

DIGITIGRADE STILTS

COMPLETE BUILD GUIDE WITH TEMPLATES



PART 1
Materials and
Preperation

By
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Please read the entire set of instructions before beginning the project build.

The reader assumes all the responsibility for the construction and use of this build/project.

This build represents a large number of hours of work for an independent builder / artist, please do not redistribute.

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Tools and Materials

Basic tools needed:

Power drill
Measuring ruler that can go up to 24 inches
Fabric tape measure
Hand Hack Saw
Center punch
Drill bits: 1/4, 19/64, 5/16
Marking Scribe
Heat Gun (not a hair dryer)
1 Lb hammer
Flat Bastard file

Additional tools (optional):

Drill press
Jig Saw or Rotary Saw
Bench Vise
Sewing Machine (If you are making your own straps)

Materials Required

6mm Sintra (6 square feet)
3/8 X 1.25 inch Aluminum Bar Stock (12 feet)
1/4 X 2 inch Aluminum Bar Stock (24 inches)
1 X 2 inch aluminum Bar Stock(6.5 inches)
1 X 2 Rectangular Steel Tube 1/16 inch wall thickness (4 feet)
1/4 20 by 1 inch Grade 8 bolts (36)
1/4 20 by 0.5 inch Grade 8 bolts (8)
1/4 20 Tee-Nuts (40)
1/4 Steel Fender washers(36)
1/4 Standard Washers(36)
1/4 Standard Nut(8)
1/4 Nylon Fender Washers(12)
1/4 by 1/4 Bolt bushing spacers(32)
5/16 X 1.25 inch bolts(4)
5/16 X 2.0 inch bolts(2)
5/16 by 3.0 inch Grade 8 bolts(4)
5/16 by 5.5 inch Grade 8 bolts(4)
5/16 Steel Fender Washers(2)
5/16 Standard Washers(16)
5/16 Nylon Fender Washers(4)

5/16 Nuts(20)
3/16 aircraft cable (6 feet)
3/16 cable sleeves(4)
5/16 by 9 inch turnbuckle(2) Verify the load limit to be over your weight
1.5 inch Velcro Strapping (12 straps 18 inches long)
1.5 inch nylon webbing (7 feet)
1.5 inch Velcro (6 feet)
1.5 inch Tri-Ring (24)
Red Loctite 271 Thread locker

Important Notes

If you are making your own straps then you will not need the pre-made Velcro strapping listed above. The pre-made straps are available at Home Depot but are weaker and considerably more expensive than making your own. I will cover how to make your own in a later section.

If you are unable to find the 1/4 by 1/4 Bolt bushing spacers then you will have to make your own from 5/16 inch steel or copper tubing. You will need a tubing cutter or hack saw for this. I will show the steps to make your own.

Sintra is available at plastics supply stores like Industrial Plastics & Paints. (ippnet.com) There are other plastics available like nylon and PVC but they are a great deal more difficult to work with. Sintra is foamed PVC which is light weight and has the strength required for this project. It is easy to cut and form.

The metals are available on-line from metalsupermarkets.com. If you go to the store be sure to check for pre-cut and scrap pieces which will be less expensive than the full lengths of bar stock.

Bolts and fasteners are available in specialty stores like calfast.com

Nylon webbing, Velcro and Tri-Ring are available from paccana.com or hudson4supplies.com

Big Box stores like Home Depot may have the materials listed here but the prices will be quite a bit higher than the specialty stores.

Measuring Your Leg

You will need to measure your leg in 6 key areas in order to get a proper comfortable fit. If the critical areas like the ankle and leg height are not correct then the entire brace will slide and chafe as you walk. Be sure to record these measurements as you will need them during the materials preparation stage.

Your thigh needs to be measured in 2 places; the first as about 4 inches above your knee and the second is approximately at the mid point.



Thigh Measurements

Your lower leg needs to be measured at approximately 4 inches below your knee and again at about 6 inches below that.



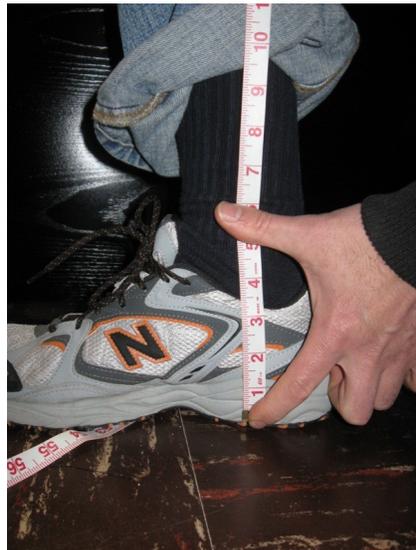
Lower Leg measurements

The first critical measurement is your lower leg height. This is measured along the side of your leg from the midpoint of your knee joint or where it bends to the midpoint of your ankle.



Lower Leg Height

The next is measured wearing the shoes that you intend to wear while wearing the stilts. With your shoes on you will need to measure the distance from the floor to the midpoint of your ankle.



Ankle Height

These measurements will be used to make the custom fit parts of your stilts.

Forming the Sintra Plastic Leg Support Pieces.

These are the 4 “butterfly” Shapes and two 2 inch wide strips that you cut from your 6mm thick sheet of Sintra plastic. You will need to be wearing heavy material pants for the forming part. Light work gloves will add to your comfort but are not necessary.

You will need to heat these with a heat gun. It is important to heat these in 3 stages. The middle, then the sides will need to be formed. Sintra will form easily when heated and will keep its shape after it has cooled.

If you notice that the material is bubbling or smoking this is an indication that you have applied too much heat in one spot and you will need to let it cool slightly before proceeding. You will heat the material from the inside or side that will be closest to your body. Using a slow sweeping motion heat an area about 2 inches wide along the narrowest point of the first Sintra butterfly shape. Depending upon you heat gun this should take approximately 1 to 2 minutes. You will notice the material begin to warp but stop heating before it freely sags.



Heating the Center of the Lower leg Sintra Shape

Press the heated side of the Sintra against the part of your leg that this piece will cover. Gripping the far edges of the wide parts, wrap the Sintra around your leg. The piece will

only go part way as this is a 3 step process. Hold the piece there until it cools, about 1 to 2 minutes and it will retain the new shape.



Wrapping the center section around the lower leg

Next heat one of the wide sections in the same manner as you just did, this time using the side drilled holes as a center reference. Once the heating is completed again place the material against the same part of your leg and wrap the side piece around towards the back, then hold it until it cools.



Heating the side of the lower leg piece



Forming the lower leg piece



Side formed

Repeat this with the other side of the piece.



Completed piece

The completed piece will now be in the same shape as your leg and will actually clamp to your leg where it was just formed. You will have to drill the holes to make them round again using the 19/64 inch drill bit and a hand drill. Check for fit and label the piece for future reference. The pieces will have to be adjusted for final fit later.



Piece fit to leg

You will need to complete this procedure for the next 3 pieces.



Thigh piece completed



Thigh Fit details

Forming the toe clip pieces.

You will need 1 section of the steel rectangular tube for use as a guide. The measurements for the toe clip are approximate and need to be corrected for the type of

footwear that you will be using. I used You will have to adjust the dimensions for your shoe size, Using the dimensions provided will provide a toe clip size for US 10.

Begin by heating one of the 2 inch wide Sintra strips at about 4 inches in and at a 45 degree angle. When the Sintra begins to sag flip the piece over and heat it again, You will have to get this piece quite hot so that it sags freely. Place the heat gun aside and using the steel tube form the Sintra so that the end goes up at 90 degree angle and is bent back at a 45 degree angle as shown.



Heating the toe clip



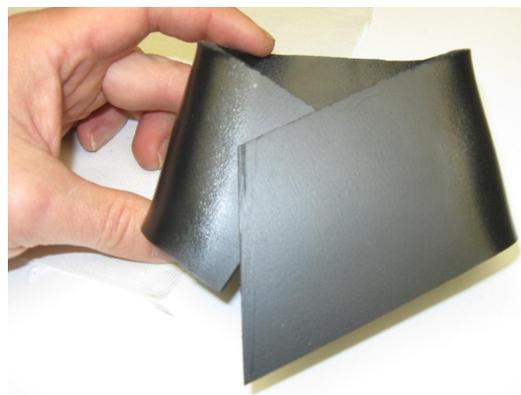
Forming the upright section

Next heat the strip at about 1.5 inches closer to the upright end and fold this section the same as the previous step.



The second fold

Repeat this for the other side at about 4 inches over again until the toe clip looks like the one shown. Check that the clip will fit over your shoe and that your shoe tip is visible along the top front edge of the unfinished clip. If not reheat the folds and shape the plastic to accommodate your shoe.

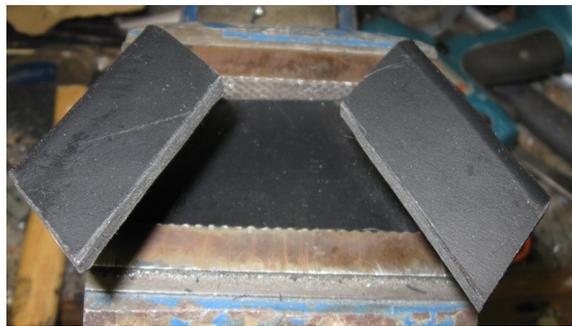


Folds completed

Next trim the edges with a hand saw and drill the holes as shown in the drawing to accommodate the toe straps and hold down bolts.



Trim with handsaw



Trimmed detail



Finished details

Strap Preparation

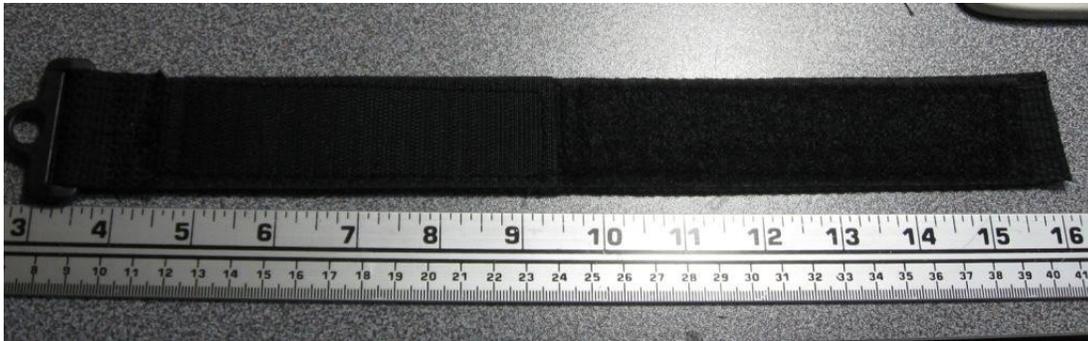
You will need 6 straps for each leg.

Velcro makes a loop strap that sell in a pack of two and retails for quite a bit more than the cost of making 12 of your own. If you go that route then you can purchase them through several different retailers. I do not recommend this method.

In order to make your own you will need the materials listed in the materials section. You will be able to produce a strap that is both stronger and less expensive than the readily made item.

For the leg straps you will need to cut sections that are a little longer than half the leg measurements for each section. A rough measurement is 16 inches for the thigh and 10 inches for the lower leg. In addition you will need 10 inch straps for the feet. There are 6 straps needed for each stilt assembly: two for the thigh plus two for the lower leg and another two for the foot.

Begin by cutting the sections of 1.5 inch wide nylon strap material. Melting the ends of the cut material will prevent fraying, this can be done with a hot knife or a cigarette lighter. For most people you will need 4 at 17 inches, and 8 at 11 inches. You can adjust the lengths as needed.



Finished Thigh Strap

You will loop one end through the strap portion of the tri-guide and sew it as shown.



Loop the end through the guide



Secure sewn as shown

Then cut at least 5 inches of the hook side of your Velcro material and sew it nearest the tri-guide.

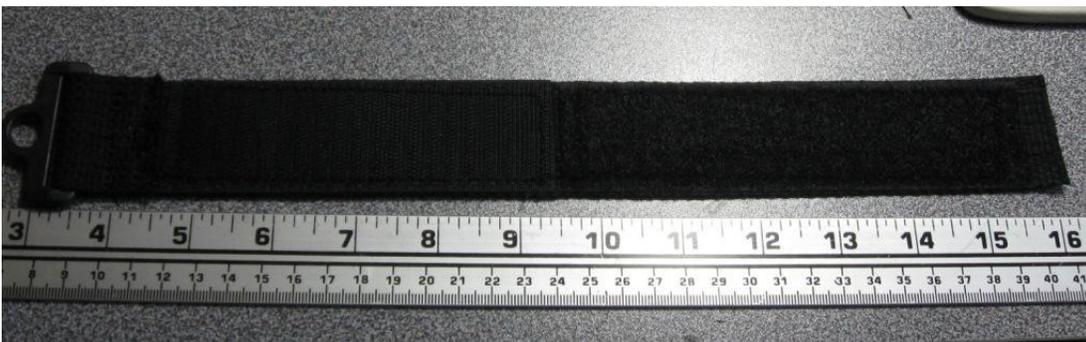


Cut the hook fastener



Sew the hook fastener

Cut the remainder of the strap length in loop fastener and sew it on the same side as the loop fastener leaving about a half an inch of bare strap at the end.



Completed strap

Repeat this for the remaining 11 straps.

Part Preparation

You will have to refer to the parts drawing section for the parts patterns.

The plastic pieces for the thighs, lower legs and toe clips are cut from the 6mm Sintra material. The drawings for these are provided but are only half of the piece. You will need to cut out 2 shapes and join them at the straight line marked as the fold line. This will create a butterfly shape and the fold line will be 1/4 of the measured leg point. You may have to add or remove paper between the fold lines of the drawing in order to get to your proper dimensions.

The Sintra material is easily cut with a hand saw but will break if your force the saw sideways to make the corner cuts. You can also use a jigsaw or RotoZip type tool to cut the outline. Try to position the cuts from your material to minimize waste as you will have to get all 4 pieces in addition to two strip of the Sintra material that is about 14 inches long and 2 inches wide for your toe clips.



Sintra Lower Leg Example

Use the pattern and mark and drill the mounting holes. The holes are to be drilled with a 19/64 bit if you are using 1/4 inch Tee-Nuts.

Place the 6 Sintra places aside for forming later.

The aluminum leg support pieces are made from the 3/8 by 1.25 inch bar stock. This material gives enough support while maximizing lateral stiffness to prevent injury.

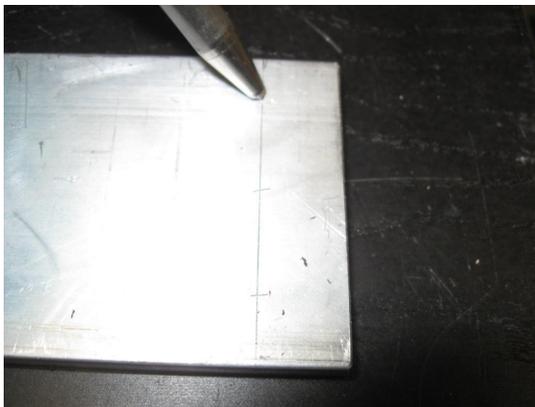


Leg Support pieces drilled ready for joint prep

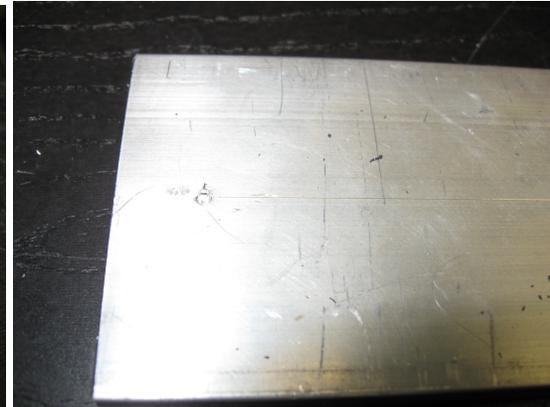
Refer to the drawings of the Thigh support and lower leg support. The Thigh Support pieces are drawn to actual scale and can be used as a template if you need to. There are 4 pieces in total that will need to be shaped.

The Thigh support pieces are made as shown in the drawings while the lower leg supports are adjusted in length according to your lower leg measurements.

It is always a good practice to use a scribe and precision measuring ruler to first mark the points where the holes and cuts will be. Any drilled holes should be further marked with a center punch to prevent the drill bit from moving away from the desired hole.



Scribe marking



Center punch marking

If you have access to a drill press, I would recommend using it for the holes in order to get them perfectly aligned. A hand drill will work but be sure to take care in drilling straight holes.

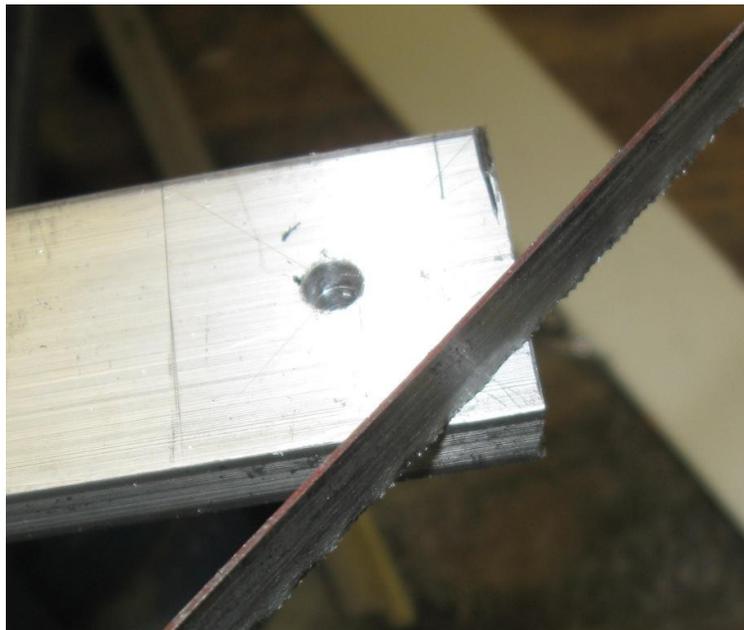
The mounting holes are drilled first with a 1/4 inch drill bit then drill about 1/4 of an inch deep from the inside with a 19/64 drill bit. This enlarging of the hole is to create a snug fit with the support plastic as the Tee Nut will extend through the Sintra material. Drill all of the way through with the 19/64 bit will create a loose fit for the support bolts and may result in a weak point so therefore it is not recommended.



19/64 inch secondary drill

The knee joint is created by cutting some of the aluminum away with a hack saw. You can overlap the material and not cut it out but this can create chafing point on your knee. The cut out method places the center of the joint in the center of the material.

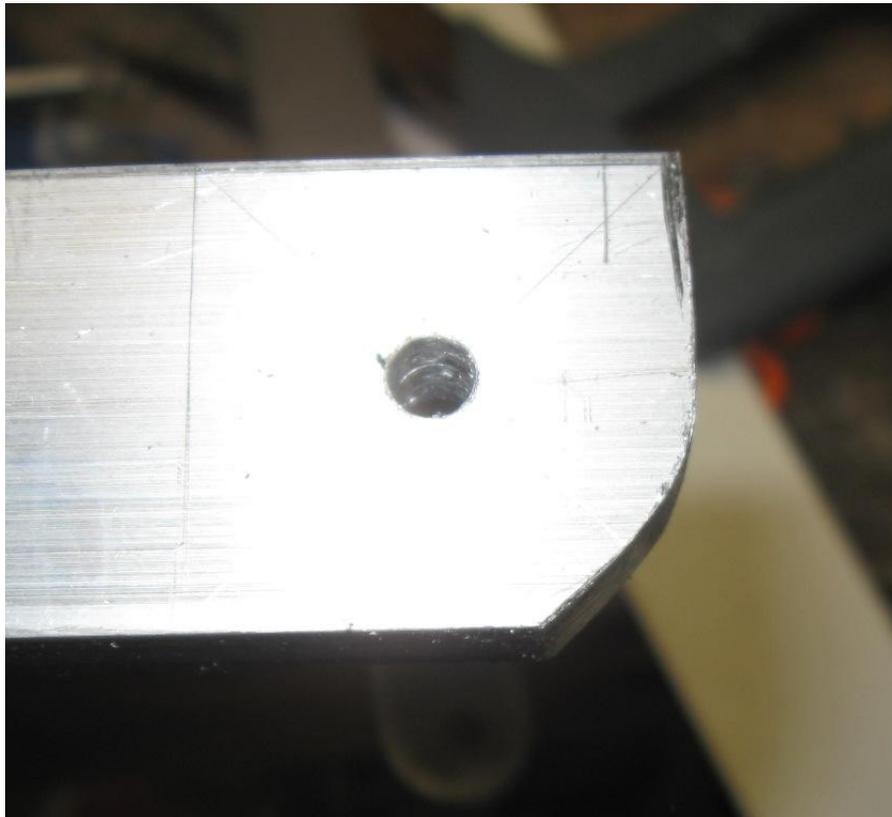
You will need to remove an area measuring 1/4 inch thick by 1.25 inches long then trimming one corner of the cut area as shown in the drawing. The trimming is accomplished by cutting with a hack saw and using the bastard file to make a nice round radius curve.



Cutting radius



Radius cut before filing



Partial filing on top edge, complete the entire curve



Cutting knee joint 1/4 inch thick



Finishing the cut on the knee joint

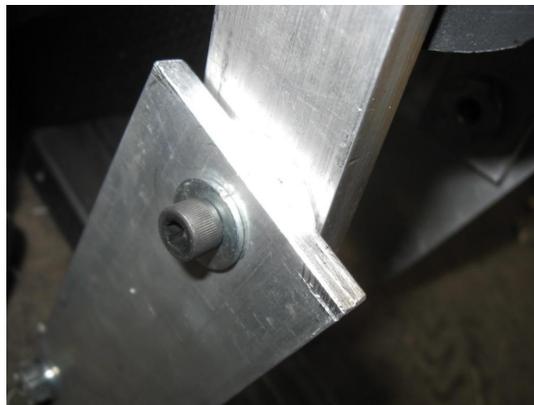


Rough knee joint before filing

The lower leg support knee joint is created in the exact manner as the thigh support pieces. Prepare those pieces now as shown in the drawings.

The length of the lower leg supports is the length of your lower leg as measured plus 1.25 inches for the joints. The support holes are to be placed by measuring from the knee joint and are placed 7.5 inches apart. Again they will be drilled first with the 1/4 inch drill bit then drilled 1/4 of an inch through from the side which faces the leg with the 19/64 drill bit.

The bottom hole is for the ankle joint. This joint is a simple overlap construction due to the slight difference in the angles of the leg support and the ankle support which you will be making next. This part is needed in order to place the pivot point at your ankle. This will reduce fatigue and greatly increase comfort when wearing the stilts.



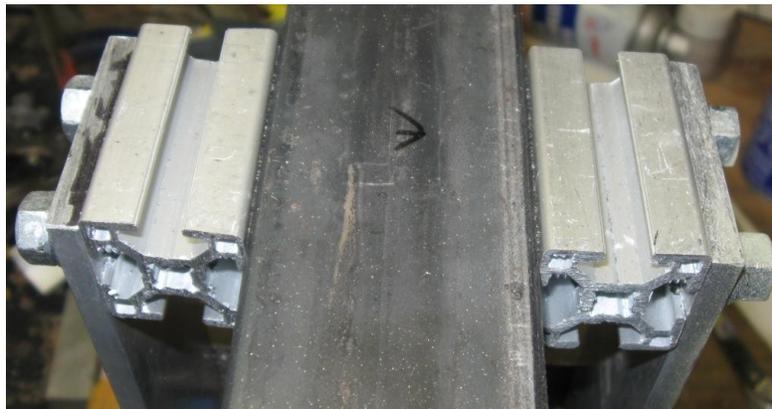
Overlap Joint Details

The ankle support is made from 1/4 inch by 2 inch aluminum bar stock. You will need 4 of these. There is only one drawing since all 4 are the same. The holes are all drilled as shown with no over drilling needed. The total length of the piece will depend upon the height of your ankle joint as you measured previously plus 1.5 inches. See the drawing for the details.



Ankle support details on finished stilt

You will need to make 4 support blocks from the 1 by 2 inch aluminum bar stock. These are all the same and need to have 2 holes drilled as shown in the drawings. It is critical to have the holes straight as this will affect alignment and make assembly difficult if they are not. Again refer to the drawings for exact dimensions. These blocks control the width of the ankle support and will not need to be adjusted any smaller. If you have wide ankles you may need to make the blocks a little wider in the same direction as the drilled holes. See the drawing for the details.



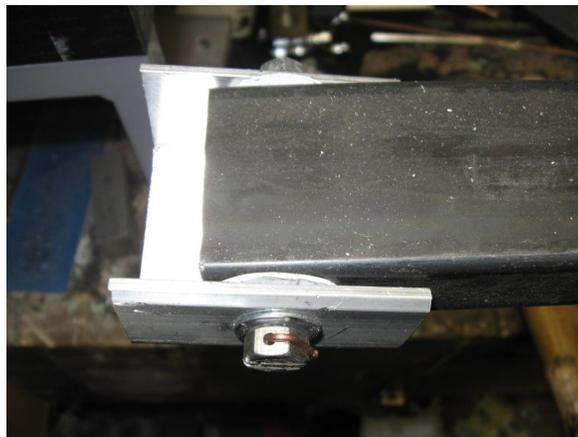
Ankle support details Blocks (yours will be solid).

The foot piece is made from the 1 X 2 X 1/16 inch steel tubing. This material will undergo the most stress of any piece in the stilt. The total length shown here is the lower leg measurement plus 4 inches. This give a proportional look but you can adjust it depending upon your tastes. Just keep in mind the longer it is the more stress is placed on your upper thigh and the taller you will be. There is a limit to the length you can use in this configuration but it varies upon each individual. See the drawing for the details.



Completed stilts

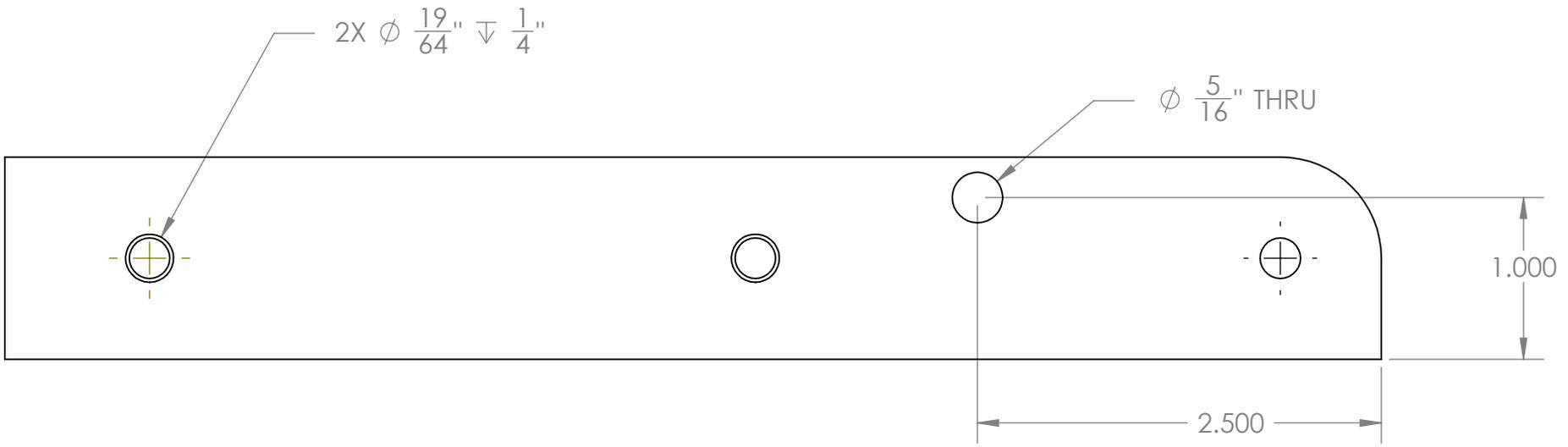
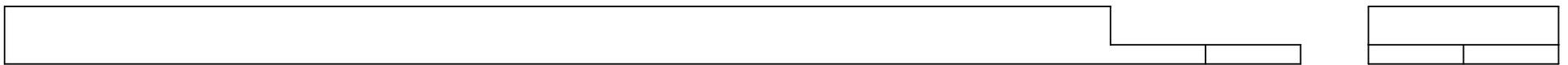
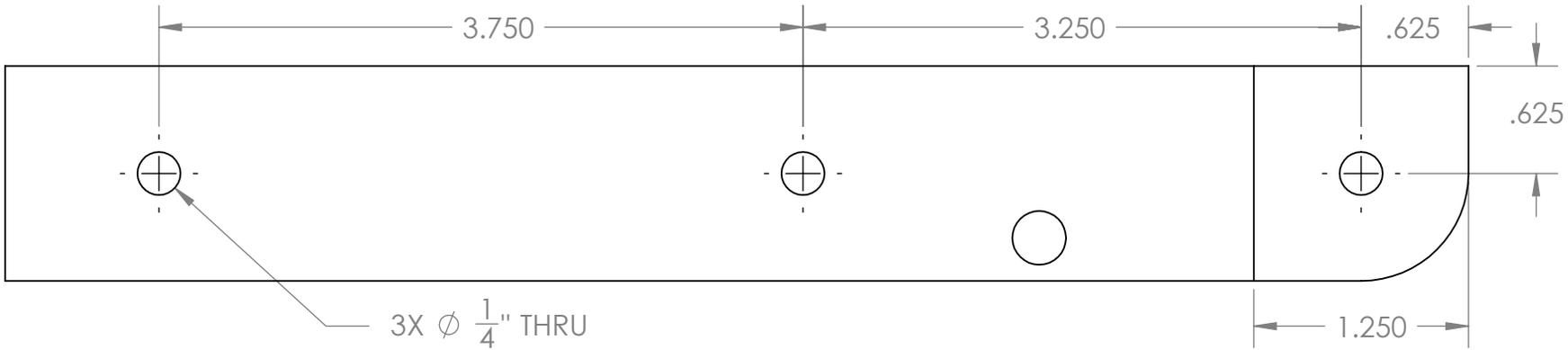
The foot is a single cut from an aluminum C-Channel that is 2.5 inches long. The foot is designed to pivot on every movement and as such will require a great deal of balance control. If you desire you can tighten the foot bolt and make the foot almost rigid using the 5/16 through bolt. This will allow you to balance with less effort. The foot is a relatively small profile which can have any number of materials attached to it to provide a larger foot surface.



Foot attached to foot support

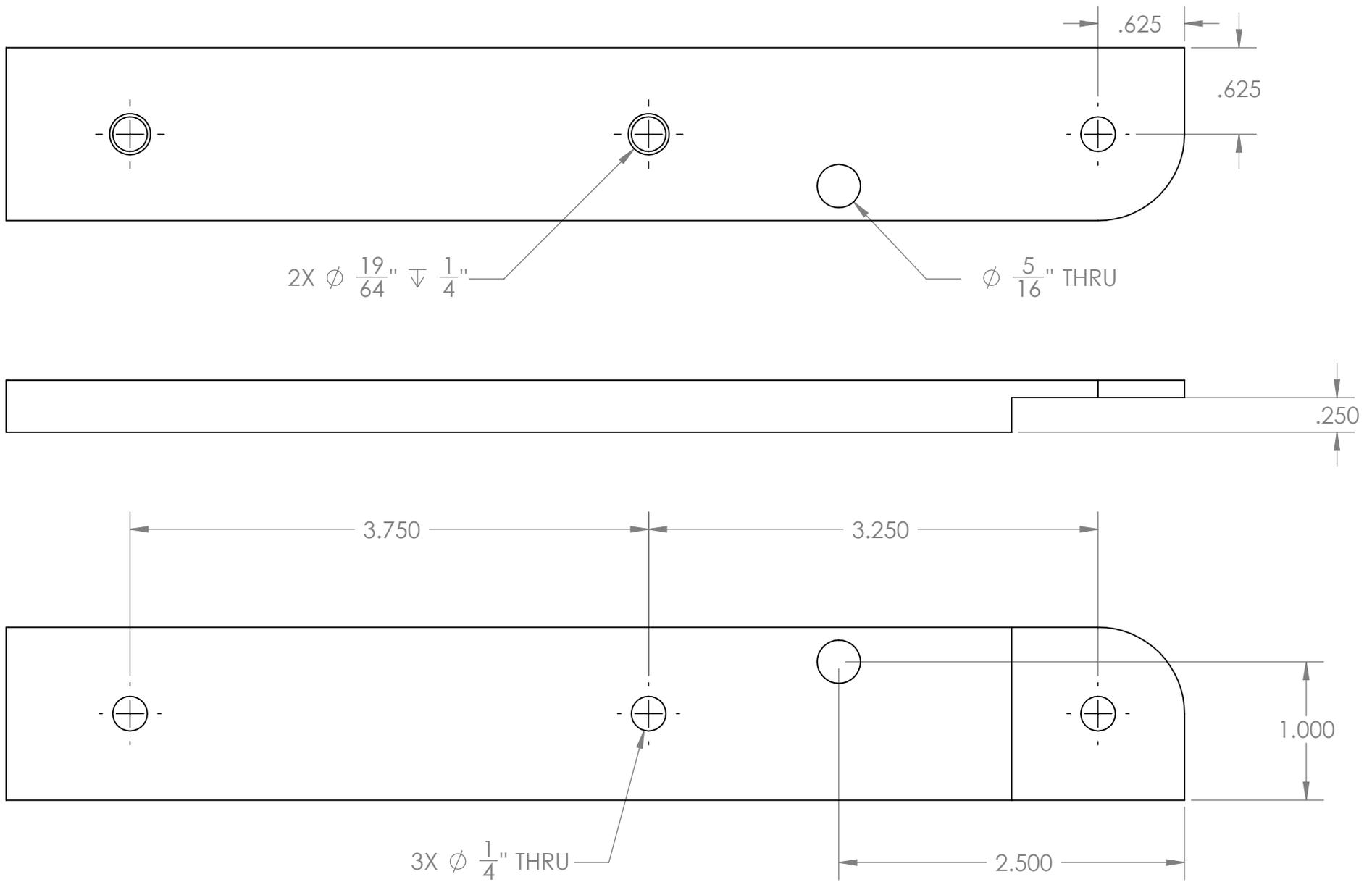
Drawings

Thigh Supports
Lower Leg Supports
Ankle supports
Ankle Support Blocks
Toe Cups
Foot Supports
Foot



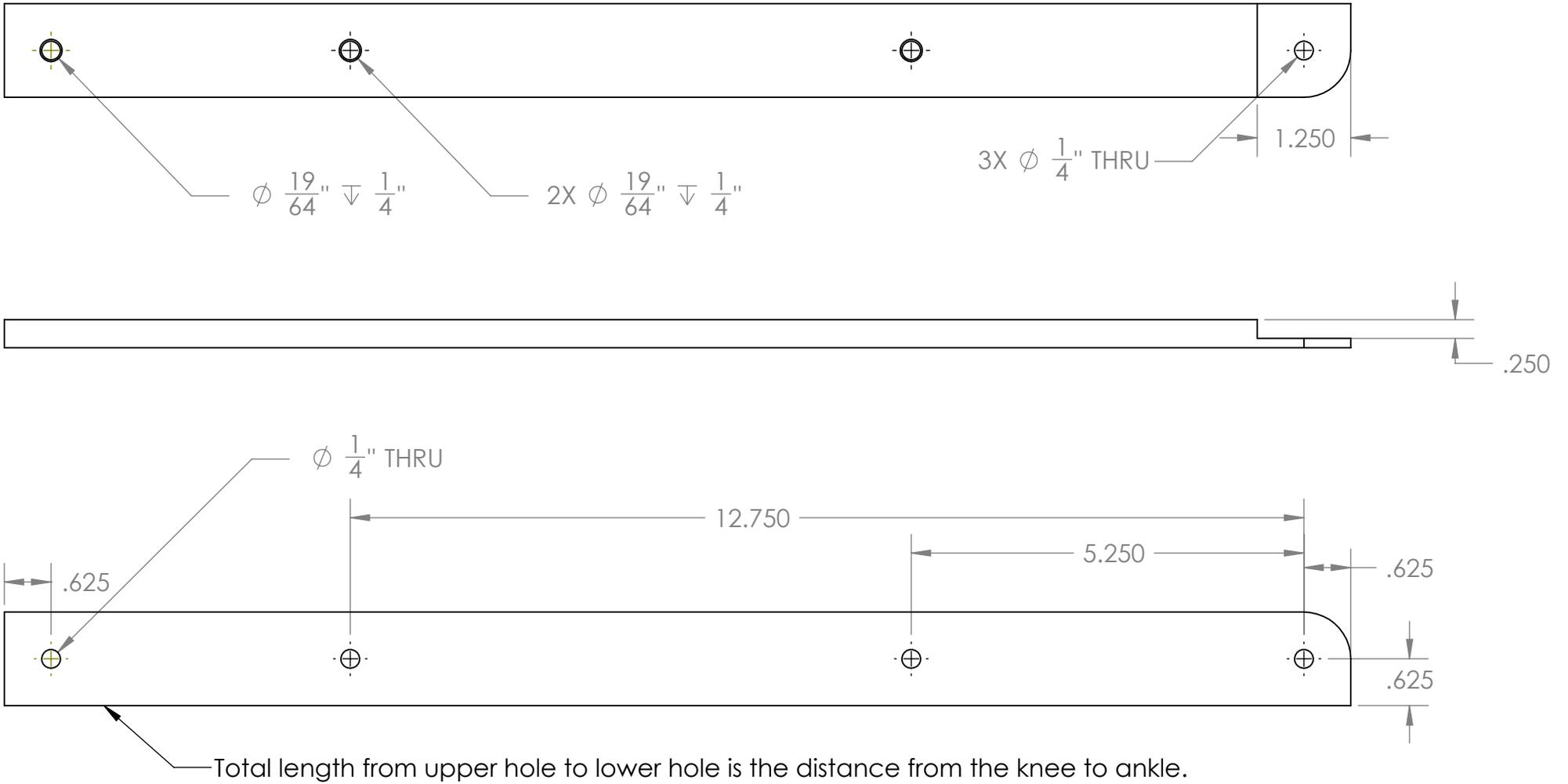
Right Side of Thigh Support
Need 2 Total

MATERIAL : 3/8 by 1.25 aluminum bar stock



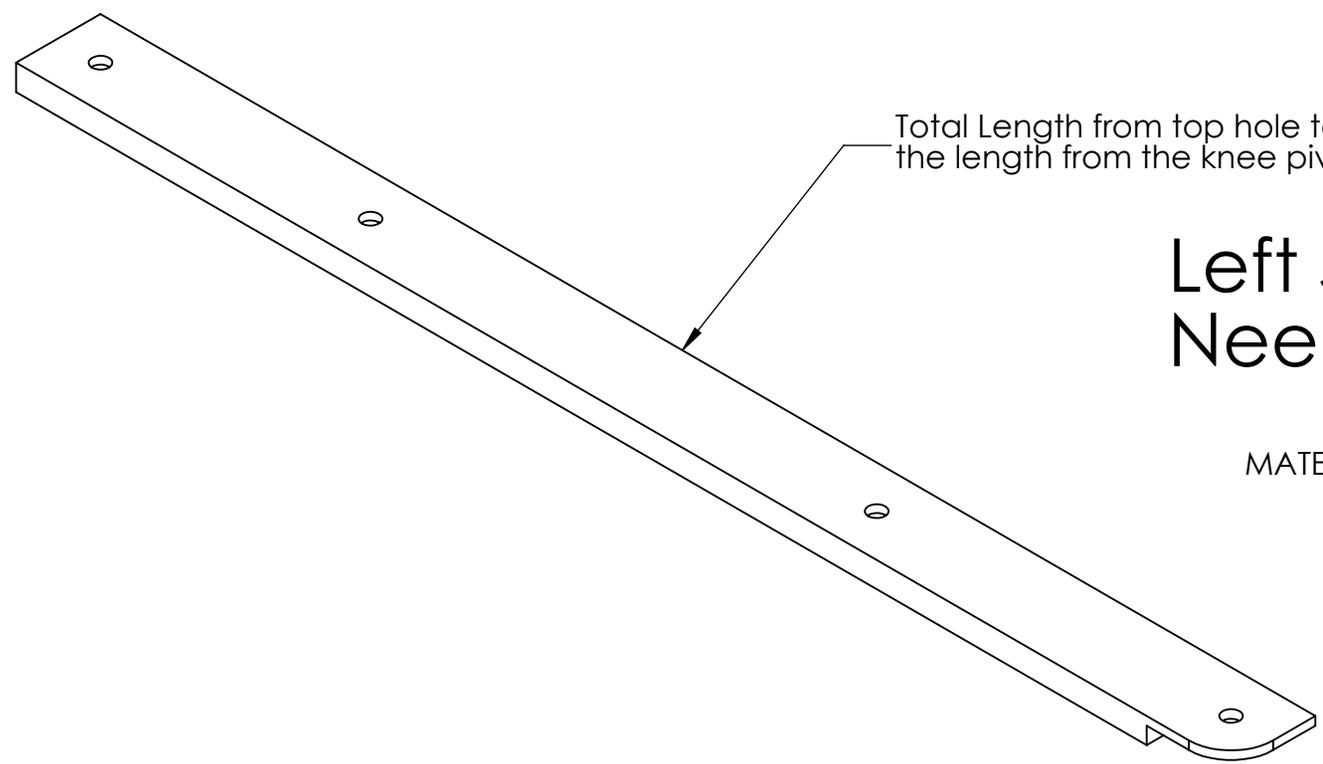
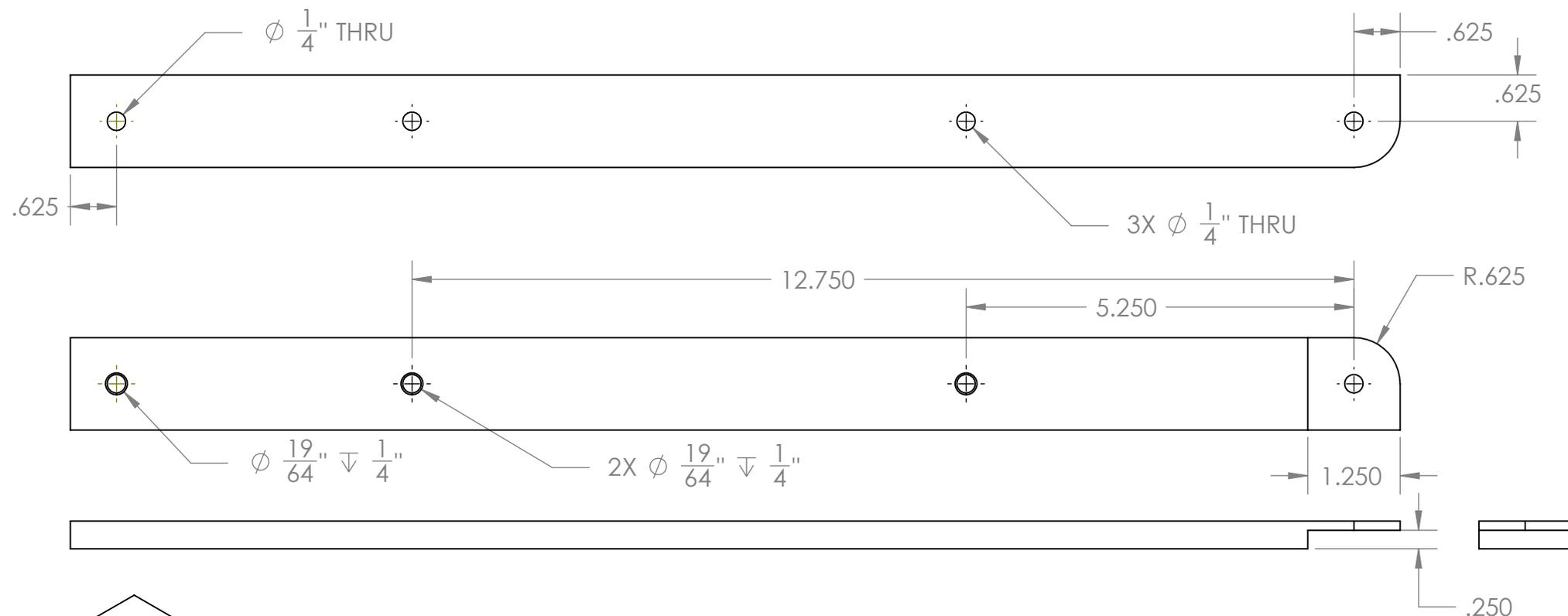
Left Side of Thigh Support
Need 2 Total

MATERIAL : 3/8 by 1.25 Aluminum Bar Stock



Right Side of Lower Leg Support
Need 2 Total

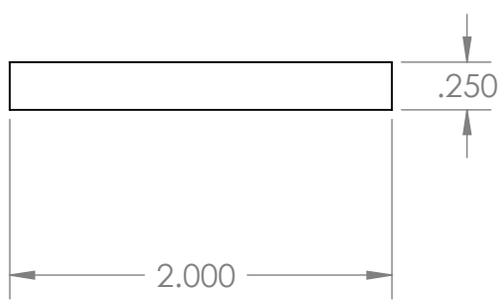
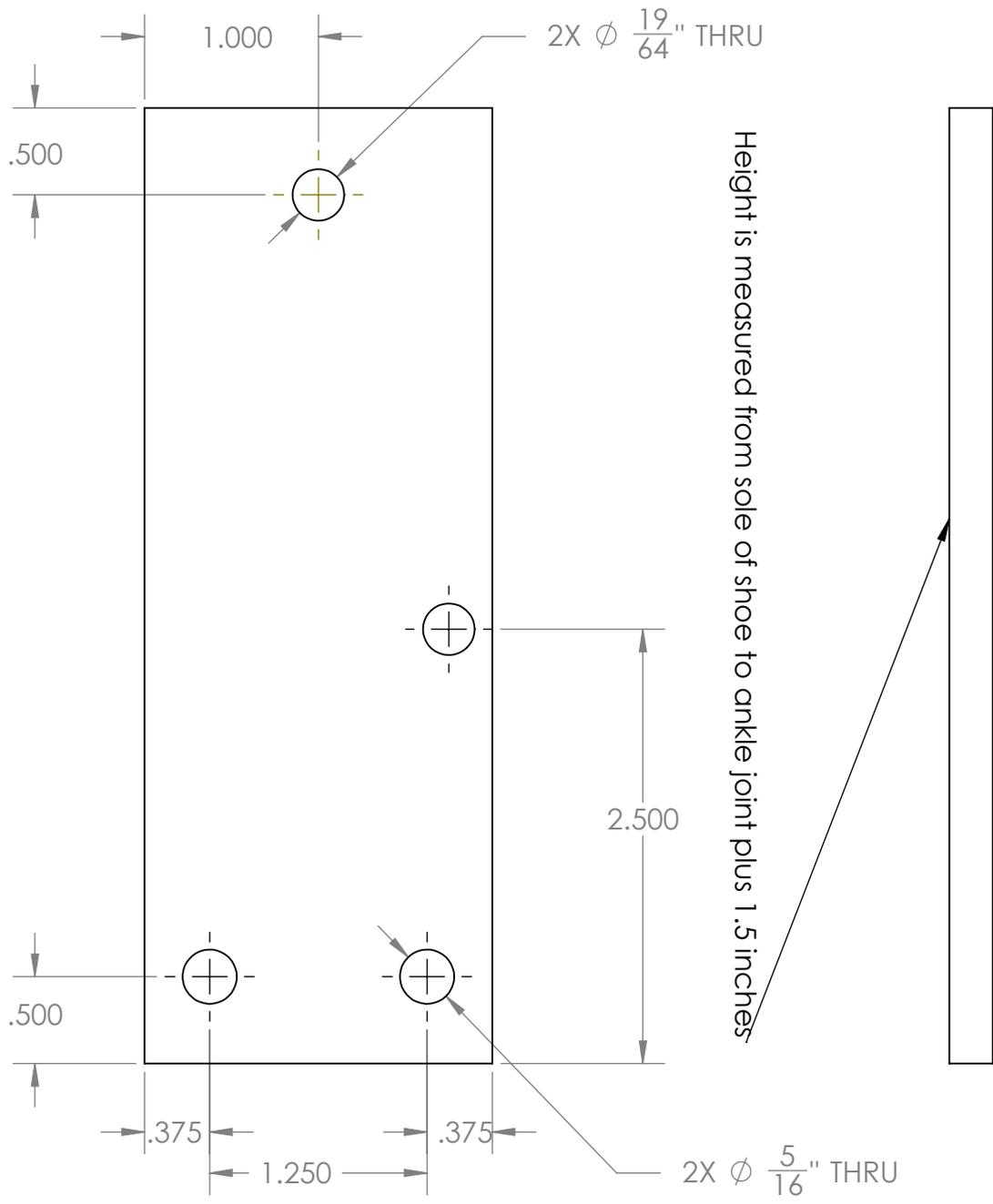
MATERIAL : 3/8 X 1.25 inch aluminum bar stock



Total Length from top hole to bottom hole is the length from the knee pivot to ankle joint.

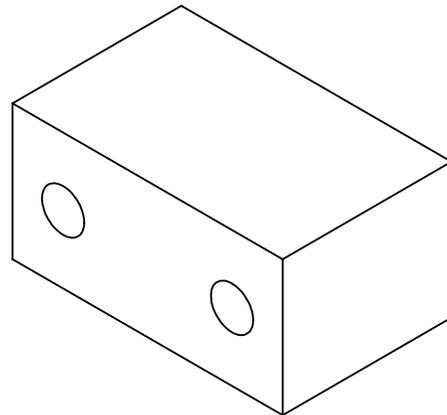
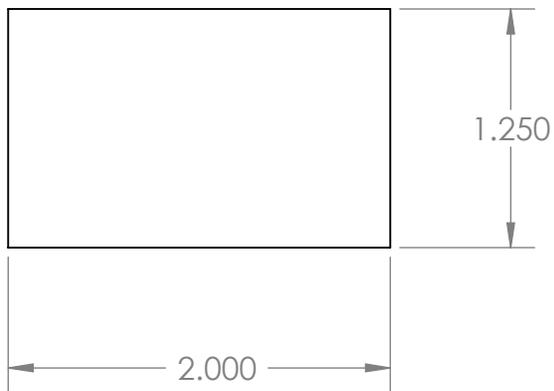
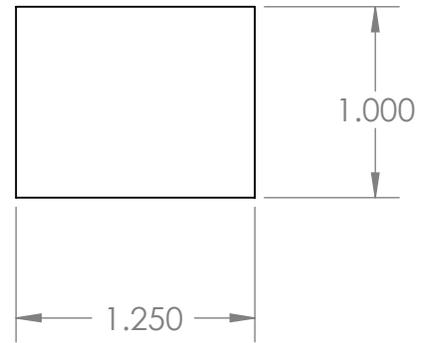
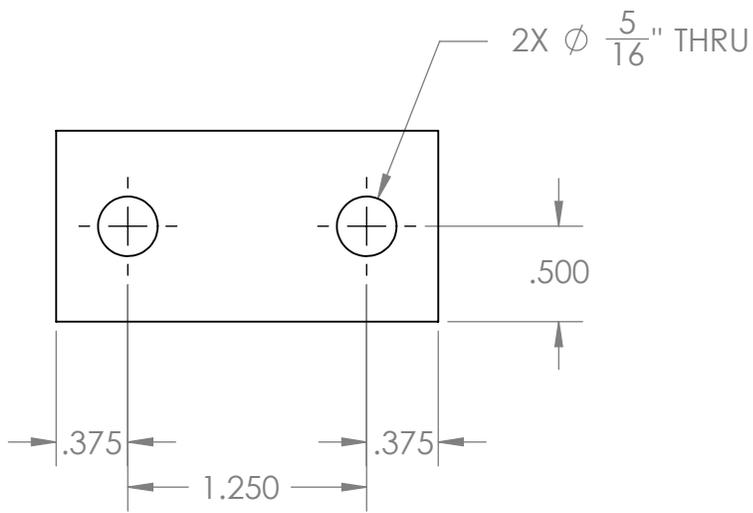
Left Side of Lower Leg Need 2 Total

MATERIAL : 3/8 X 1.25 inch aluminum bar stock



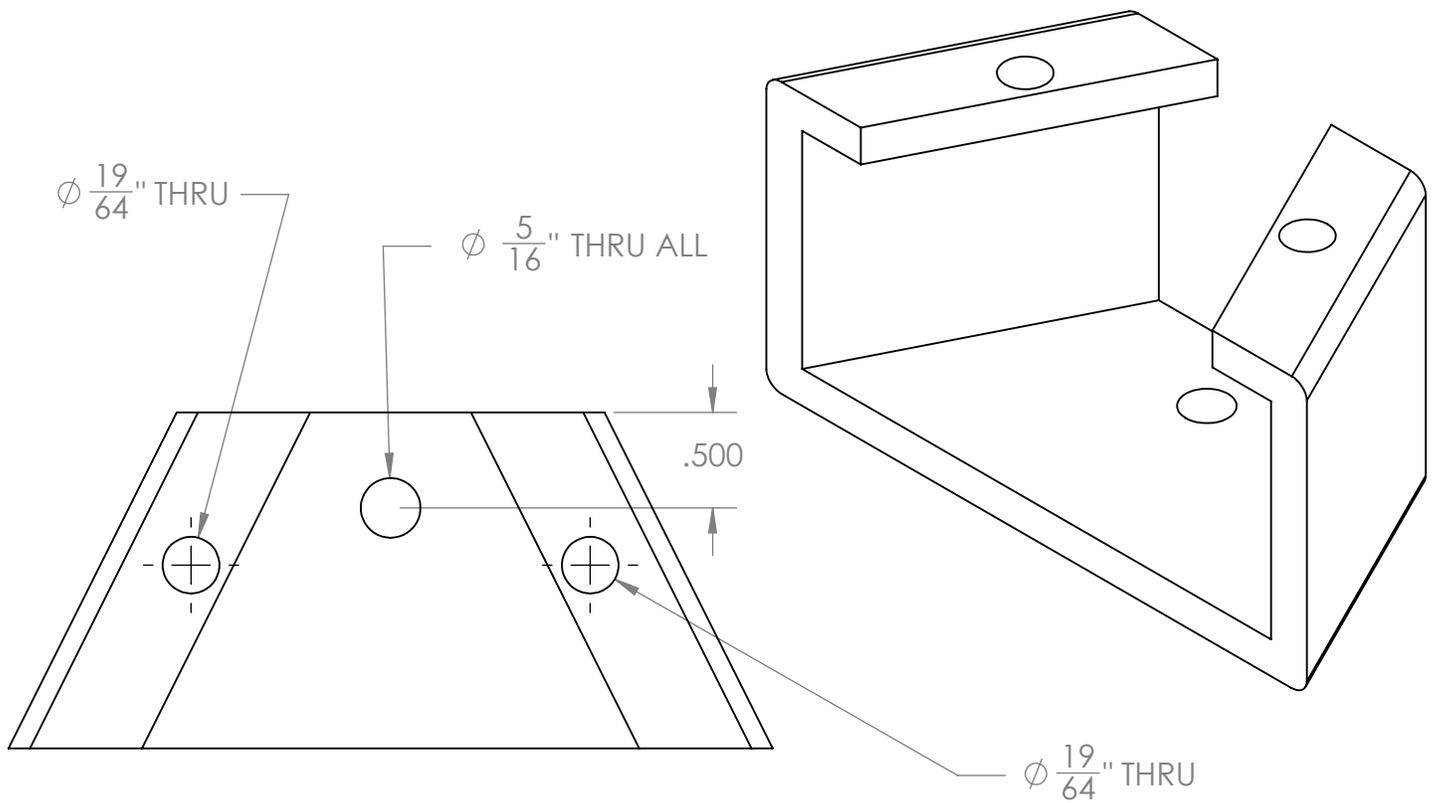
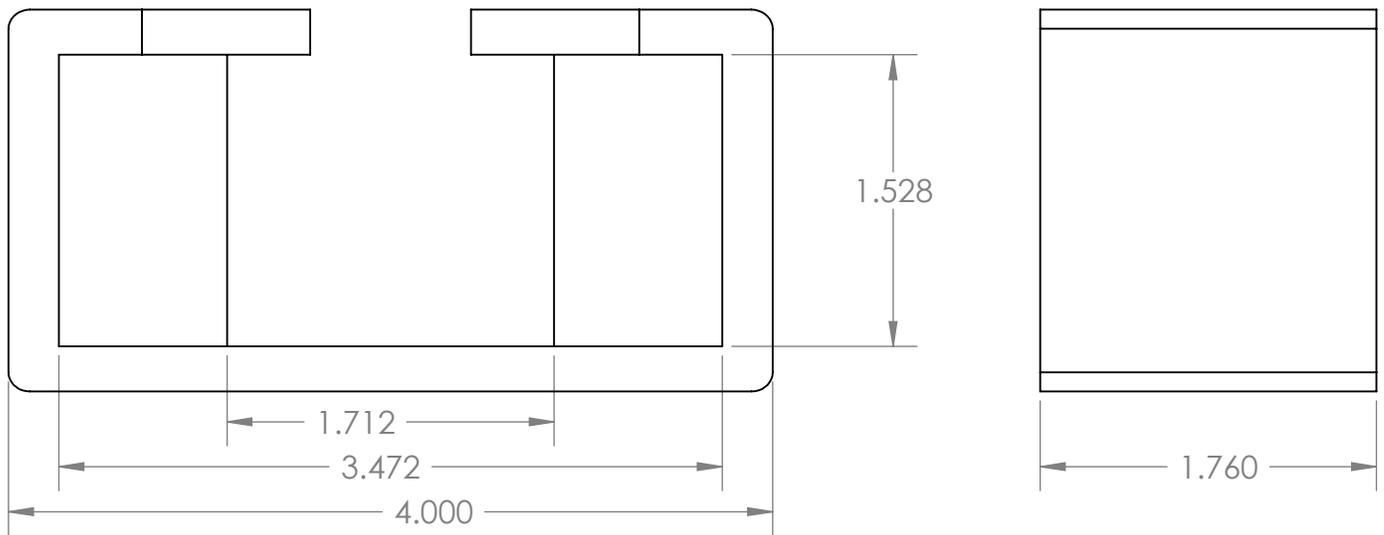
**Ankle Support
Need 4 total**

MATERIAL: Aluminum bar stock



Ankle Support Block Need 4 Total

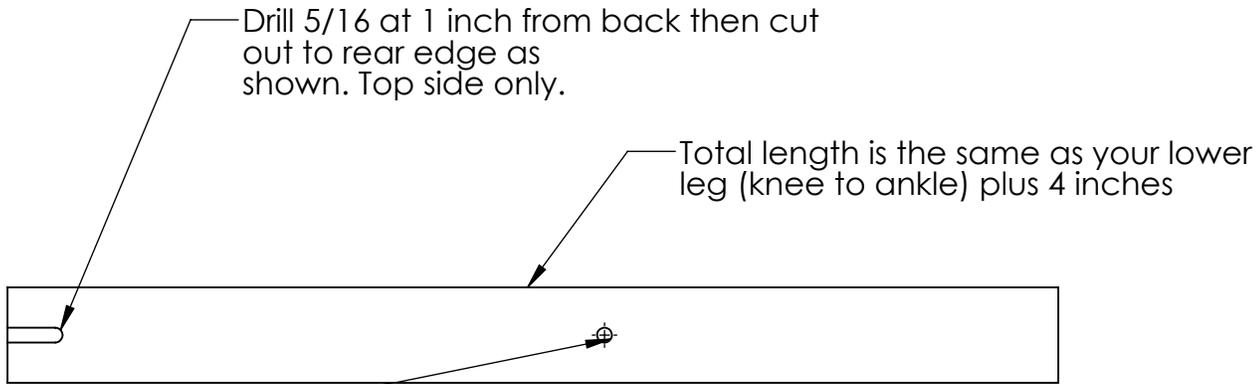
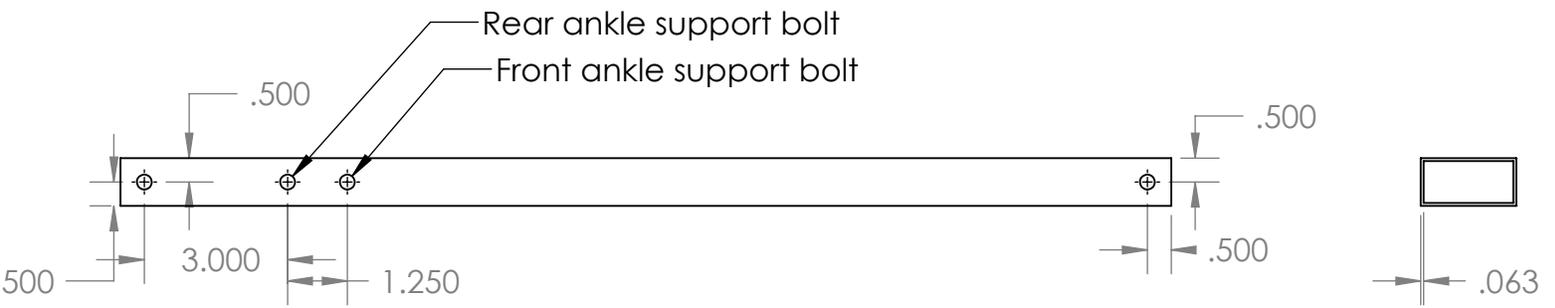
MATERIAL : Aluminum Bar Stock



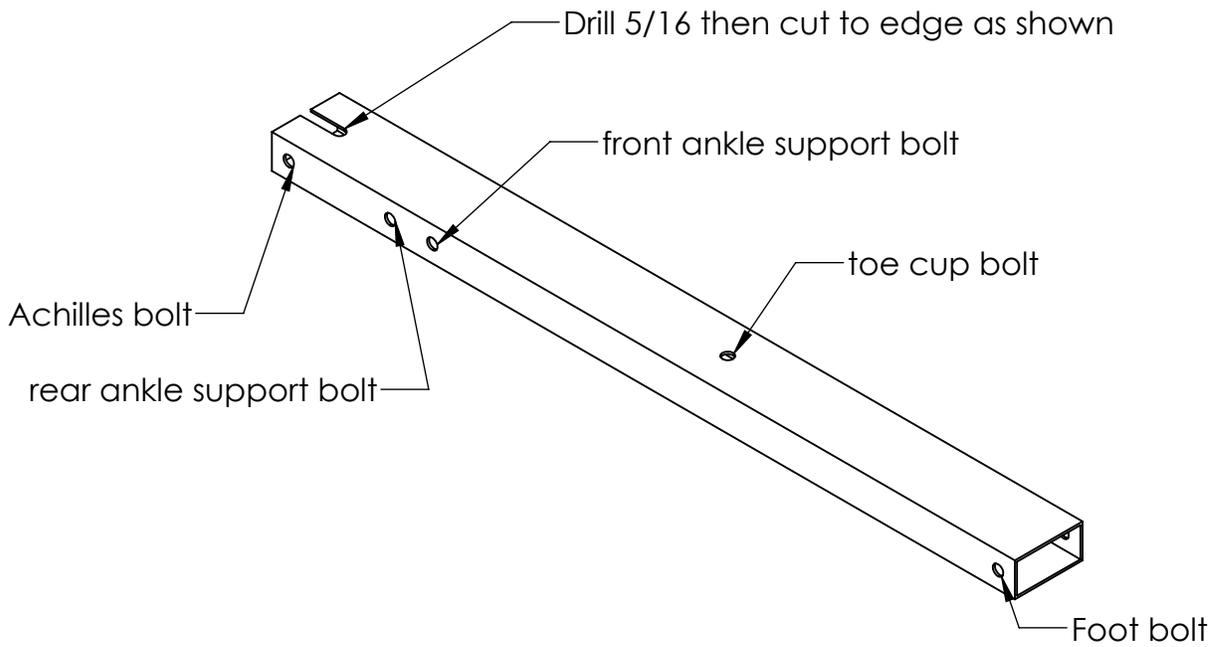
The width dimensions will have to be adjusted according to the the size and type of shoe that you plan on wearing. The dimensions shown were fro a US size 10 runner.

Toe Cup Need 2 Total

MATERIAL : 6mm Sintra Plastic

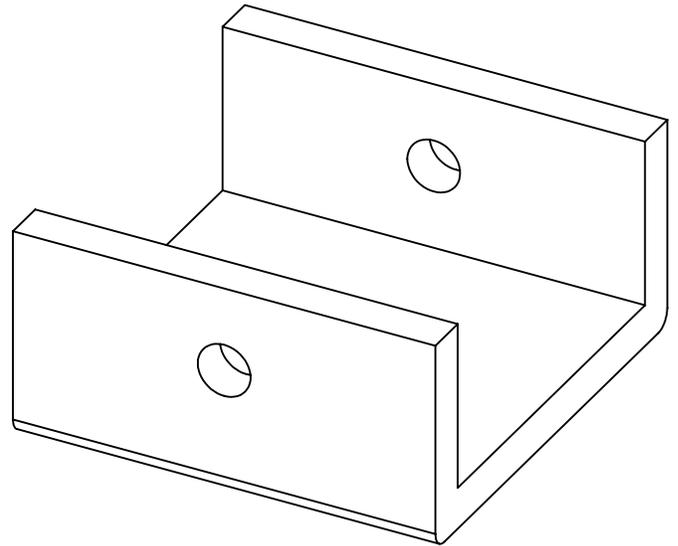
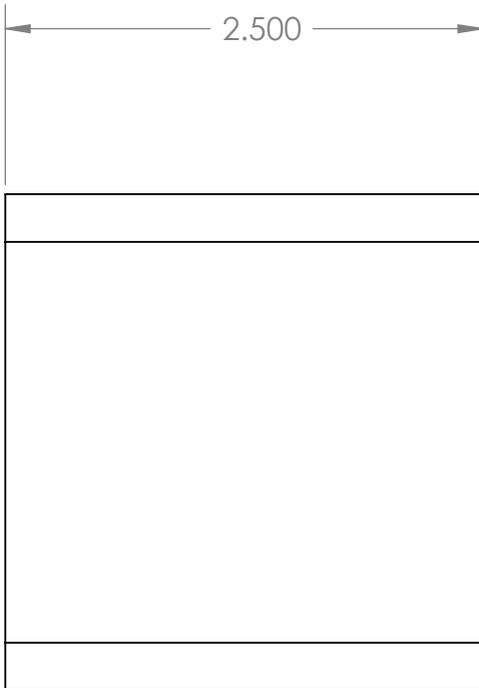
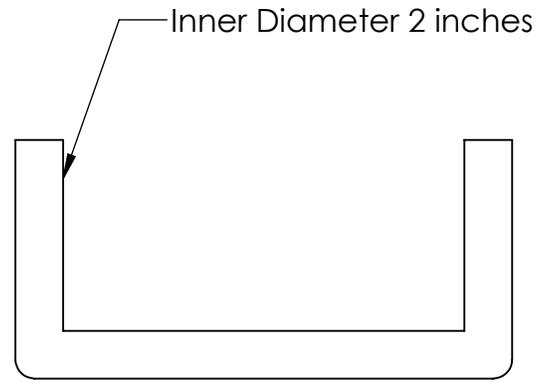
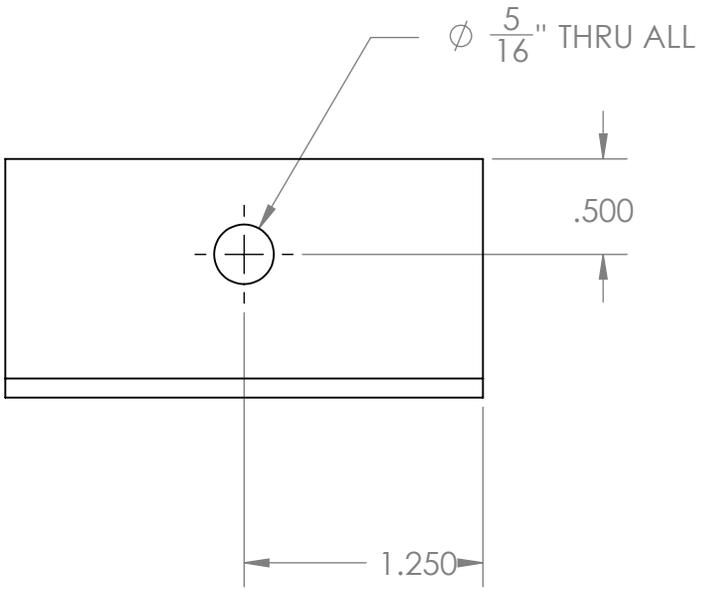


Set ankle pivot between 2 rear support holes then place shoe and snug toe cup to center of toe cup support. A size 10 is at 7.75 inches to the center of the front ankle support bolt. Your ankle must be between the 2 rear ankle support bolts.



Foot Base Need 2 Total

MATERIAL : 1/16 inch by 1 inch by 2 inch steel tube



Foot Pad
Need 2 Total

MATERIAL : Aluminum U-Channel

Templates

Thigh Brace

Calf Brace

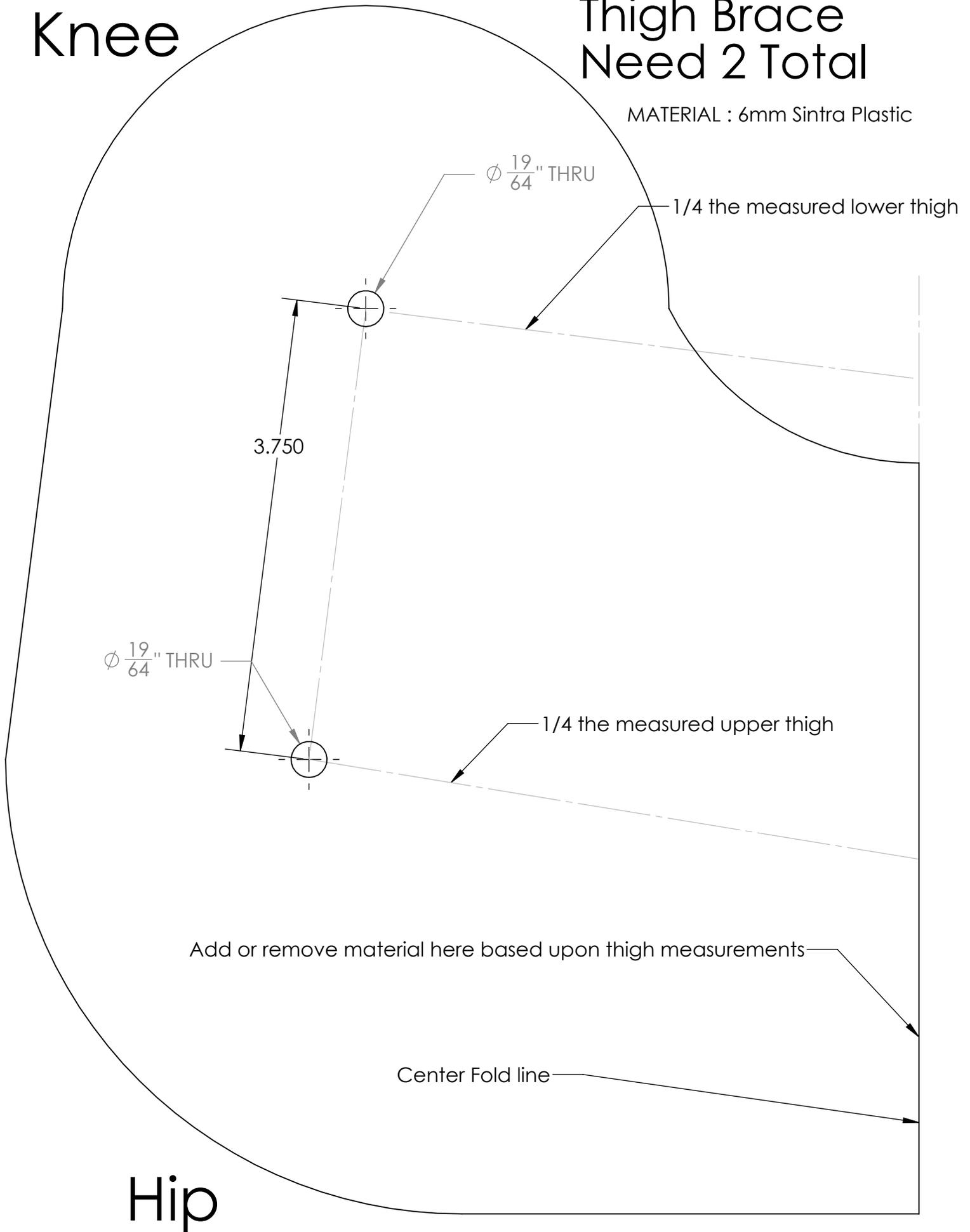
Important Note:

**Print the Templates at 100%
Do Not Shrink to Fit Page.**

Knee

Thigh Brace Need 2 Total

MATERIAL : 6mm Sintra Plastic



$\phi \frac{19}{64}$ " THRU

$\frac{1}{4}$ the measured lower thigh

3.750

$\phi \frac{19}{64}$ " THRU

$\frac{1}{4}$ the measured upper thigh

Add or remove material here based upon thigh measurements

Center Fold line

Hip

Knee

Distance from this hole to the center fold line is 1/4 your upper calf measurement

Center fold line

Add or remove at this point according to your measurements

Measure along this line

$\phi \frac{19}{64}$ " THRU

7.500

$\phi \frac{19}{64}$ " THRU

Distance from this hole to the center fold line is 1/4 your lower calf measurement

Calf Brace Need 2 Total

MATERIAL : 6mm Sintra Plastic

Measure along this line

Ankle

