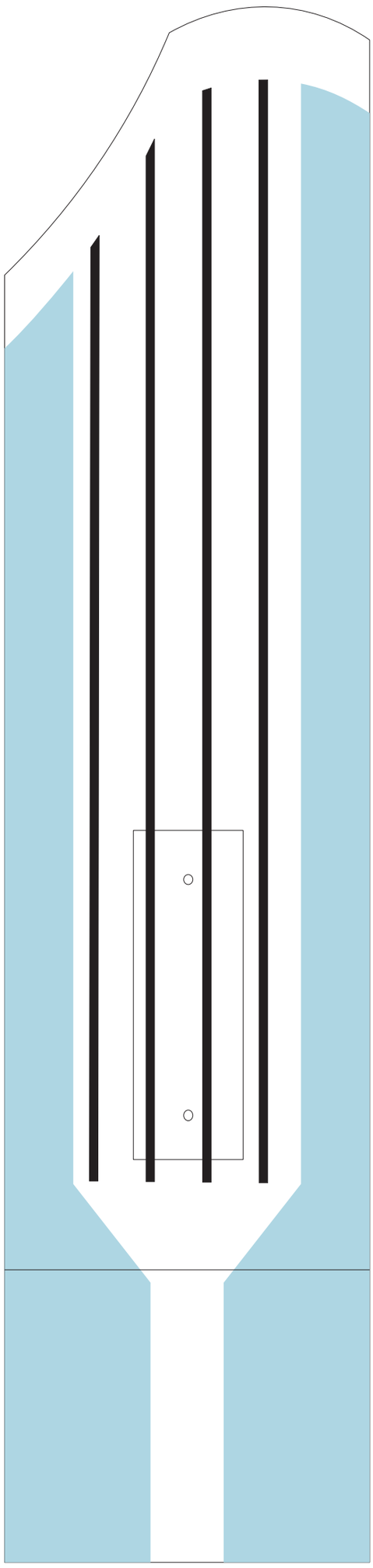


Outside Face of
Warp Engine Vertical

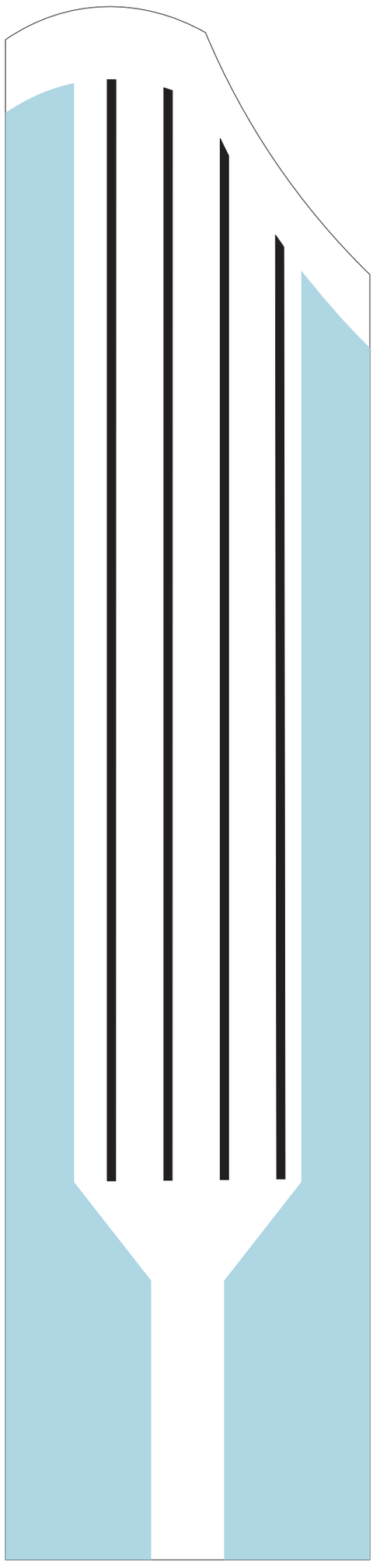


Inside Face of
Warp Engine Vertical

Assembled Graphics



Warp Engine Bottom



Warp Engine Top