

Congratulations on your purchase of the Warwolf Trebuchet PLANS!

We hope you enjoy building and shooting it as much as we've enjoyed creating it. So good luck, and have fun!



Hardware :

1 swath of burlap 6" x 8"
15 feet of light rope (1/4" or less)
1 dowel 1/2" x 2"
5 steel rings,
3/4" inside diameter
(part #3769T41 at
www.mcmaster.com)

30 5/16" dowels 2 1/2" long
4 3/16" dowels 1 1/4" long
4 3/8" wood plugs (optional)
1 welded steel ring,
1" inside diameter
(part #3769T42 at
www.mcmaster.com)

4 wood screws 1" long
20 small nails
16 wood screws 1-5/8" long
1 trigger (We use the
Seadog 4" bronze pelican hook
in these plans- search for
"bronze pelican hook" on
google.com. Or, you can use
anything that works as a quick
release under tension.)

Wooden parts (see drawings):

2 base beams 34" long
4 base cross-braces 11 1/4" long
1 base cross beam 31-1/4" long
2 outrigger braces 21 1/2" long, tip-to-tip
2 side beams 14" long
4 A-frame legs, 32" long
2 vertical beams, 29 1/2" long
1 plywood base plate
2 plywood bucket sides (12" x 6")
2 plywood bucket sides (6 sided)
2 CW bucket end plates 9" x 5"
1 CW bucket bottom plate 10 1/2" x 5"

1 trough board 34" long
4 axle block mount plates 6 1/2" long" with four holes
2 axle block plates 6 1/2" long, grooved, with two holes
2 axle block plates 6 1/2" long, grooved, with four holes
1 small block.
1 main axle dowel 3/4" x 11 1/2"
1 counterweight axle dowel 3/4" x 6 1/8"
1 main arm beam 35" long
2 short arm beams 23 1/2" long with two big holes
2 arm plates 23 1/2" long tip-to-tip
2 arm spacers 3 1/4" long tip-to-tip
2 counterweight hangers 15" x 2 3/8" with a big hole

Tools you will need:

1. A table saw
2. A drill press
3. A miter or chop saw
4. A Phillips-head screwdriver (#2 size will work for all screws)
5. Two or four clamps capable of spanning 6" (Craftsman's mini bar clamps work great)
6. A carpenter's square, or any good 90 degree reference.
7. Scissors , and 8. A light hammer

NOTES ON SAFETY AND WORKING WITH WOOD:

Thank you for purchasing the Warwolf Trebuchet plans!

Please read this important notice before you begin.

Wood is a funny material. It's a product of nature, and as such, it can be a little bit unpredictable. Experienced carpenters say you never know how strong a piece of wood is until it breaks. **We agree.**

We strongly advise that you use a good, strong wood for this kit. Be sure to look for any defects in the wood, such as: knots, checks, cracks, worm-holes or evidence of other wood-boring insects, water damage, etc. **DO NOT USE** any pieces that have any defects, **ESPECIALLY THE ARM!** Make a new piece instead. Also, it's important to be aware that a piece of wood can look perfectly fine and apparently free from defects, but can still have faults such as internal stresses, voids and fractures that cannot be seen on its surface.

Ultimately, you are building this model **AT YOUR OWN RISK**. If you are not qualified to use the tools required, nor to select appropriate pieces of wood to use, we recommend you seek out qualified professional help- an experienced carpenter, cabinetmaker, mechanical engineer or other suitable expert.

We have taken every reasonable precaution in designing this kit, but we cannot be responsible for your choices in wood, how you make the pieces, how you assemble the kit, or how you use it.

While we've never had a problem with the kits we've made, we cannot make the same assurance with one that you might make.

By building a model based on these plans, you agree that you are doing so at your own risk, and that you will not hold RLT Industries or any of its employees or principles liable for any damages or injuries that may occur as a result of the construction or use of this model.

Please be thoughtful and cautious as you proceed. Thank you, and have a wonderful day!

-- Ron L. Toms.

NOTES ON SCALING:

A lot of people make bad mistakes when trying to scale a model to different sizes.

1. Length

This is the easy one. If you have a measurement four feet long, and you want to double it's size (increase its scale a factor of two) then it will be eight feet long. A one foot measurement, scaled up three times, will be three feet long. Scaling a 4 foot measurement to $\frac{1}{4}$ scale will make it one foot long. And so on...

But what a lot of people forget is that they have to scale it in all three dimensions. So, if you have a board that is 2 inches by 4 inches by 8 feet long, and you want it half scale, then you have to cut it to 1 inch by 2 inches by 4 feet. I've seen a lot of people just cut a 2x4 in half and think they are done. If you're doubling the scale of your board, you can't just get a 16 foot 2x4 either. You need a 16 foot board that is 4 inches thick by 8 inches wide, and those are hard to find....

2. Mass / weight

This one loses a lot of people, so try to keep up- First of all, mass and weight are not the same thing. But they scale similarly, so don't worry about it. Mass and weight DO NOT scale the same as length though! Too many people make the mistake that if they double the length, then all the weights double too. No so.

Think about a cube that is one foot by one foot by one foot in length on each side. Its total volume is one cubic foot. Now let's double its scale to 2 feet by 2 feet by 2 feet. Now its volume is $2 \times 2 \times 2$, or 8 cubic feet. So, what's obvious here is that the length doubled, but the volume increased by a factor of eight!

If we tripled it, to 3 feet by 3 feet by 3 feet, then it's volume would be $3 \times 3 \times 3 = 27$ cubic feet! Now the volume is 27 times as much even though the length only went up three times! Volume is how we figure weight. What's the weight per cubic foot of something, times the number of cubic feet you have = the weight of the whole thing.

Mass (or weight) scales as the cube of the length. So, if you want to quadruple (four times) the size of a machine, then its weight needs to increase by $(4 \times 4 = 16, 16 \times 4 = 64 !!!)$ 4 cubed = 64 times as much counterweight on a trebuchet. Scale it up five times, and the weight goes up 125 times. Obviously, your machine is going to have to be a lot stronger!

3. Strength

Here's where people get into real and serious trouble. When you scale a machine up, say four times, the weight of each member will go up sixty-four times!! The properties of the material (shear strength, bending resistance, etc.) haven't changed, and the beam has to

support its own weight in addition to the increased weight of any other members that it supports. The result is that the total strength of the machine gets proportionally weaker as the scale goes up.

Strength scales as a smaller-than-one fraction of the length.

Examples: Fractions smaller than one: $\frac{1}{2}$, $\frac{1}{4}$, $\frac{2}{3}$...

Fractions larger than one: $\frac{3}{2}$, $\frac{16}{12}$, $\frac{4}{3}$...

The problem is, we don't know what fraction to use unless we know the specific properties of the material how it's being used. Things like compression, tension, flex, shear, and tear can all scale very differently even in the same material.

What does this mean? Basically, when you scale things up, they become relatively weaker. They have more trouble supporting their own weight, and the weight of everything else it supports is also increasing cubically, so at some point you have to change the design, or use materials that are inherently stronger to begin with, and keep their limits in mind too.

4. Non-scalables.

There are things that you can't scale, like gravity. Unless you're willing to go to the Moon or Mars, etc.

Friction is a product of the frictional coefficient (non-scaleable), times surface area (scales as the square of the length), times pressure (uh...). Too complicated for this document. Density doesn't scale. So, air resistance (a product of air density and cross sectional area and velocity) isn't easy to scale either. All these things can affect performance, so if you have a trebuchet that hurls 200 feet, and you double the scale (with eight times the counterweight), don't expect it to hurl 400 feet (unless your projectile is considerably less than 8x the weight). Try to figure out more scaling problems on your own. This is a great project for experimentation!

Good luck, be careful, and have fun!

Assembly Instructions:

1. The Frame

Start with the long base beam and the two cross braces with the holes in the ends. Put the long pieces on top of the short pieces to make a rectangle, then insert a 2 1/2" dowel into the holes to secure it (Figure 1). Slide the long 30 1/4" crossbeam under the base beams in the center, and the other two short crossbeams under the holes (on the sides) of the base beams. We'll attach these pieces later (Figure 2).

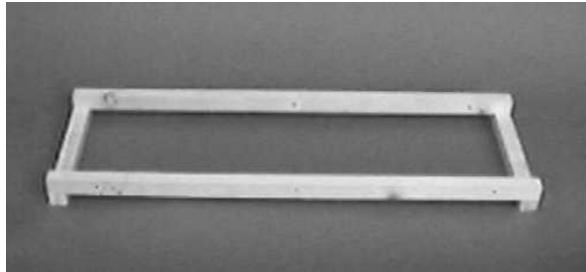


Fig. 1

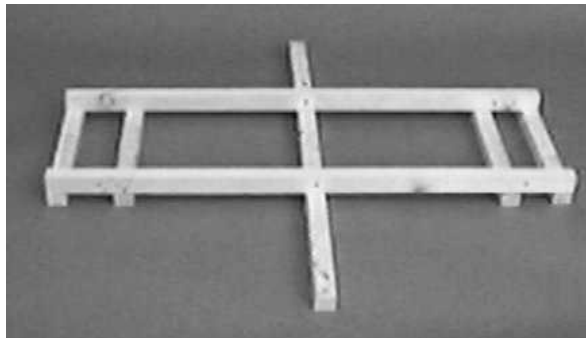


Fig. 2

On one side, get a vertical beam and set it to the inside of one of the base beams, on top of the crossbeam. The two holes in the middle of the beam should be near to the top. Attach it to the base with a dowel. Make an 'A' frame with two of the A-frame beams and attach them to the base beam with dowels (they should be resting on top of the crossbeams, and again, the middle hole should be near the top- Fig. 3). Use an axle block mount plate (with three holes) to hold the top of the 'A' frame together (Fig. 4). Attach it with the 2 1/2" dowel pins and some wood glue on the inside surfaces. It will seem loose right now. Do the next step before the glue sets!

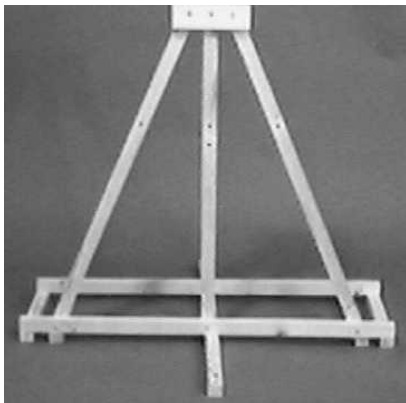


Fig. 3

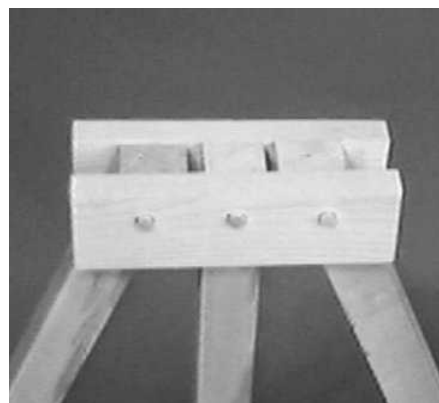


Fig. 4



Fig. 5a



Fig. 5b

Put the axle block plate with 4 holes on top of the struts so that it's flush with the ends of the mount plate as shown in Fig. 5a. Do the same to the other side so you have two 'A' frame assemblies. Use the axle dowel to insure that the slots are lined up straight and level (fig. 5b), and screw the blocks into the frame. Now clamp the mount plates so the glue can set properly. This will make the top of your frame strong.

Attach the outrigger beams to the 'A' frame, then the side beams. The side beams must go on the outside of the frame. It's ok if the holes don't line up exactly. Just twist or warp the beam enough to get the dowels in. This will actually make the dowels hold better. You may need to glue the side beams in place if the dowel pins are not tight enough (Fig. 7).

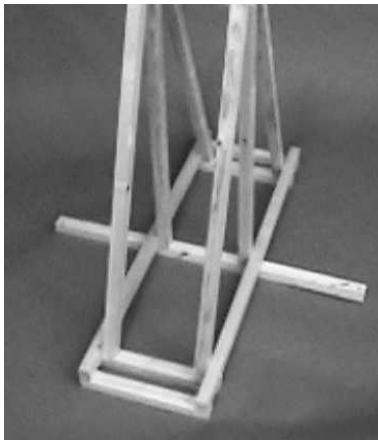


Fig. 6

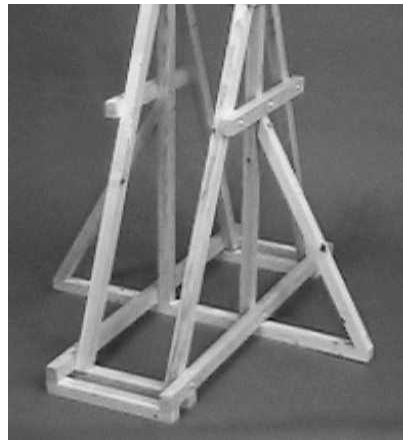


Fig. 7

Carefully turn the frame upside down. Align the cross beams with the vertical beams and drive gold screws into the holes in the crossbeams. Make sure the base is square (90 degrees) with the cross beam (Fig. 8), and attach the plywood base plate to the bottom of the base beams using the 4 black screws (Fig. 9).

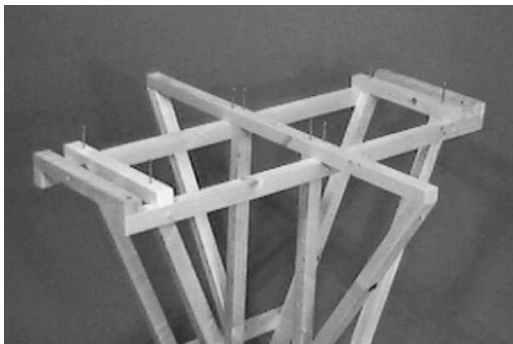


Fig. 8

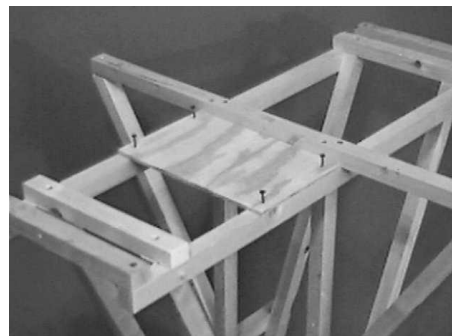


fig. 9

Turn the frame right side up again, and place the trough board onto the frame (Fig. 10). Don't glue it down. It can be shifted to one side or the other as a crude aiming technique (Fig 11).

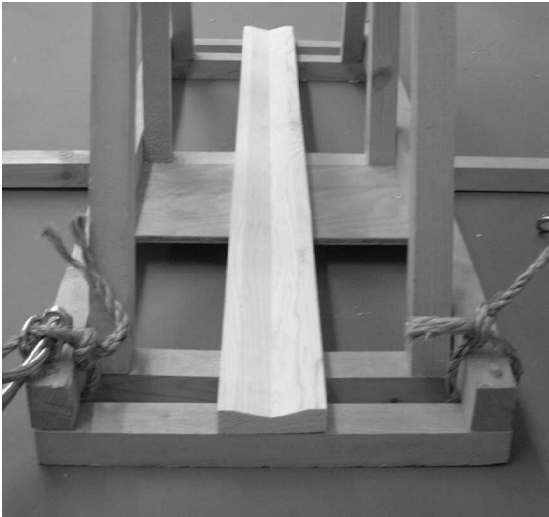


Fig 10

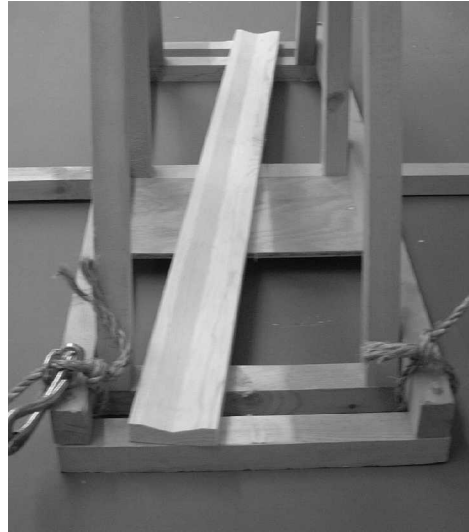


Fig. 11

This will finish the frame assembly! If you ever need to remove the arm and axle block assembly, you can remove the six dowel pins that hold the axle mount blocks to the frame, and lift them off.

1. The Arm

The arm is the most important part of the assembly. It must be glued together properly to make it strong. A glued joint is stronger than the wood itself if you use a good carpenter's wood glue and glue it properly.

Get the two short arm pieces with the large holes in them. Draw a line 8 inches from the ends without a hole all the way around the sides. Don't worry, this line will get covered up and won't show on the finished arm. Apply a layer of glue to one side of the wood from the end of the board to the mark you just made. Then sandwich the main arm beam between these two glue-covered surfaces, so that the end of the main arm is lined up with the marks. IMPORTANT! Make sure the pieces line up with each other or the arm might be crooked! A crooked arm can damage or destroy your machine. Adjust as necessary to make sure the holes are aligned, and the top and bottom of the arm pieces are all flush with each other.

Clamp the pieces together hard with a couple of good clamps so the glue will be forced into the pores of the wood. Let the glue set for at least an hour before removing the clamps, but don't apply any stress to the joint for at least 24 hours.

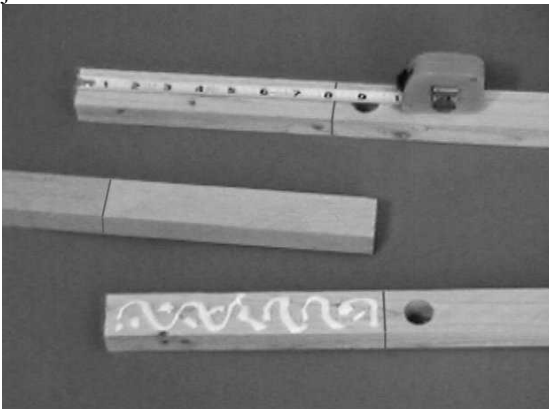


Fig. 12

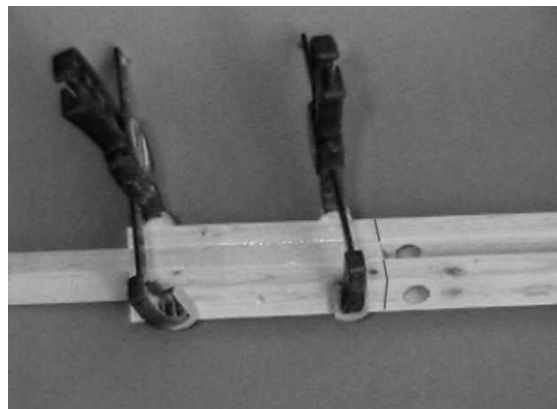


Fig. 13

Glue the small block between the short arms at the end so that it is flush with the ends of the short arms. Don't block the axle holes! Then glue the arm spacers to the sides of the arm so that the main axle holes are all aligned and the axle turns freely. If necessary, use a half-rounded file to widen the holes a little so that the axle can turn easily. Don't get any glue on the axle or on the inside surfaces of the axle holes!

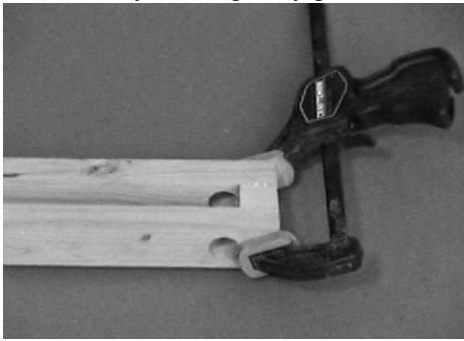


Fig. 14

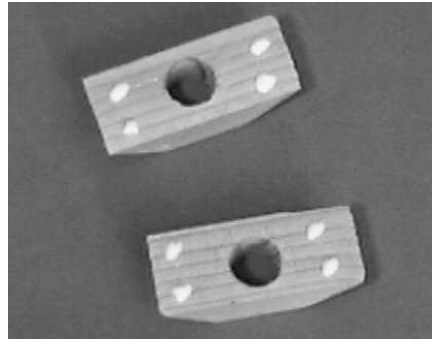


Fig. 15

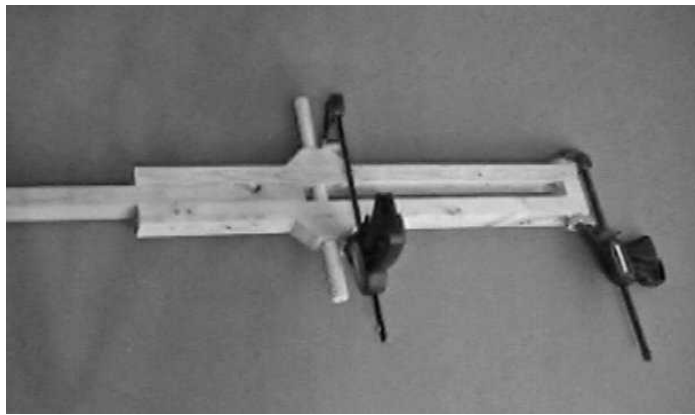


Fig. 16

Use the same gluing procedure to attach the top and bottom plates to the arm, flush with the short arms.

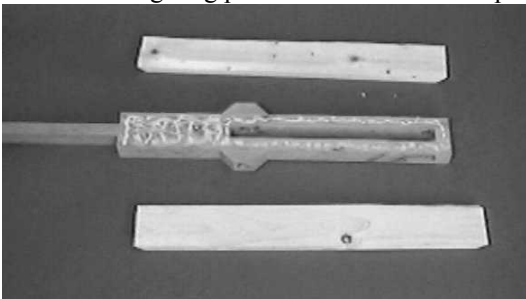


Fig. 17

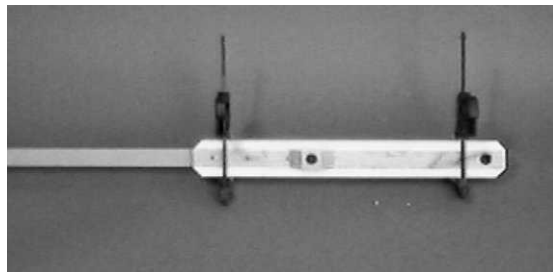


Fig. 18

Put glue in the hole at the end of the long arm beam, and insert the $\frac{1}{2}$ " wide dowel into the hole (Fig 19.)

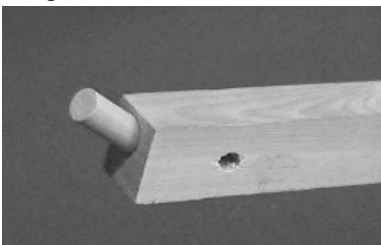


Fig. 19

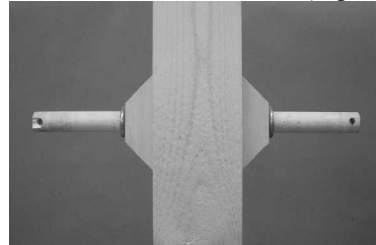


Fig 20

You should now have a completed arm. Once all the glue is dry, put the main axle (11" dowel) through the arm and slide a steel ring onto each end, up against the arm (fig. 20). Rest the axle in the channel of the block. It may be a tight fit. This is ok, the steel rings will act as a bearing and you should still get it to turn pretty easily. You can always dab a little axle grease on it too. Now put the block with only two holes on top of that. Use the pegs to secure the top block, but don't glue it. It's not necessary, and this makes it easier to remove the arm for transportation.

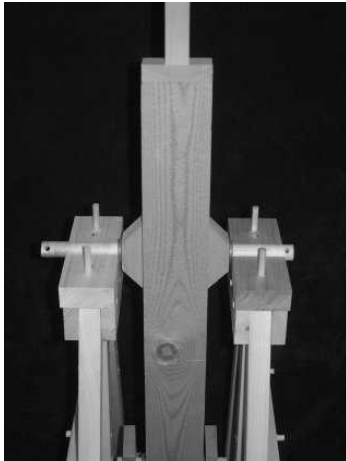


Fig. 21a

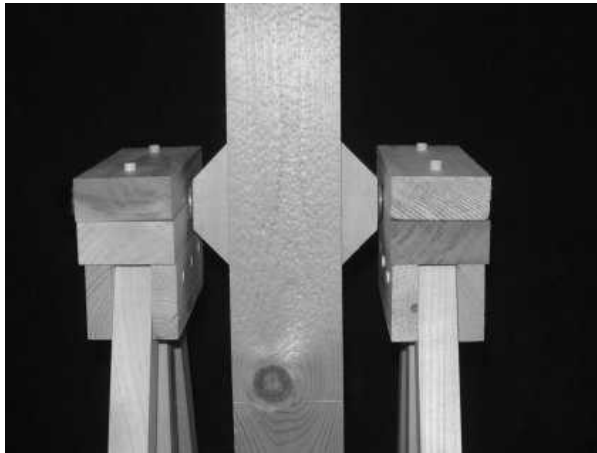


Fig. 21b

Put small dowel pins into the holes on the ends of the arms to keep it from sliding into the mount blocks.

The Counterweight Bucket

It is very important that the counterweight bucket be constructed squarely. If it is twisted or crooked, or it doesn't hang straight, it may strike the frame when firing and that can eventually destroy your machine. Be sure to double-check everything while putting the bucket together!

Start with the 4 plywood sides. Lay them together as in fig. 22.

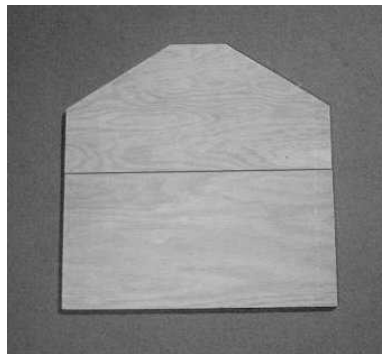


Fig. 22

Glue the counterweight hangers onto the plywood sides so that the bottom of the hanger is $\frac{3}{4}$ inch from the bottom of the plywood, and $4\frac{3}{4}$ " from the sides. Be sure to use enough glue to cover the surface entirely, and clamp the pieces together, or set something heavy on them while the glue dries. The two sides of the bucket should be exactly the same. An easy way to check this is to hold them back-to-back with each other. While the glue is still wet, hold the side assemblies together to make sure the hangers are exactly the same length and have the same alignment. Clamp them hard so the glue will set properly, and be sure to check for any slippage after you've clamped it! The counterweight hangers **must** be properly aligned with each other, so double and triple check everything!

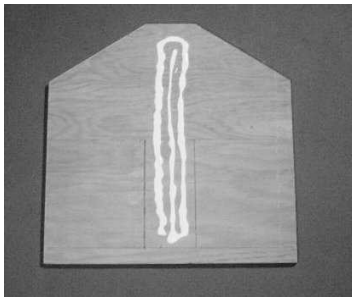


Fig. 23 A

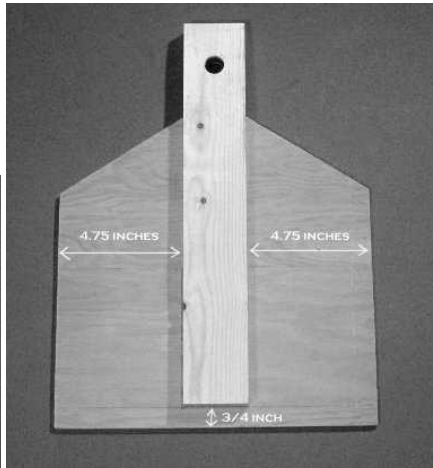


Fig. 23 B

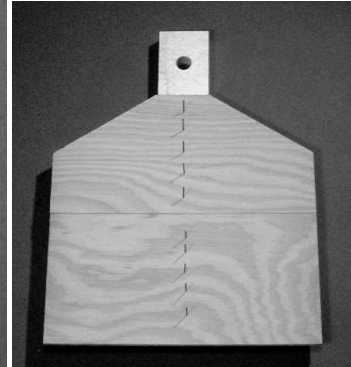


Fig. 23 C

Once the glue has set, you should nail several of the small nails into the plywood side through to the hanger for even more strength (Fig. 23 C).

Put a bead of glue near the edge of the plywood where the end plates and bottom plates will attach.

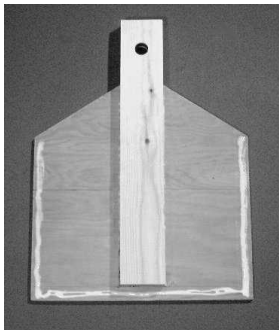


Fig. 24

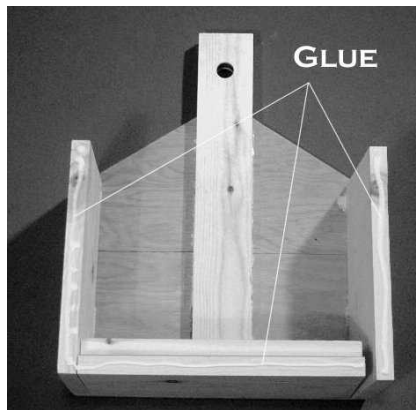


Fig. 25

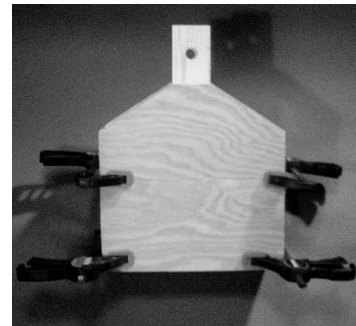


Fig. 26

Put all the pieces together to form your counterweight box, with glue between every joint. Clamp the sides together hard to set the glue. Use as many clams as you can, or use a heavy weight to press them together. (See fig. 26) Put the axle through the counterweight hangers. Make sure that the axle spins freely and is perpendicular to the sides of the box. The bucket should hang level from the axle. The sides of the bucket must be square (90 degrees) with the axle! If this is not so, adjust the bucket while the glue is still wet. Strengthen the bucket more by driving the small nails through the sides and into the plates. Don't put any nails within 1/2" of the ends of the plates or you might split the wood.

Assembly

Tie the base of the trigger and one steel ring to the end of the base as in Fig. 27. Be sure the slide link is on! Tie a steel ring on one end of a piece of rope (be sure the knot is STRONG!) and hook the ring into the trigger, then take the rope over the arm (in cocked position) and tie the other end of the rope to the frame on the opposite side from the trigger, as in Fig. 28. The rope should be just long enough to hold the arm down in a fully cocked position when the ring is hooked onto the trigger (Fig 29a)

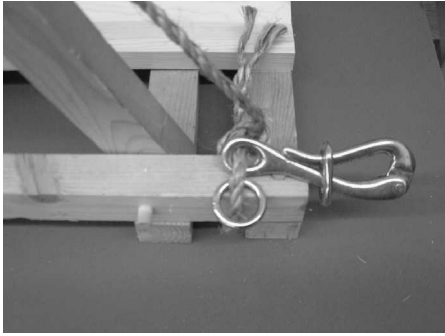


Fig. 27



Fig. 28



Fig. 29a



Fig. 29b

To fire the machine, tie a rope or piece of twine to the base near the trigger, carefully thread it through the trigger, over the oval slide ring, and down through the steel ring (See Fig. 29b). From a safe distance and with no people or property within 200 feet of the machine, stand well off to the side of the machine and pull the string to fire. **BE CAREFUL!** This is a very easy pull trigger!

Hang the counterweight bucket in place at the end of the arm. Slide the counterweight axle into place, again using a steel ring as a spacer wherever needed. Put the 3/16" dowels into the CW axle holes to keep it in place. You may need to glue the 3/16" dowels. Put the white poly sand bag inside of the counterweight bucket. Fill the bag with your counterweight material, and tie the top of the bag closed so the material won't spill out when the bucket swings around. You can fill it up now, but **DO NOT** fire the machine without a missile! This is called a dry-fire, and it will damage your machine! Always have an appropriately balanced missile in the sling for the amount of counterweight you are using. See the section on tuning for more info.

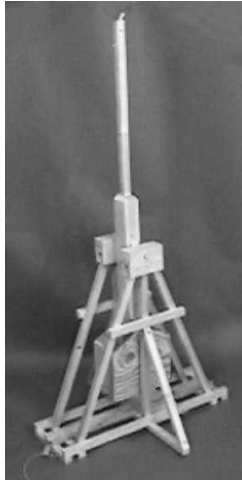


Fig. 30

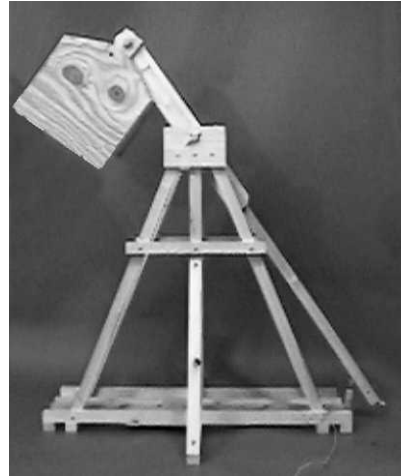


Fig. 31

5. The sling

Cut a piece of the burlap about 8" x 12" and lay it flat. Fold two sides over so they touch in the center, making a strip 12" x 4" double thick (A). Then fold the edges of this strip (lengthwise) up (B), then in half back down (C) to form an 'M' shape. Turn this over so the 'M' is now a 'W' (D).

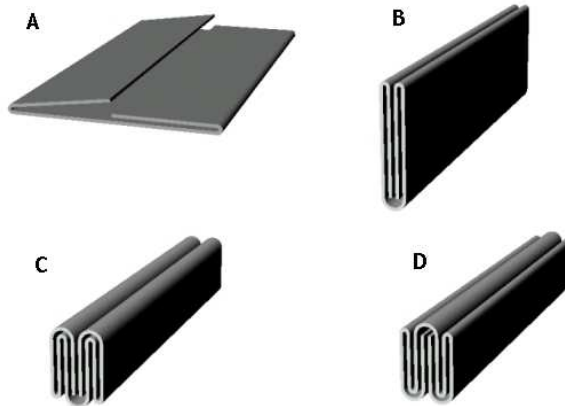


Fig. 32

Tie each end **tight** with the rope about 2" from each end of the sling pouch so that the knot is on the top of the 'W'. Fold the loose ends of the pouch around the knot and secure them tightly with another piece of rope or twine. You may even want to glue the knots so they won't come open. If the pouch is not secured well, it can slip off the sling during firing. Push the center of the 'W' inside out (through the bottom, see Fig 33) and you should be left with a perfect sling-pouch (Fig 34).



Fig. 33

Now cut the rope 40" from each end of the sling. Tie one end through the hole in the end of the arm so that the knot is on the bottom side of the arm (Fig. 35). Tie the 1" steel ring to the other end of the sling, and put the ring over the pin. With the arm horizontal make sure that the sling-pouch hangs properly and cradles a ball about 2" to 4" in diameter about 32 inches from the ring to the sling pouch. If one side of the sling is too long, you can just tie knots in the rope to make it shorter. This also gives you the opportunity to lengthen the sling if needed by simply untying the knots! (You may want to make it a bit longer if you want to fine-tune the sling length for maximum range -see the section on tuning).



Fig. 34

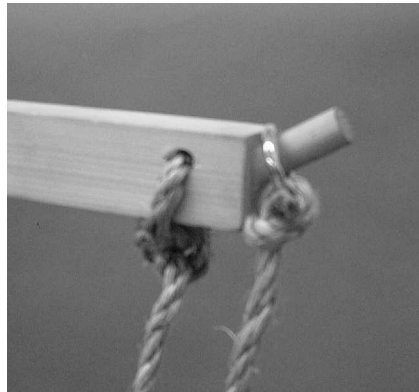


Fig. 35

6. Firing the machine.

Pick a spot that is flat and level to set the machine on. Pull the arm down and set the trigger. **BE VERY CAREFUL!** The trigger is very easy to release! Stay clear of the path of the arm and counterweight, and put the sling's steel ring over the pin and pull the sling back into the trough so that the lines are not twisted. Fig. 36



Fig 36.

The pouch goes over and under the ball, not around its sides. Verify that the sling loop is still on the pin. Make sure there is nothing for 200 feet in front of or in back of the machine! A trebuchet that hasn't been tuned can just as easily throw something backwards, forwards, or even straight up! Perhaps you should wear a hardhat too! With the machine aimed, stand at least 6 feet away from the side of the trebuchet. Pull the trigger string slowly (do not 'jerk' the string) until it releases. Then watch it fly!

Always remember that the arm moves very fast and with a lot of power behind it! It can knock you out if it hits your head. **NEVER** stand over, in front of or behind a cocked machine, whether it is loaded or not!

Never fire it at any person or thing. The trebuchet should only be fired into an open field and under strict adult supervision.

7. Tuning the machine.

A trebuchet can be a slightly complicated thing to tune properly. There are a lot of variables that all affect each other. Things that you can easily tune are:

The counterweight

The projectile weight

The sling length

The first thing most people think is that increasing the counterweight will make the machine throw farther. It might, a little. It might also make the trebuchet throw backwards or straight up, or you might just create more stress on the machine and break something. More counterweight usually only allows you to throw a comparably heavier projectile. Doubling your counterweight should mean that you can double the weight of your projectile and get the same performance. If the projectile is too light in relation to the tuning of the machine, it will probably come out of the sling at the wrong time.

More counterweight means that you have more power. To convert that power into more range, you'll need to adjust a few other things. Changing the counterweight without a corresponding change in the projectile weight will probably require a little additional tuning of the sling length.

Note: Do not "dry-fire" the machine (firing with no projectile loaded)

We recommend these ratios:

For a ¼ lb missile, use 15 to 20 lbs of counterweight.

For a ½ lb missile, use 20 to 30 lbs of counterweight.

For a 1 lb or greater missile, use 30 to 50 lbs of counterweight. Use NO MORE than 50 lbs of counterweight. Too much weight may cause your counterweight bucket to shatter.

Do not hurl any missiles greater than 1.5 lbs.

The sling length:

Watch the missile very carefully while firing the machine. If it flies in a high lob, the sling probably needs to be shorter. To make it shorter you can just tie knots in both sides of the sling. This is a great way to make fine adjustments in the sling length.

If the missile flies low to the ground and not very far, a longer sling should make it fly higher, and therefore farther.

How to calculate your range efficiency:

The range efficiency is a measure of how well your machine converts all the energy available to it into throwing the ball. It's really simple.

The ball travels in an arc when it's thrown. There are two components to this arc, the vertical (how high it goes) and the horizontal (how far it goes). They relate to each other by the angle that the ball was thrown.

Using the physics of ballistic motion, gravity, and some trigonometry, we've derived this equation for the maximum theoretical range a machine like this can throw.

$$2 * (CW * \text{drop}) / P = \text{Theoretical range.}$$

CW is the weight of your total counterweight. The **drop** is the number of feet it falls when firing. This kit drops 2 feet. So, if you have 25 lbs of counterweight your available energy is 25 lbs * 2 feet = 50 foot-pounds of energy.

Multiply by **2**, and then divide by **P** (the weight of your projectile). If your projectile is ½ lb, your maximum theoretical range is $100 / 0.5 = 200$ feet, IF you have a 100% efficient machine! The theoretical range is never really possible though. Most machines are never more than about 50% efficient due to things

like friction, air resistance, non-perfect release angles, compression and elasticity of the various parts, etc., so your maximum *realistic* range is about half (50%) of your maximum theoretical range. Or:

$$\mathbf{CW * drop / P = realistic\ maximum\ range.}$$

Now that you know the realistic and theoretical range of your machine, you can calculate your efficiency! If you calculate your theoretical range with the CW and projectile weights you have, then measure the actual distance of your shot, your efficiency is

$$\mathbf{Actual\ measured\ range / Theoretical\ range * 100 = percent\ efficiency}$$
$$\mathbf{Actual\ measured\ range / Realistic\ range * 100 = percent\ effectiveness}$$

Here are some web links for more information-

History and types of trebuchets-

<http://members.iinet.net.au/~rmine/ht/ht01.html>

<http://members.iinet.net.au/~rmine/middel.html>

<http://www.middelaldercentret.dk/acta.html>

<http://www.castlewales.com/siege.html>

The Warwolf described in history-

http://www.brechin-angus.co.uk/brechin/history/h_sir.htm

<http://www.clanmaxwellusa.com/trebuchet.htm>

How trebuchets work-

<http://www.ripcord.ws>

<http://members.iinet.net.au/~rmine/howtreb.html>

<http://www.geocities.com/SiliconValley/Park/6461/trebuch.html>

Trebuchet discussion group-

<http://www.trebuchet.com/boards/Catapults>

Many more links:

<http://members.iinet.net.au/~rmine/seemore.html>

If you have any questions or problems with these instructions or your trebuchet, please email your questions to the expert! Ron@Trebuchet.com We will respond as quickly as possible!

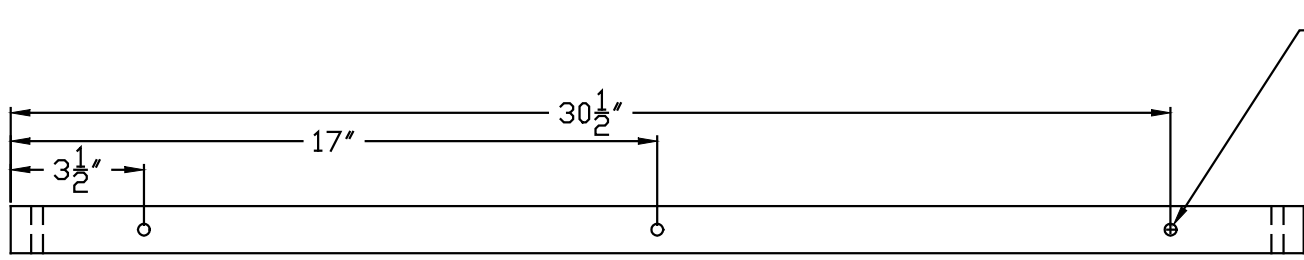
Good luck, be careful, and have fun!

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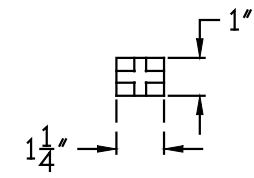
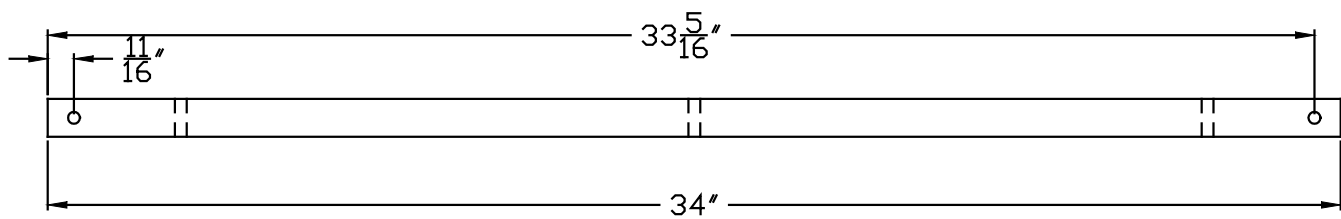
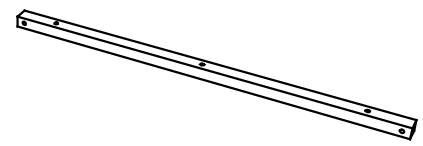
ADDENDUM TO THE DRAWINGS:

These notes correct some inaccuracies and discrepancies on the drawings below. Please make note!

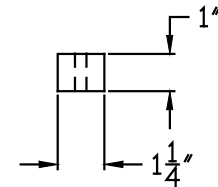
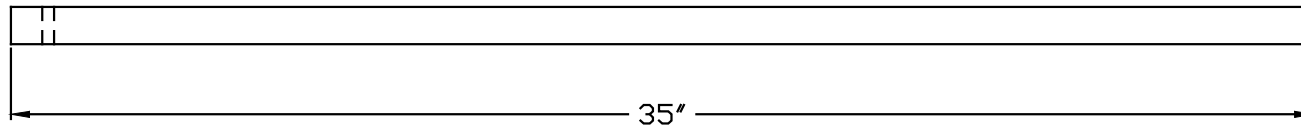
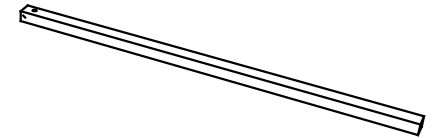
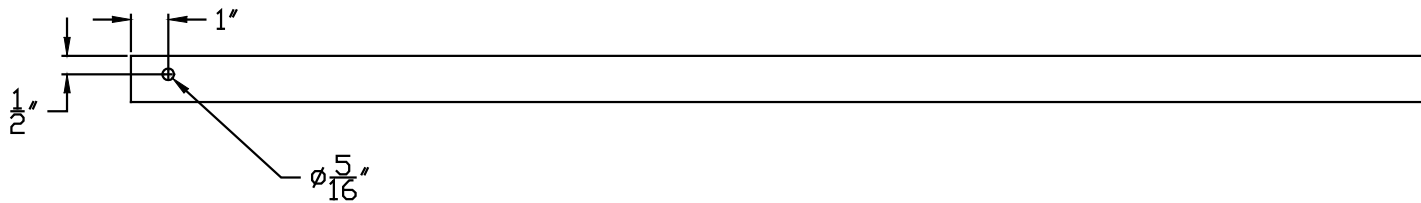
- 1. Drawing WW-2. This 1/2" hole should be at a 30 degree angle. Make it as deep as you can without cutting into any face of the beam.**
- 2. Drawing WW-3. The stock (thickness) dimensions are 1 inch by 1-1/4 inches.**
- 3. Drawing WW-5. The 30-3/8" measure should be 31-1/4" to the end of the beam (not to the center of the hole it points to) and that hole should be one inch from the end, just like the hole on the opposite end.**
- 4. Drawing WW-9. The plates should actually be 23-1/2", NOT 32-1/2" The thickness of this piece should be 3/4", NOT 7/8".**
- 5. Drawing WW-12. The dowel holes should be 5/16 inches, NOT 3/8 inches.**
- 6. Drawing WW-14 and WW-15. Thickness should be 3/4", NOT 7/8".**



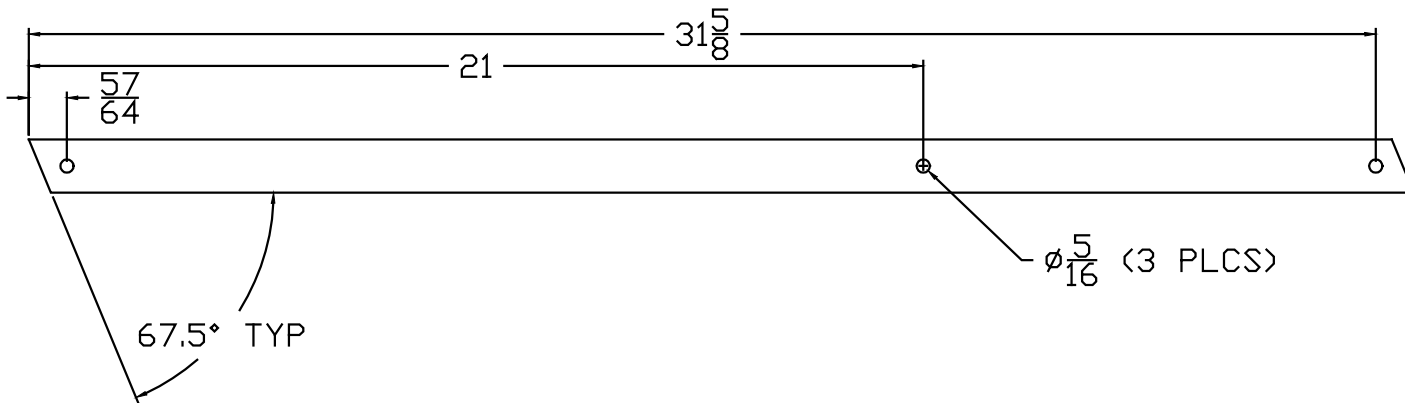
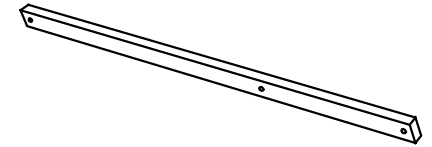
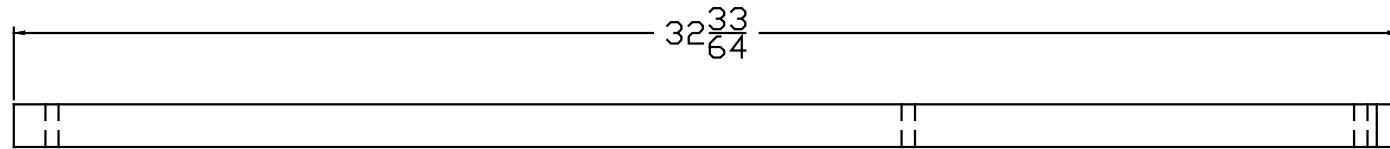
$\phi \frac{5}{16}$ " DRILL 5 PLCS



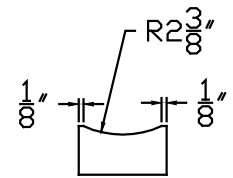
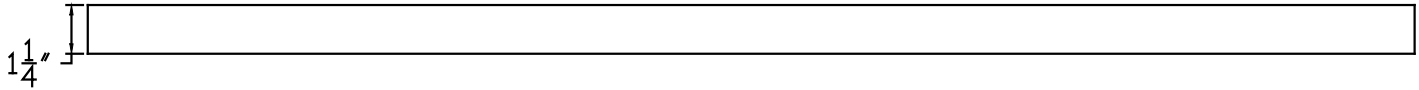
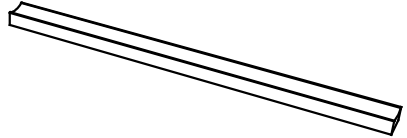
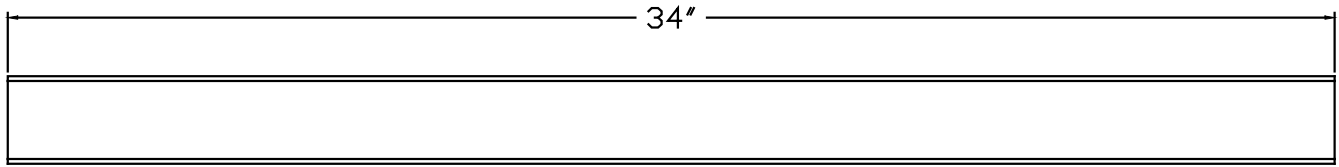
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DWG BY: RRG	SCALE NONE	SHEET	



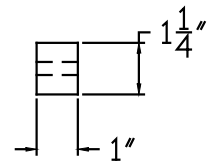
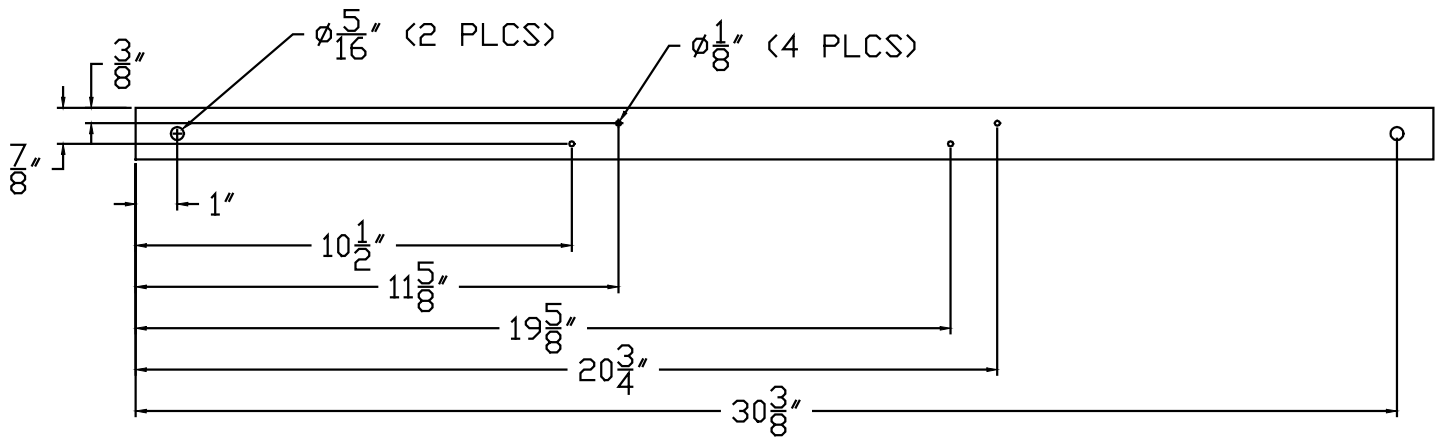
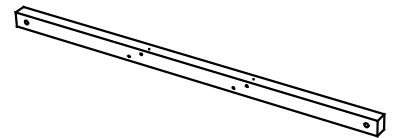
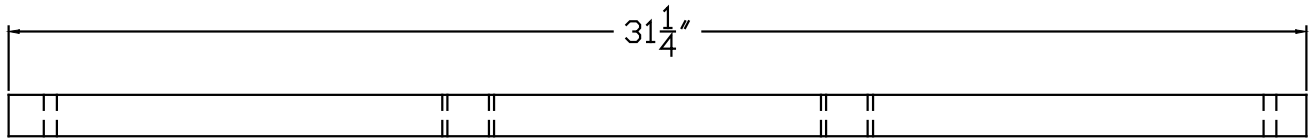
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DWG BY: RRG	SCALE NONE	SHEET	



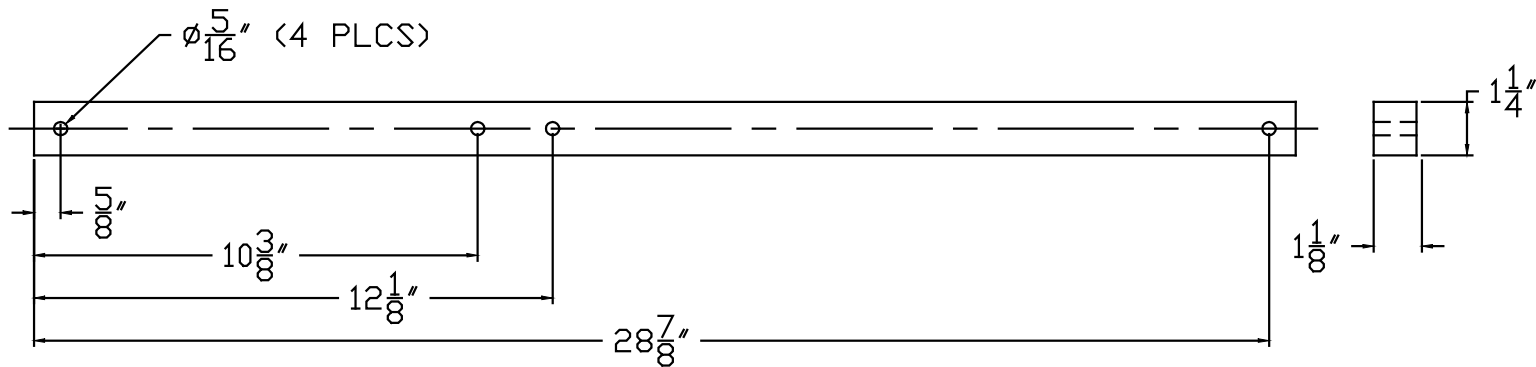
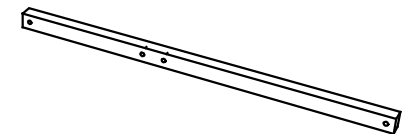
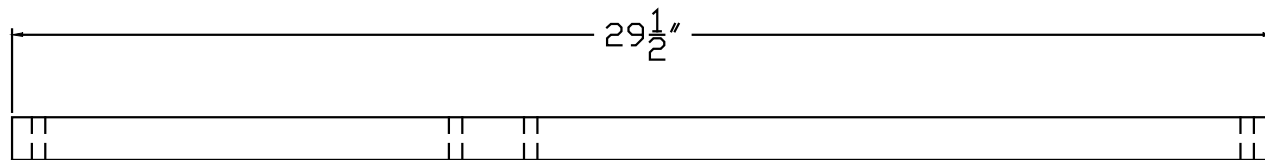
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DWG BY: RRG	SCALE NONE	SHEET	



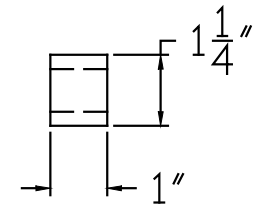
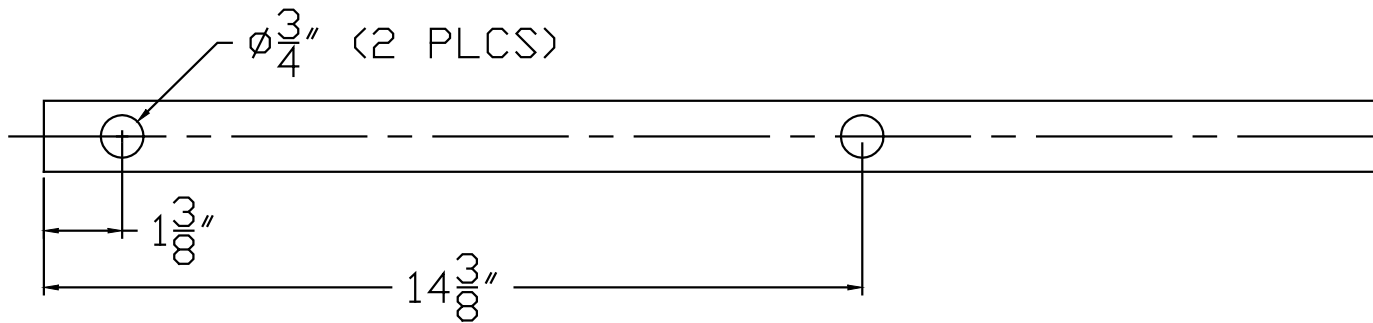
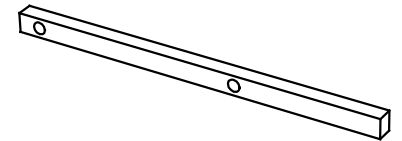
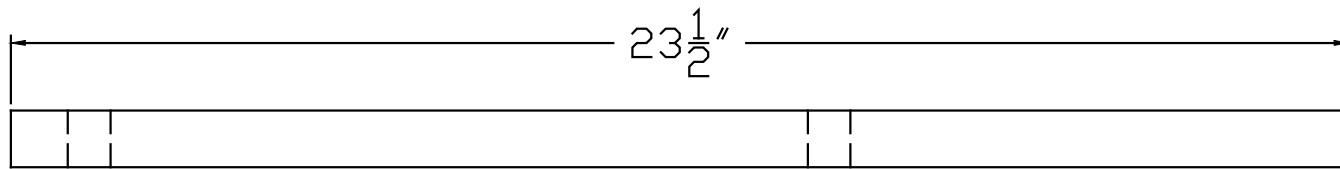
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DWG BY: RRG	SCALE NONE	SHEET	



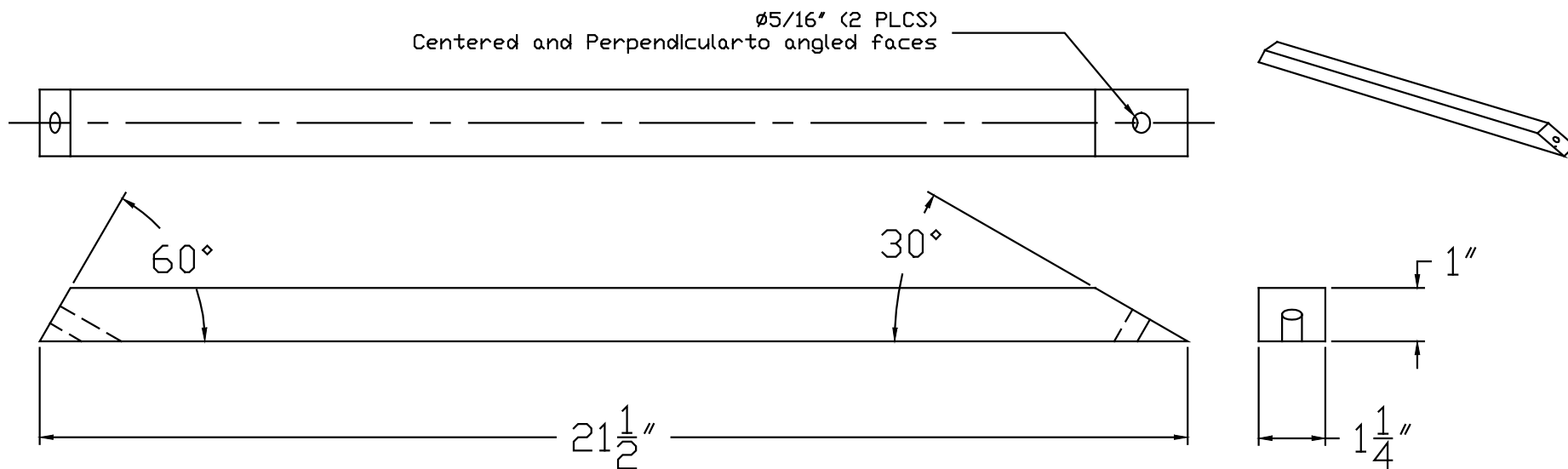
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DWG BY: RRG	SCALE NONE	SHEET	



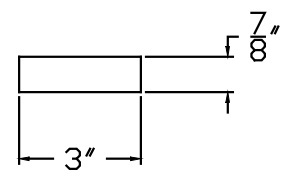
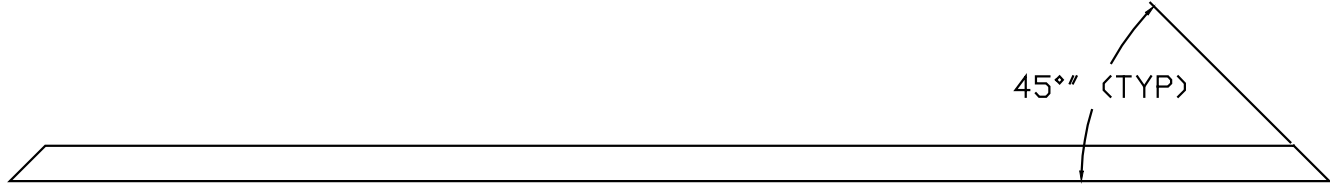
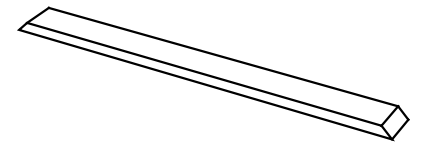
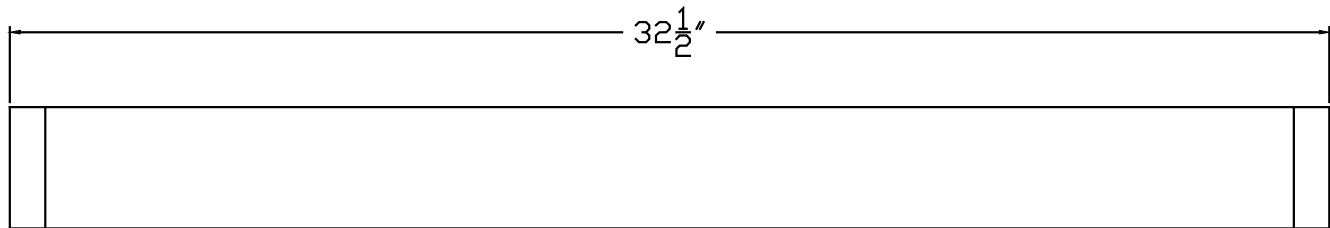
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DWG BY: RRG	SCALE NONE	SHEET	



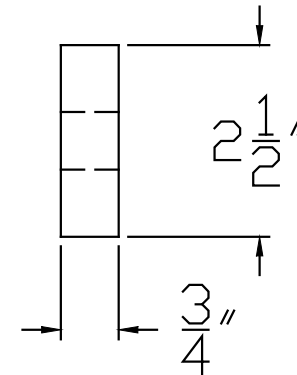
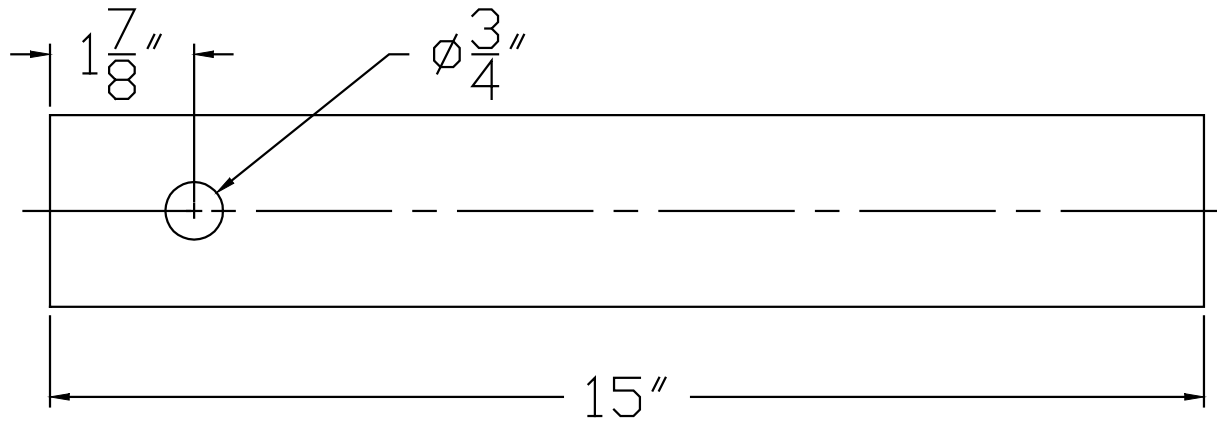
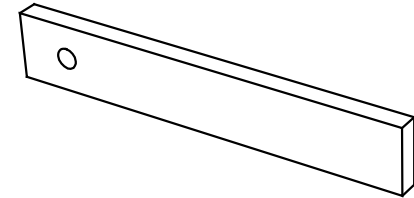
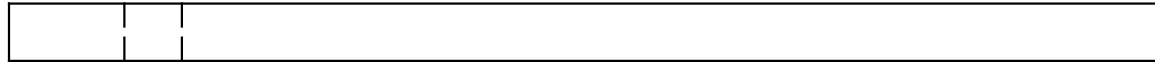
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DWG BY: RRG	SCALE NONE	SHEET	



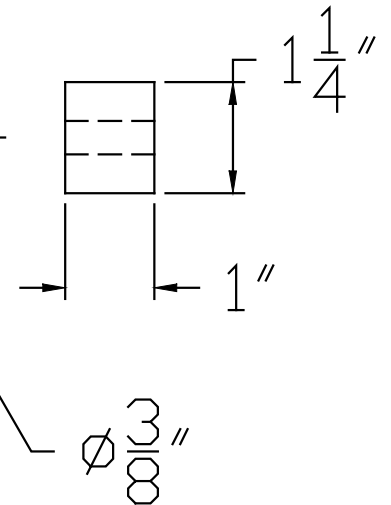
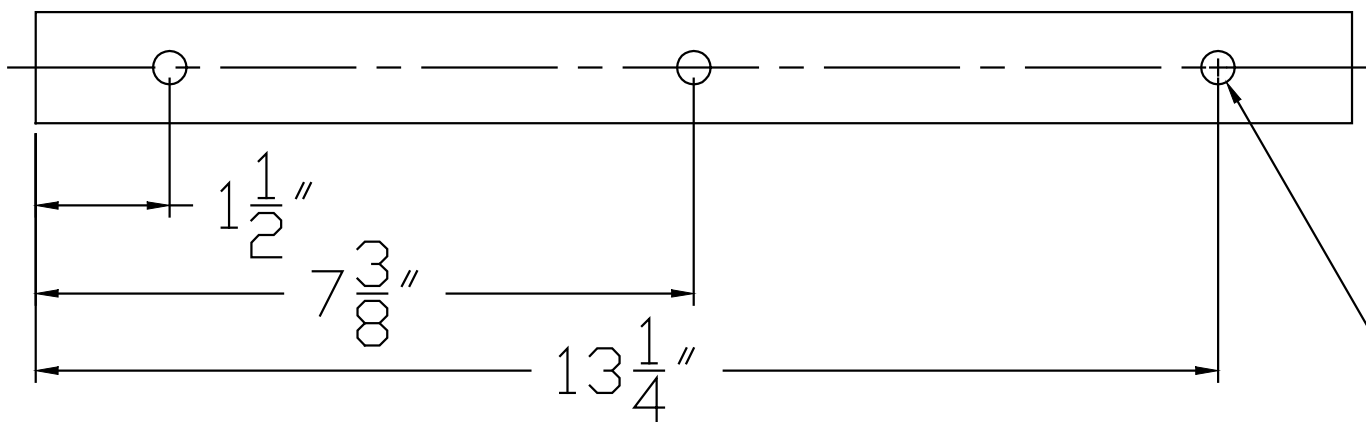
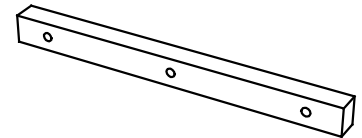
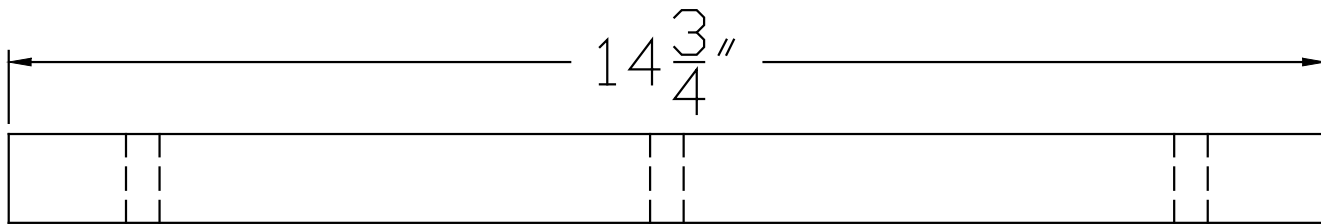
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DWG BY: RRG	SCALE NONE	SHEET	



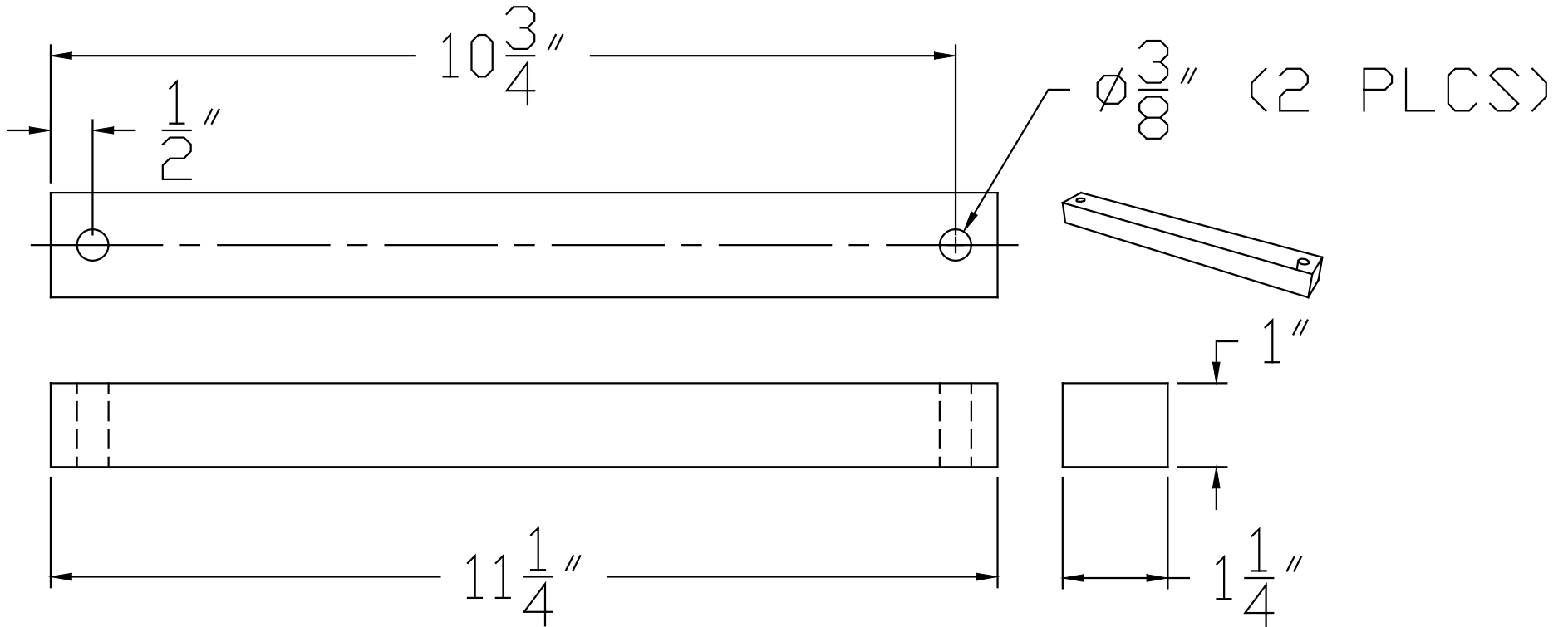
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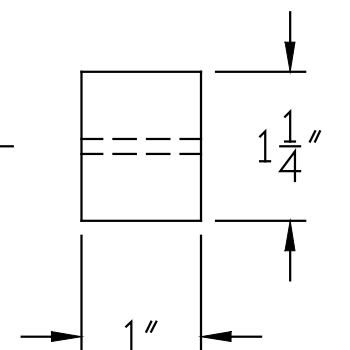
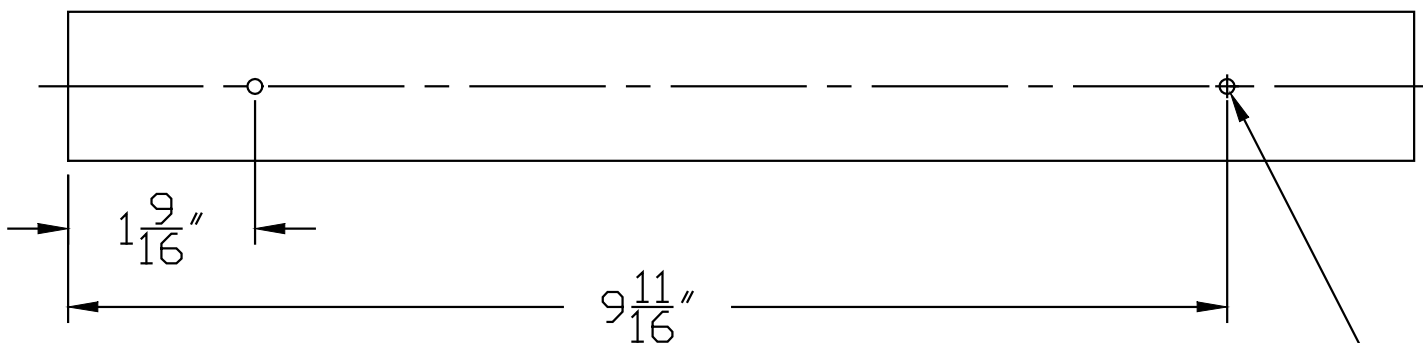
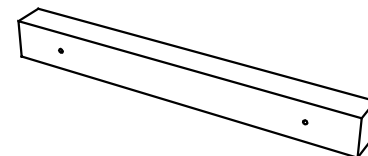
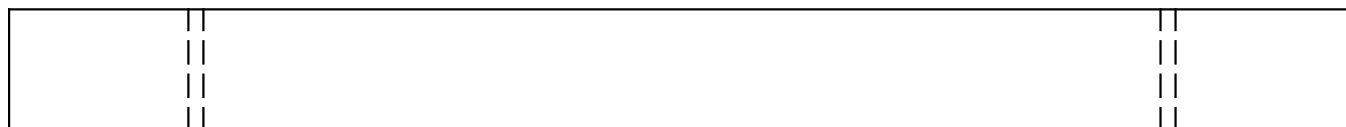
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DWG BY: RRG	SCALE NONE		SHEET



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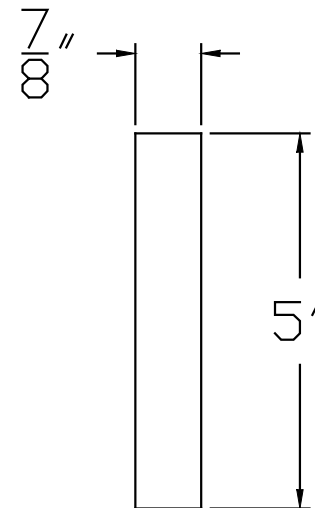
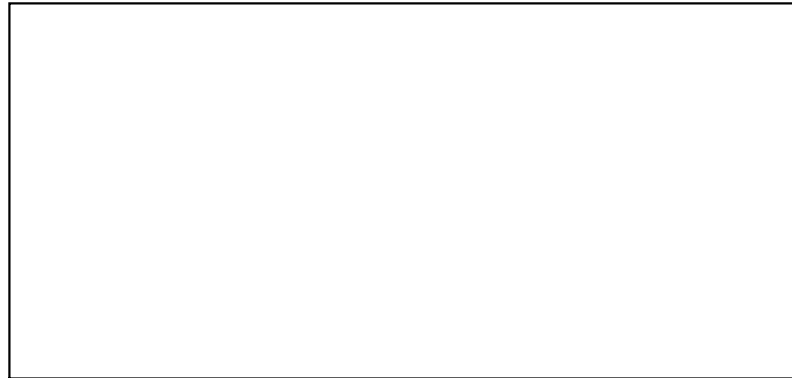
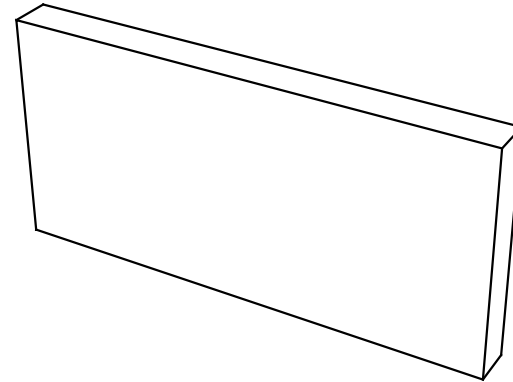
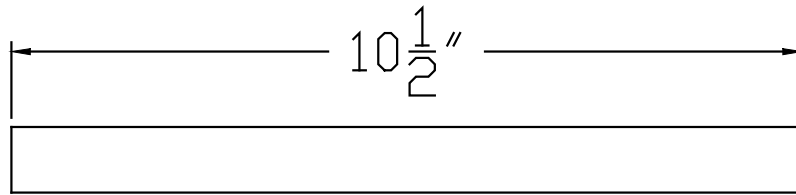


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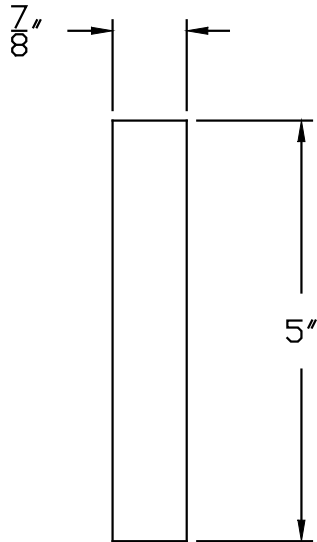
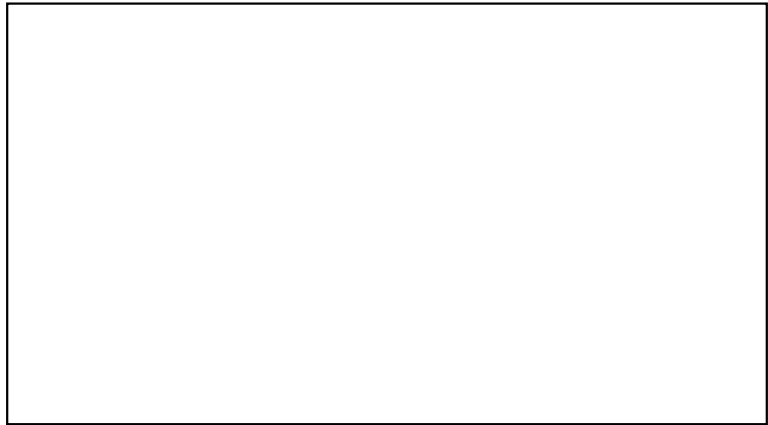
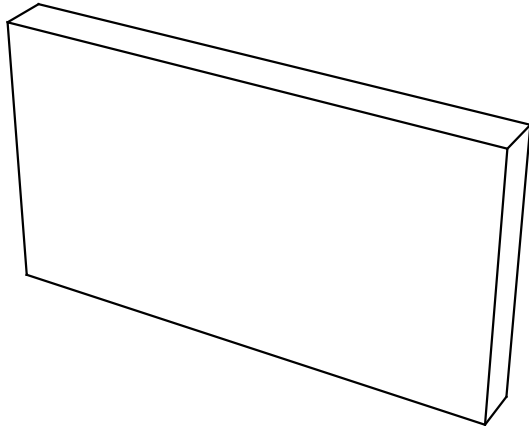
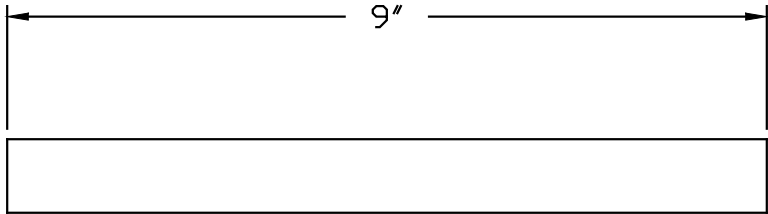


$\varnothing \frac{1}{8}''$ (2 PLCS)

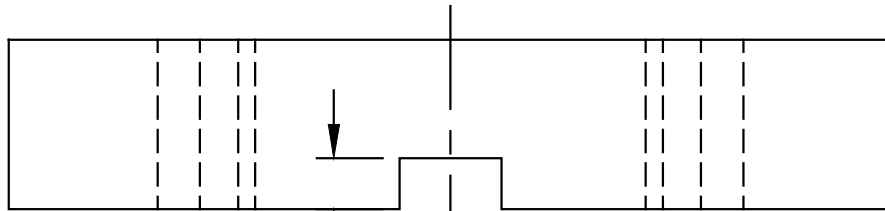
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DWG BY: RRG	SCALE NONE	SHEET	



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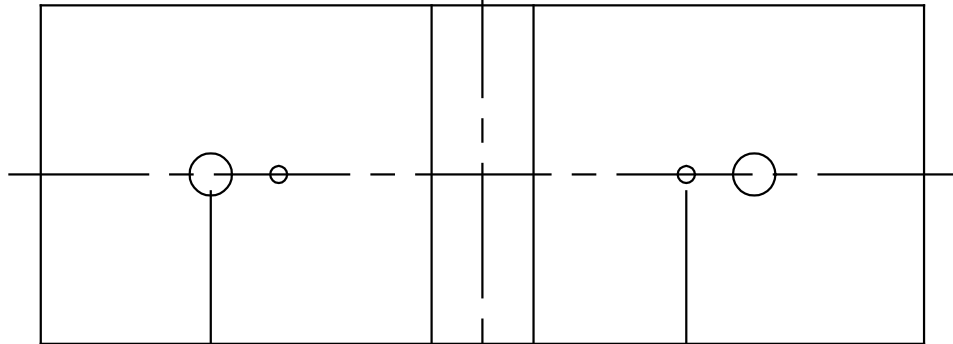


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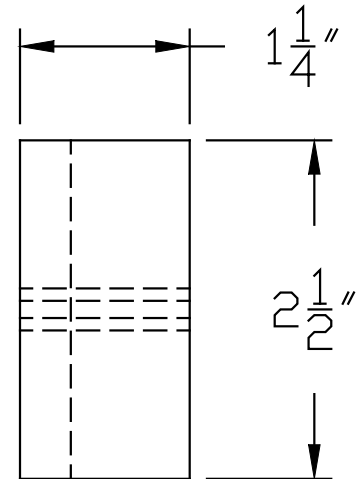
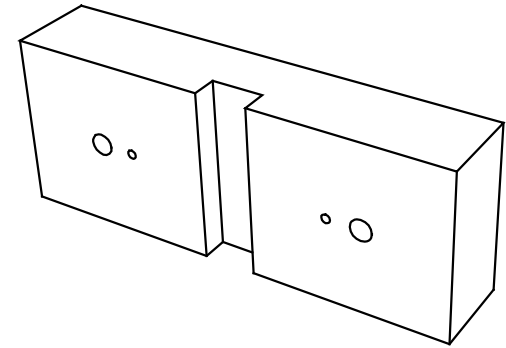
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$\frac{3}{4}$ "



2" (TYP)

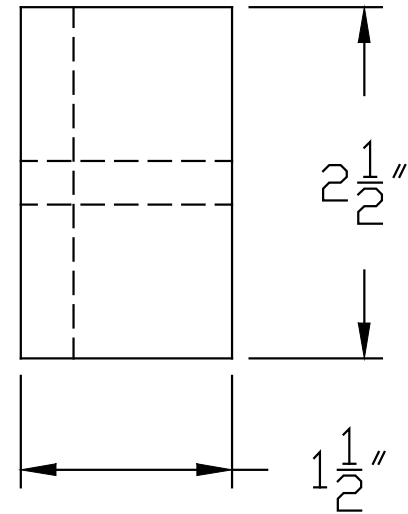
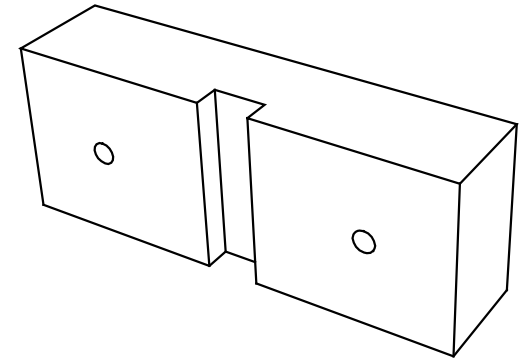
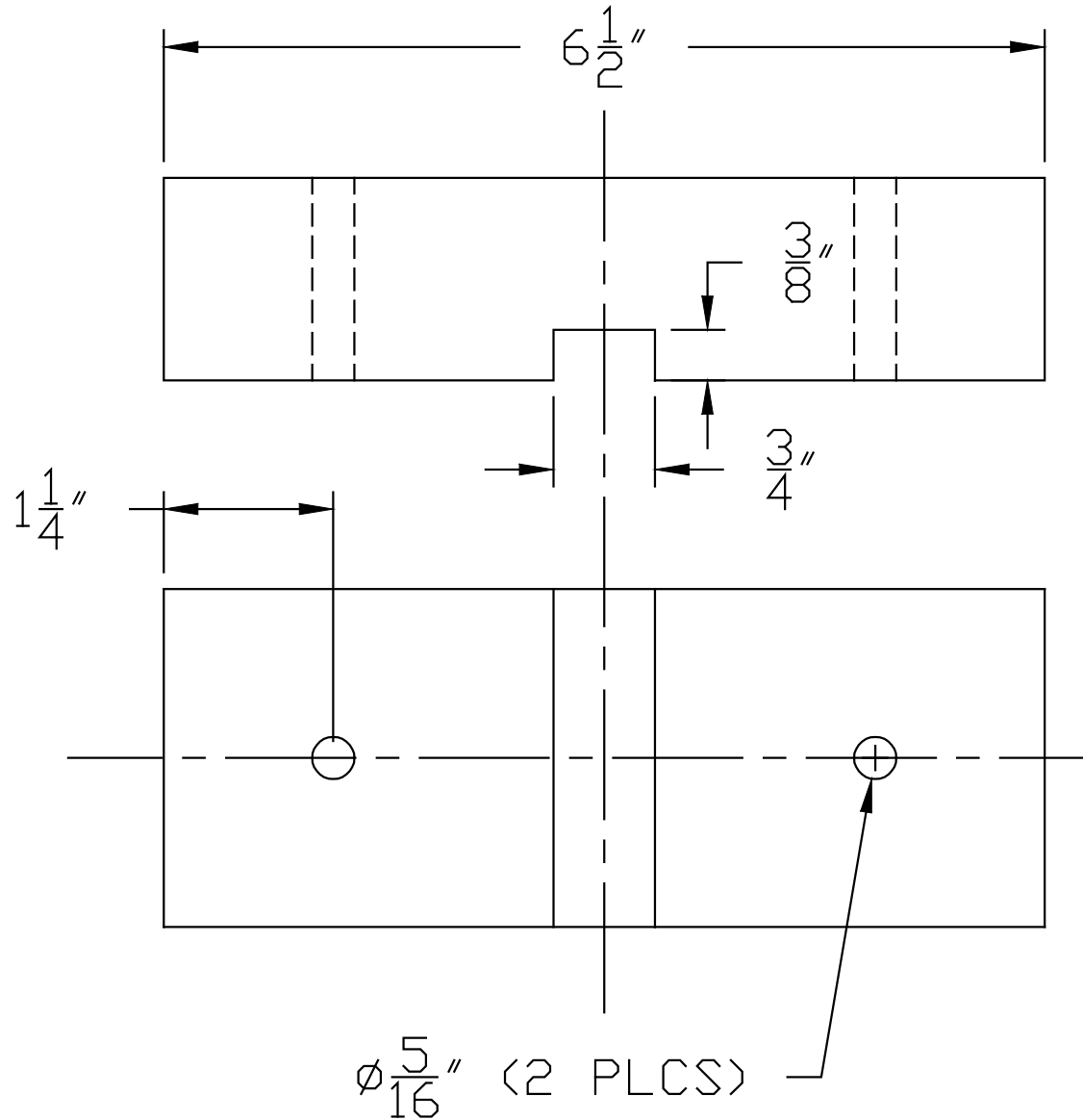
$1\frac{1}{2}$ " (TYP)



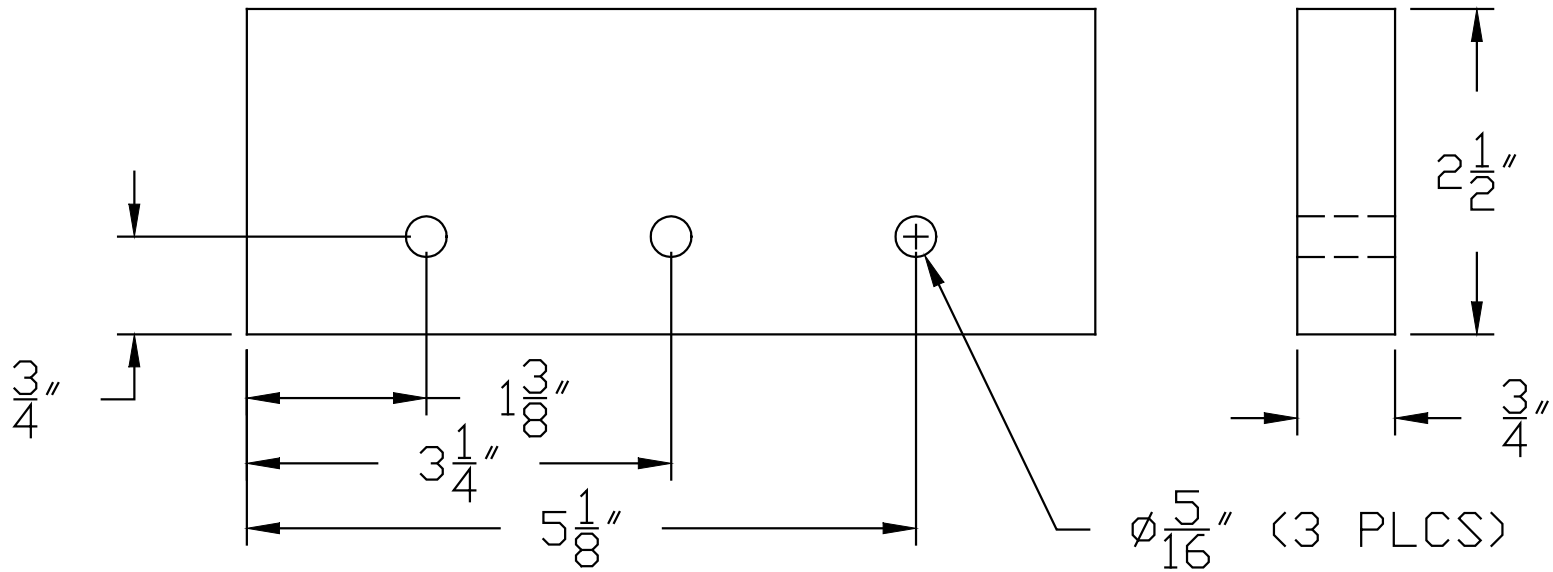
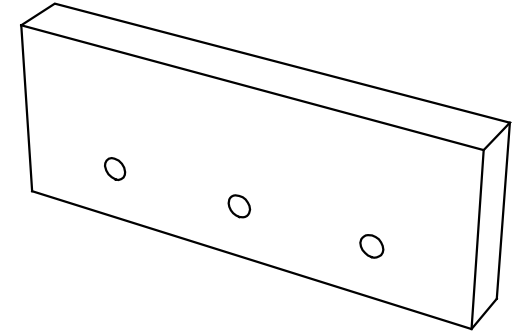
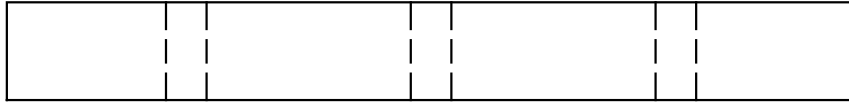
$1\frac{1}{4}$ "

$2\frac{1}{2}$ "

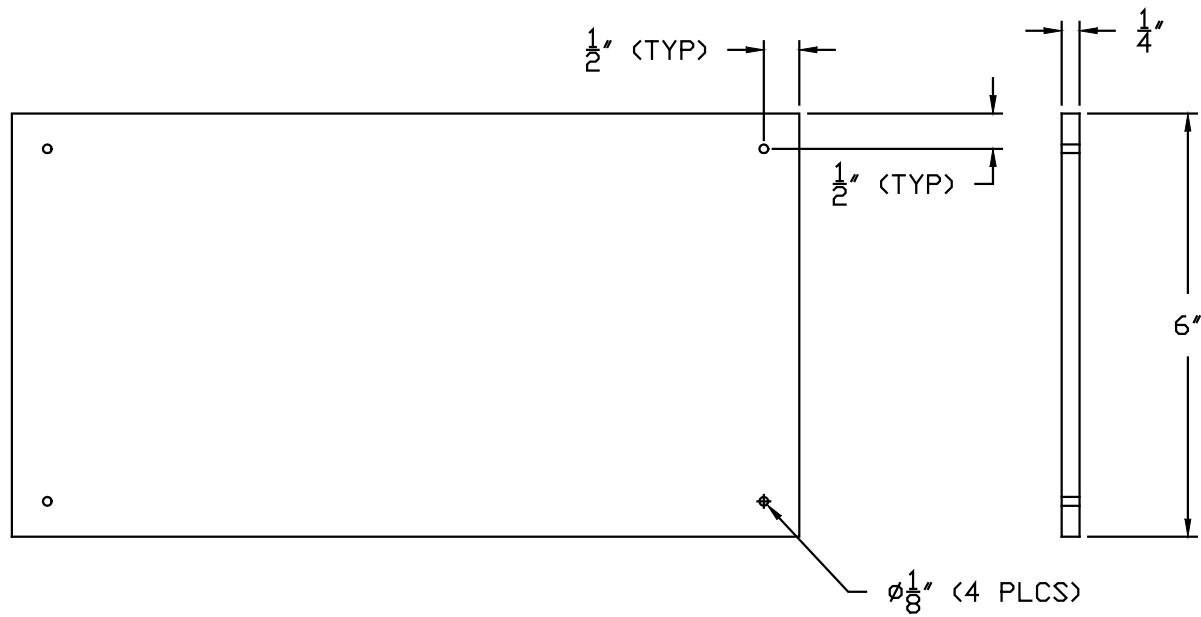
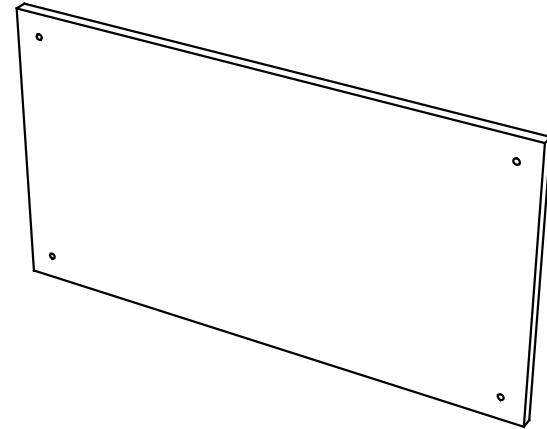
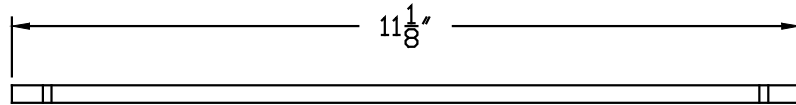
TOLERANCE: Unless noted all tolerances are $\pm 1/64$. Angles $\pm 3^\circ$	RLT.COM, Inc.		
	PART NO. WW-16		
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE	SHEET	



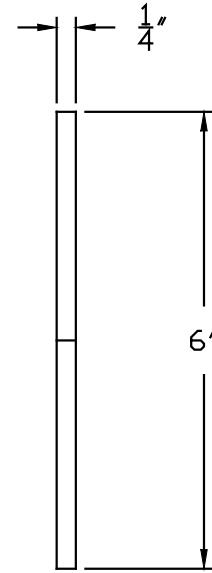
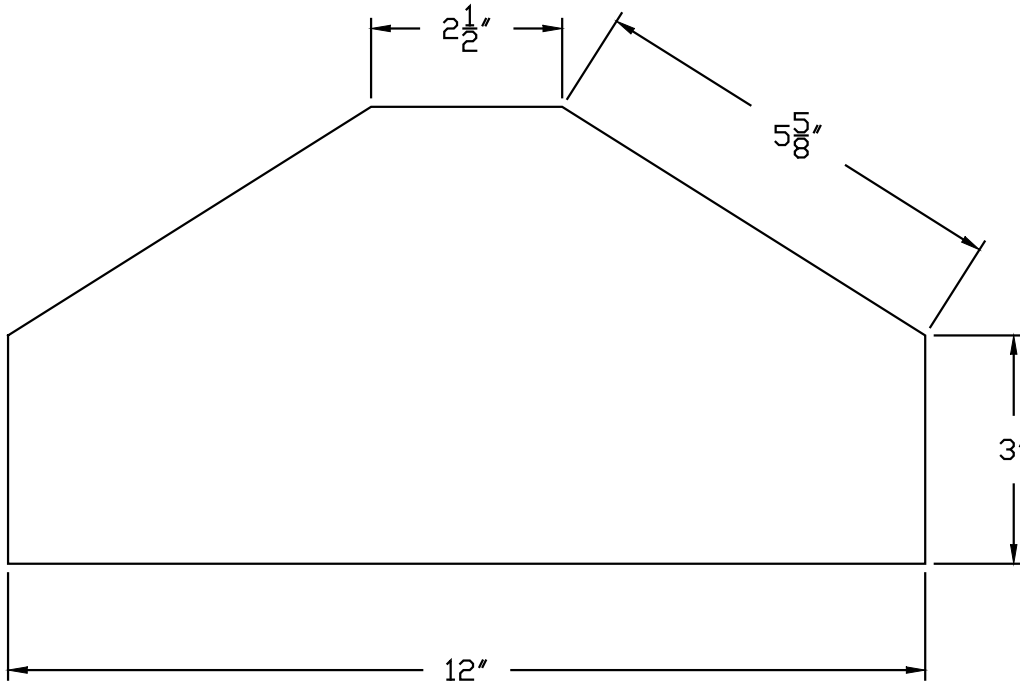
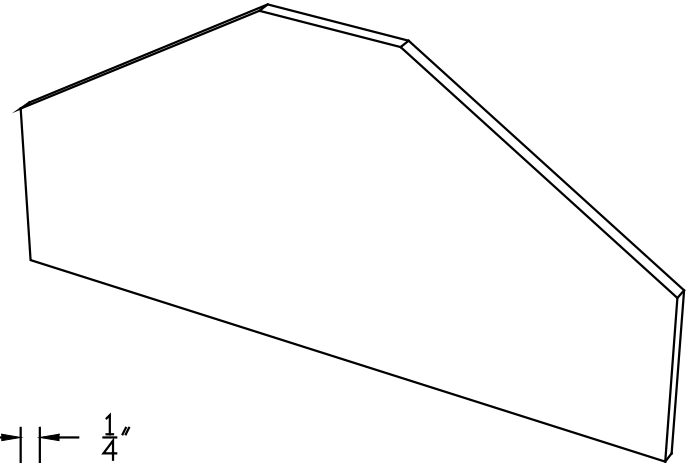
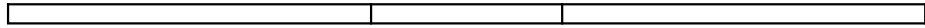
TOLERANCE: Unless noted all tolerances are $\pm 1/64$. Angles $\pm 3^\circ$		RLT.COM, Inc.	
		PART NO. WW-17	
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE	SHEET	



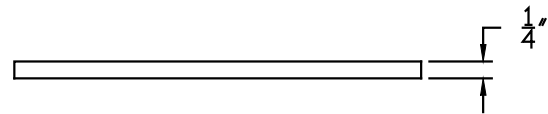
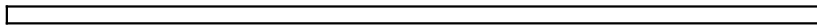
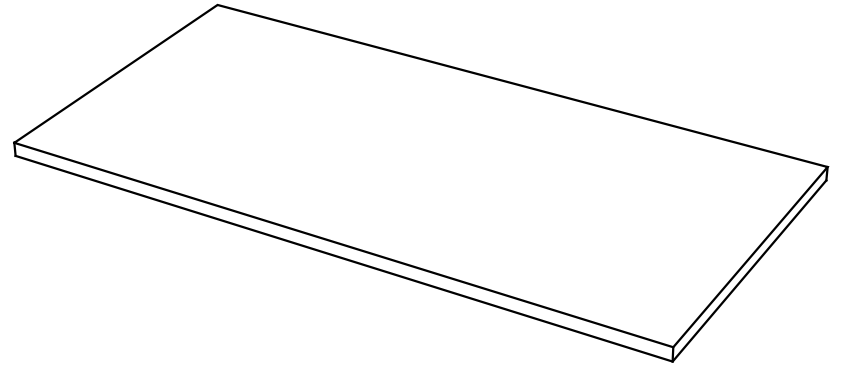
TOLERANCE: Unless noted all tolerances are $\pm 1/64$. Angles $\pm 3^\circ$	RLT.COM, Inc.		
	PART NO. WW-18		
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE	SHEET	



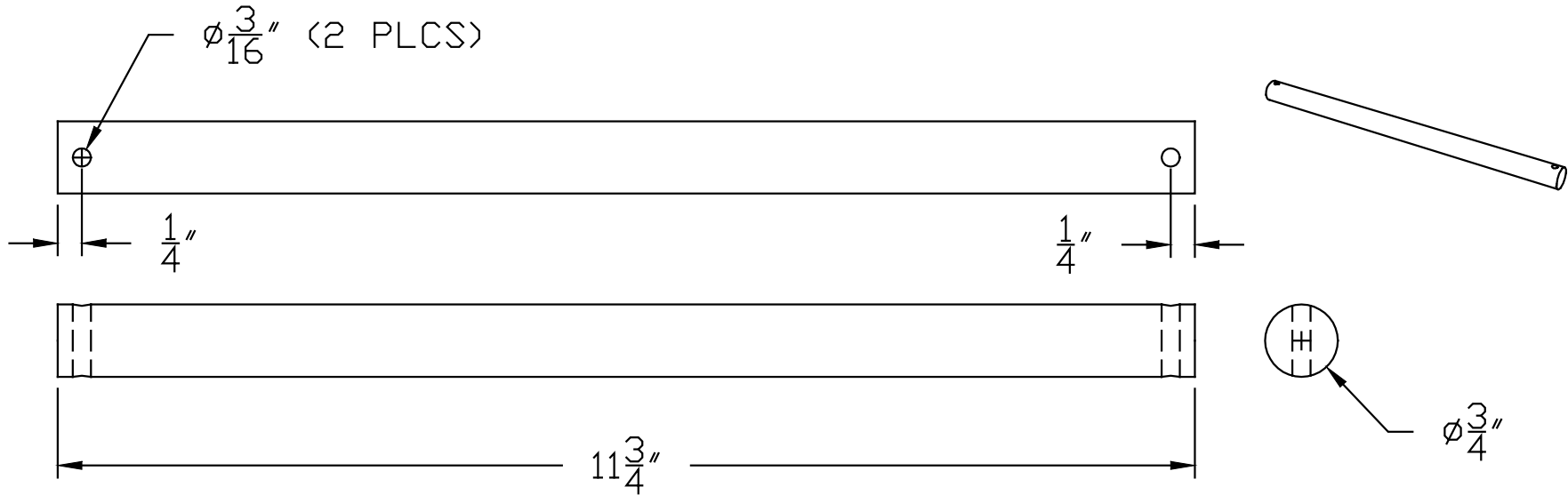
TOLERANCE: Unless noted all tolerances are ± 1/64. Angles ± 3°		RLT.COM, Inc.		
		PART NO. WW- 19		
Material:	DWG APRV:	DWG NO. War Wolf	REV A	
DWG BY: RRG	SCALE NONE			SHEET



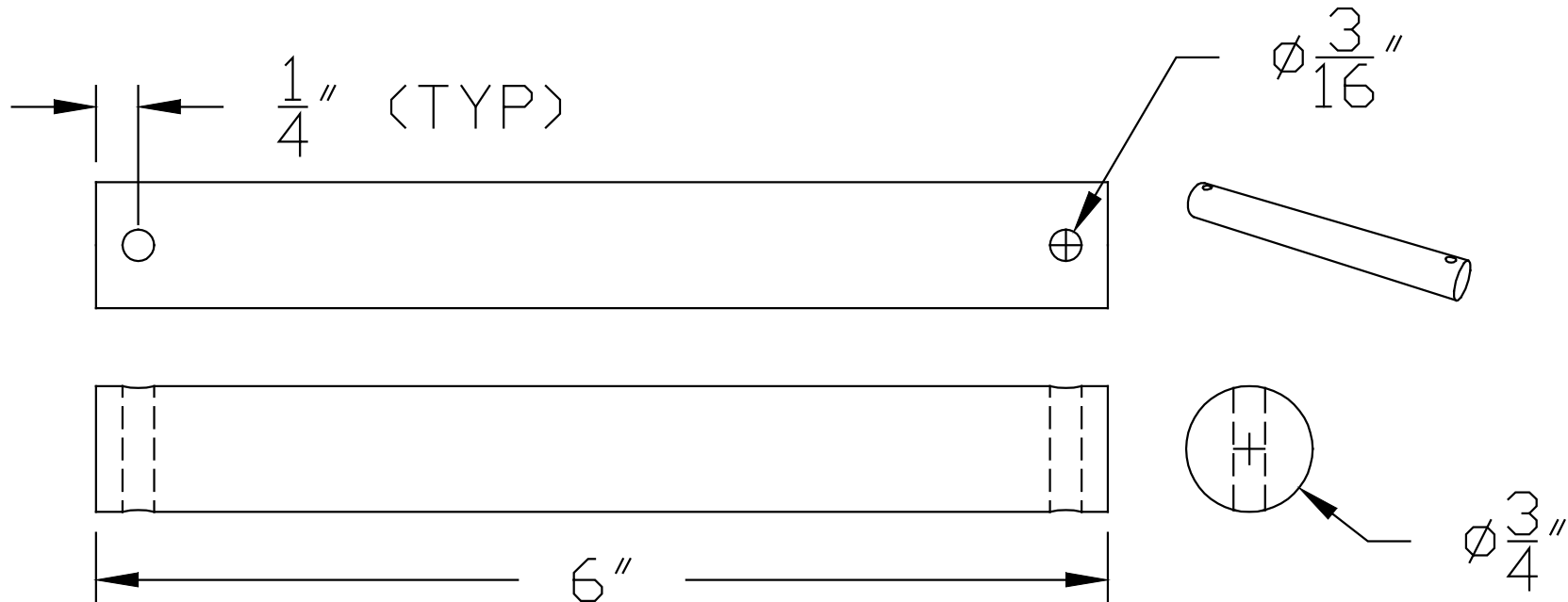
TOLERANCE: Unless noted all tolerances are ± 1/64. Angles ± 3'	RLT.COM, Inc.		
	PART NO. WW- 20		
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE		SHEET



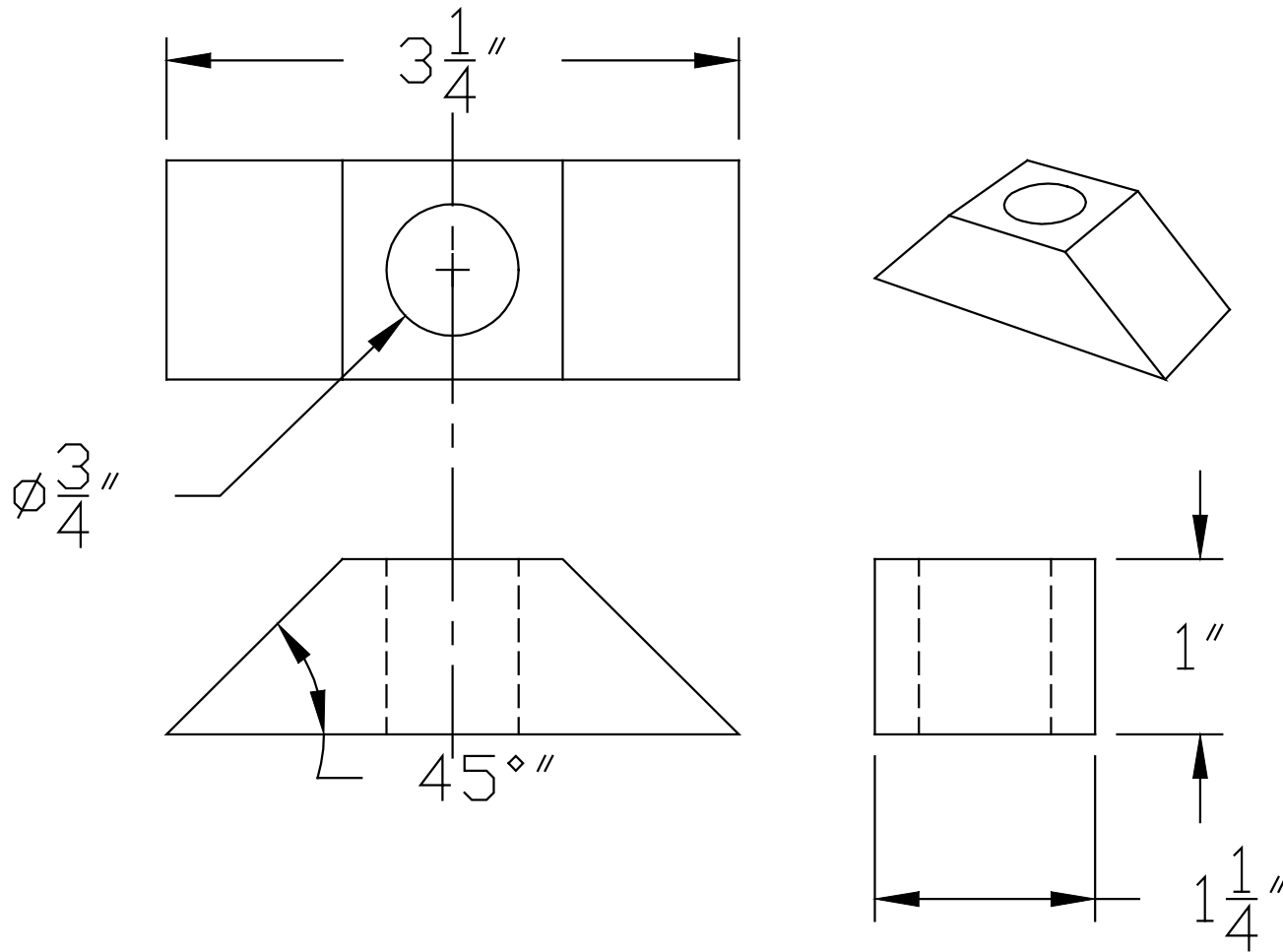
TOLERANCE: Unless noted all tolerances are $\pm 1/64$. Angles $\pm 3^\circ$	RLT.COM, Inc.		
	PART NO. WW- 21		
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE		SHEET



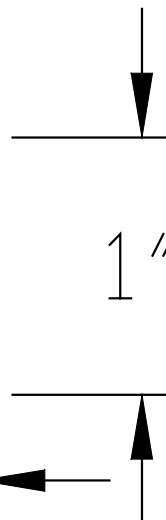
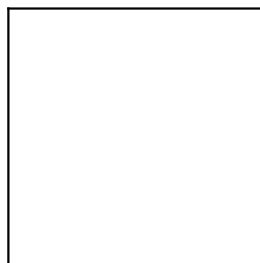
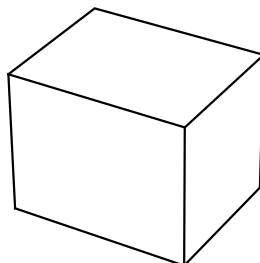
TOLERANCE: Unless noted all tolerances are $\pm 1/64$. Angles $\pm 3^\circ$	RLT.COM, Inc.		
	PART NO. WW- 22		
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE	SHEET	



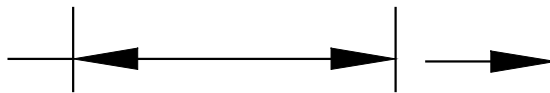
TOLERANCE: Unless noted all tolerances are $\pm 1/64$. Angles $\pm 3^\circ$	RLT.COM, Inc.		
	PART NO. WW- 23		
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE	SHEET	



TOLERANCE: Unless noted all tolerances are $\pm 1/64$. Angles $\pm 3'$	RLT.COM, Inc.		
	PART NO. WW- 24		
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE	SHEET	



$1 \frac{1}{4} //$



$1 //$

TOLERANCE: Unless noted all tolerances are $\pm 1/64$. Angles $\pm 3^\circ$	RLT.COM, Inc.		
	PART NO. WW- 25		
Material:	DWG APRV:	DWG NO. War Wolf	REV A
DWG BY: RRG	SCALE NONE	SHEET	