



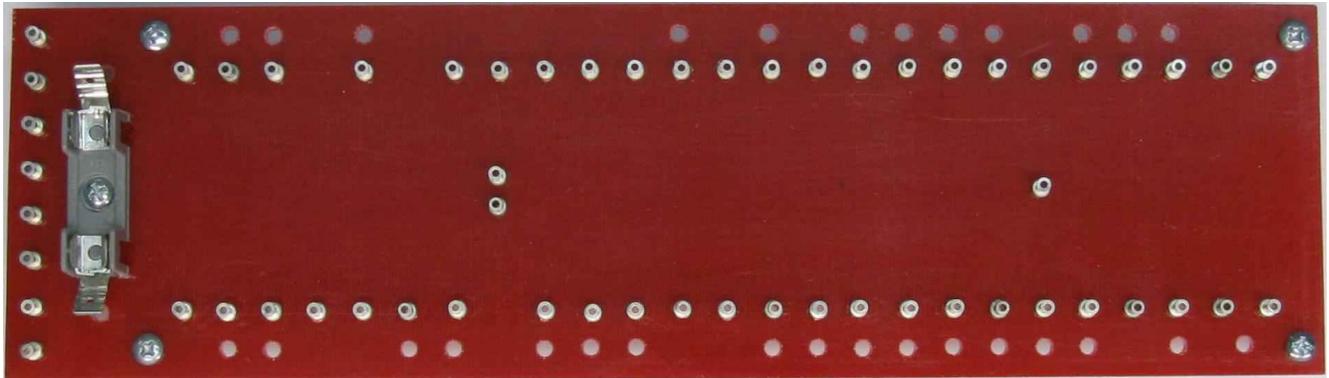
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How to Make Top Quality Turret Boards (with simple tools)



Robert Hull

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January 13, 2010

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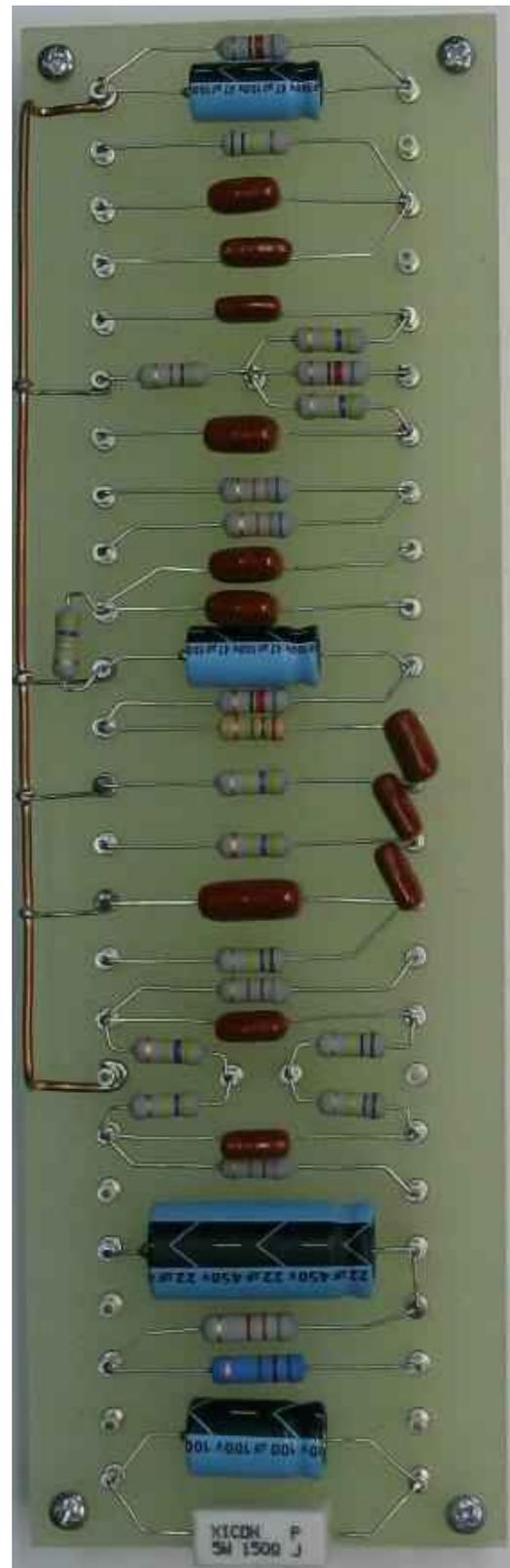
Preface

A turret board just speaks “superior cool”. And when installed in a tube amp, the look is pure industrial reliability and delicious tone. The typical reaction is something akin to, “after a thermo-nuclear attack, this amp will still sound great”. This is the kind of expectation we all want from our own amp creations ... immortality and great tone. And a well made turret board says it all.

So, instead of installing a pre-built turret board into your pride-and-joy creation, I'm going to show you how to build a quality turret board yourself ... even right on your dining room table and with minimal tools. These simple directions should have you building a turret board with great satisfaction and truly, the look of immortality, within no time.

So let's get started...

Robert Hull



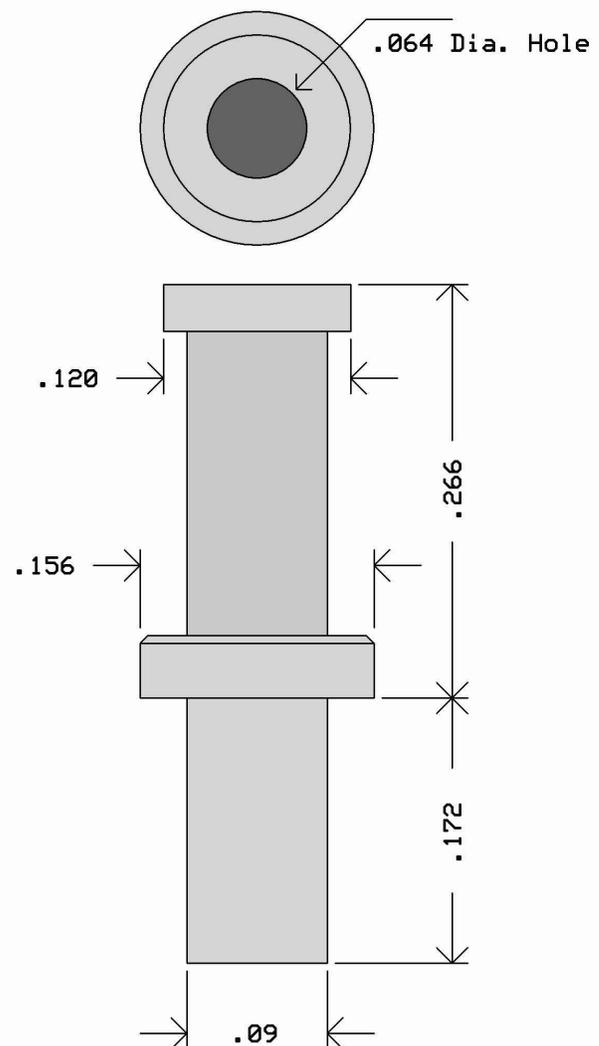
As with any project that utilizes hand and power tools, I like to begin with a quick safety discussion. Of course, safety isn't limited to only the below points. The most important safety consideration is to use good common sense when working with all tools.

1. Safety goggles or glasses should always be worn when using power and hand tools.
2. Keep loose clothing, hair or jewelry away from rotating drills.
3. Operate tools according to the manufacturer's instructions.
4. Use the right tool for the job and never use any tool without proper training.
5. Inspect tools before each use and replace or repair any worn or damaged tools.
6. Keep all work areas clean and clutter free.

GENERAL NOTE:

In the following discussions, all turret board construction will be utilizing 3 1/8" wide, 1/8" thick blank G10 epoxy board. The color of board materials may change as will the running length, however the above dimensions will remain the same. This is only my personal choice for dimensions and other thicknesses and widths are usable based on your preferences. The 3" width is great and widely available through many sources. Additionally, other standard thicknesses can be used with the appropriate terminal of choice.

As for turrets, I have chosen to use the Keystone 1540-4 hollow turrets exclusively. The Keystone 1540-4 terminal has been designed for 1/8" thick boards and a 3/32" mounting hole. There are many other great terminals (such as the 1525 or 1557 forked terminals) one could use. I have chosen the 1540-4 based on both its great economics and the connection options provided by this turret.



Keystone 1540-4

Building a turret board is great fun and doesn't require expensive tools. Several of the tools used in the following pages will be constructed before hand. Therefore, I've labeled the basic tools below as well as the tasks they are used for. I've separately listed the tools that will require do-it-yourself (DIY) construction as well any tools needed to build them:

Press Fitting Tools:

[Press Fit Turret Kit](#) includes:

[#43 drill bit](#) – used for creating holes in epoxy board for press fitting turrets.

Rubberized Work Mat – for supporting epoxy board while press fitting turrets

[TD Turret Setter Tool](#) – used with a hammer to press fit turrets into board.

Hammer – used with turret setter tool (DIY or TD) to press fit turrets into board.

Alternate Press Fitting Tools:

Hand Punch – for pressing holes in board instead of drilling.

[DIY Turret setter kit](#) – see DIY tools below for description.

Swage Fitting Tools:

[Swage Fit Turret Kit](#) includes:

DIY Swaging Tool and DIY Anvil Assembly – see DIY tools below for description.

[3/32" drill bit](#) – used for creating holes in epoxy board for swage fitting.

Drill press – for drilling holes in board and building DIY tools. Also for installing turrets.

Additional tools:

Center punch – for creating dimple in board before drilling (preferred tool).

Hobby Knife – for creating dimple in board before drilling and for deburring holes.

Permanent Marker, ultra fine tip – for making layout marks on board.

Hand Drill – for drilling holes in board and / or DIY tools.

[1/8" drill bit](#) – used for creating wire routing holes in epoxy board. Also for building DIY turret setter and DIY anvil.

[5/32" drill bit](#) – used for creating chassis mounting holes in board.

Flat File – for building DIY tools.

Hack Saw – for building DIY tools.

Flat Ruler – for measuring and laying out templates

DIY Tools - These are the turret installation tools that require the builder to construct before hand. The directions for building each of these tools can be found in the appropriate appendix sections at the end of this manual.

DIY Turret Setter (press fitting) – requires hack saw, flat file, and 1/8" drill bit and drill to build.

DIY Swaging Tool (swage fitting) – requires hack saw and flat file (lots of filing) to build.

DIY Anvil Assembly (swage fitting) – requires flat file and 1/8" drill bit and drill to build.

*I recommend reading **all** of the following pages prior to beginning any construction. The information contained here will assist you in choosing the best methods for building your turret board based on the tools you have available.*

Over the years of building turret boards, my personal experiences have shown that there are four major steps in creating a quality turret board:

- 1. Make a Template of the Circuit Layout**
- 2. Transfer the Template to the Board**
- 3. Create the Turret Holes in the Board**
- 4. Install the Turrets into the Board**

Depending on the tools available to you, there are various ways you can choose to complete each of the above steps. In the following pages, we will discuss each of the various tools and construction methods, allowing you to choose which is the best for your situation.

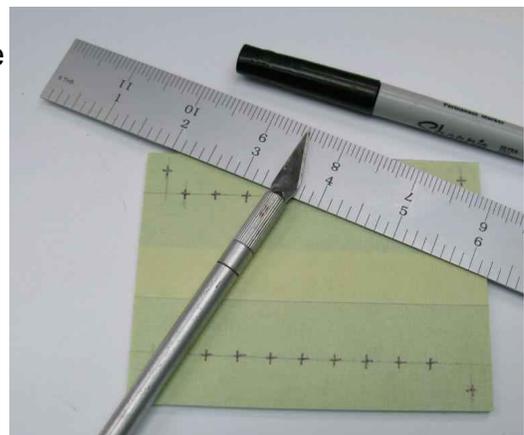
Step 1 - Making a Template of the Circuit Layout

This step is truly the hardest and most time consuming of the four steps. There are so many options and design decisions that make every template different. Even so, most designs are created from one or both of the below starting points:

1. Design a template from a previous layout or
2. Design a template from a schematic.

It is much easier to construct a template from a previous layout. With a layout to work from, it is possible to draw the components on the template in a similar fashion to the original layout. This is of course reliant on the original layout being correct.

Working from a schematic is much more challenging. The sizes of the individual components will need to be determined; the proximity of various components will need to be taken into account; the grounding of various stages will need careful attention. All of these are a bit beyond the scope of this discussion, but below are a few hints to help you design a good physical layout and eventually, a good drilling template.



1. **Determine the largest size board (width and length) you could theoretically use inside your chassis.**

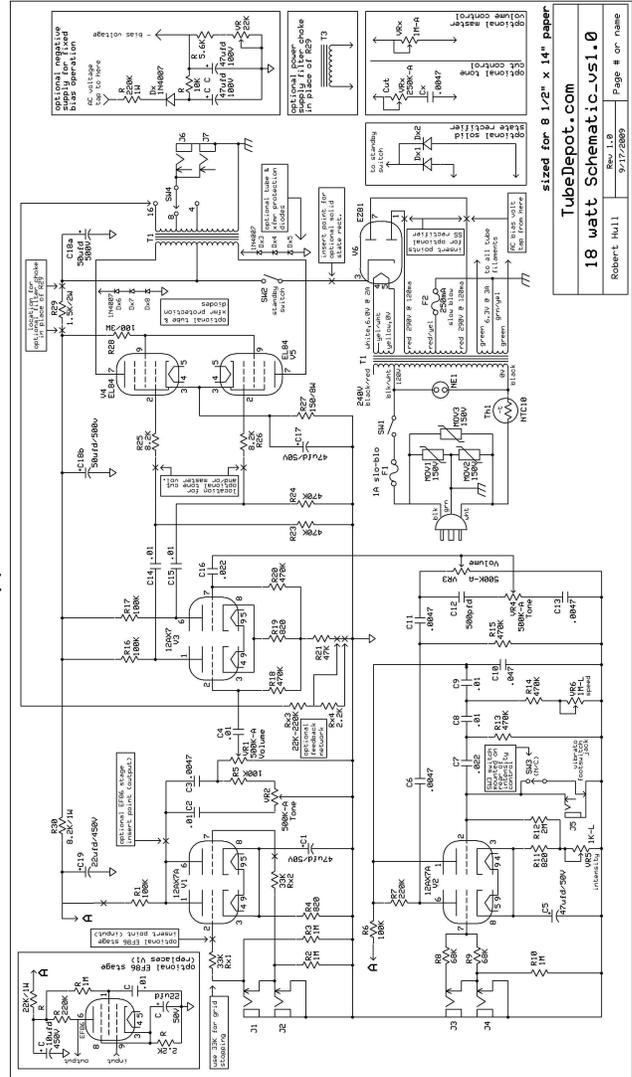
Take into account the jacks and controls on both the front and back panels, as they will take up internal space. These are only the maximum dimensions you could use, it doesn't mean you have to build a board this size.

2. **Locate several different amp layouts as reference.** This will help in scaling the size of the components in relation to each other as well as assist in laying out the various stages on the board. As you study these layouts, you will begin to see similar design trends which you can implement in your own designs.

3. **Draw your initial template out on paper.** Don't worry too much about exact scale right now. It is more important to get the components aligned correctly, scale will come in the final drawing.

4. **Check your design against the schematic.** Make sure all is correct. It is very important that your layout has the same electrical connections as the schematic or else the amp will not work when you install the finished turret board.

5. **Structure the layout to fit your board.** This is the point where you decide what size board to use (length and width) with in your chassis. Decide the final turret quantities and spacings. Eventually, all must fit within the limits of the board.



Here are three helpful guidelines to follow when structuring the physical layout of a board:

1. **The closest spacing from turret to turret should be about 1/4".** I prefer 3/8" myself which is a good distance that allows adequate space between most components without consuming too much space on the board. I use 1/4" spacing for mounting components in the middle of a board. For smallest lead to lead turret spacing of a single component is determined by the length of the body of the component, and a little extra for bending the leads. I find 1" is good for this.
2. **The farthest spacing from turret to turret should be about 2".** This is the farthest safe distance that most resistor leads can straddle. Most of today's components (resistors and capacitors) are designed for PC board mounting which does not require long leads. Therefore any stretches over 2" and the leads may not reach.
3. **Make room for mounting hardware.** The heads of screws and nuts take up space on a board so don't forget to provide room for hardware.

Scale drawing the template

A template can be just a drilling template with only marks for holes or it can be a layout representation with components and wires and such. Either is acceptable. My preference is usually the minimal drill template. I like seeing just the drill spots. Although, even in the process of designing a drill template, I will also make a full scale layout drawing of the entire board. This preliminary layout will have all the components and wires and could be used as the final template if I felt like using it. The properly scaled layout template is a way of verifying that the components will all fit on the final board.

Once you have a final drawing, it is time to draw the actual scale template. There are two options here, either draw the template on a sheet (or sheets) of paper, or draw it directly on the board.

I prefer paper templates for ease. Often I will make the design using the computer and print out a paper template. With this method, I can always recall the saved template if I want to make the same board again. However, a paper template has to be secured to the surface of the raw board before the design can be transferred to the board. This securing process can be inexact as the paper may shift during the transfer. And it is very difficult to realign a template once it has shifted. Even with these struggles, I still use this method the most.

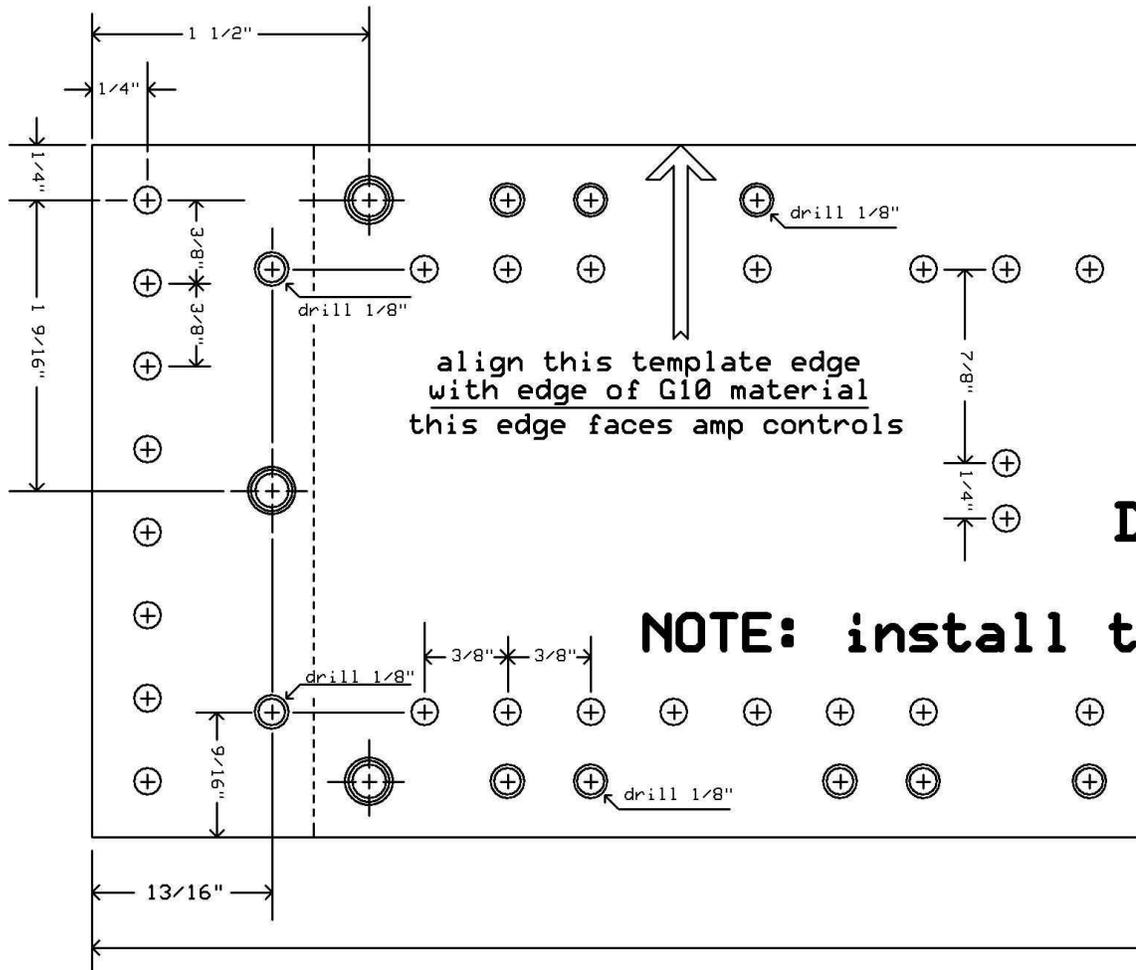
The second option is to draw the layout directly onto the board. When I've used this option, I will first place masking tape onto the raw board and draw the layout on the masking tape. This makes the marks easier to see as well as no layout marks are made directly on the board. The downside of this method is that if you want to make another board, you have to remeasure everything. This method is fast if building only one board.



Below is an example of a typical drill template.

There is not a standard distance between turrets. However, the below values are what I find most useful.

Note that I have identified the three hole sizes. Because each hole position is marked on the board at the same time, and all the marks look alike, it is important to keep the template near by when drilling the holes. In this way, you are less likely to accidentally drill the wrong size holes because the template can be referred to easily.



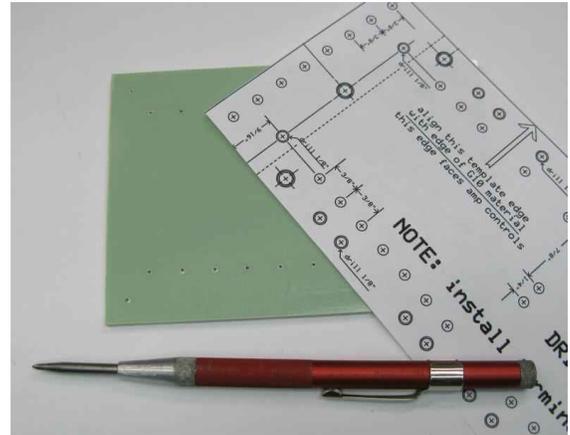
Drill Legend	
	drill 5/32" - mounting holes
	drill 1/8" - wire routing
	drill #43 - press fitting method or drill 3/32" - swage fitting method (see note 1)

NOTE 1 - for press fitting the terminals, drill with #43 bit
for swage fitting the terminals, drill with 3/32" bit

Step 2 - Transferring the Template to the Board

A paper template can be taped to the board. It is important to make sure the template can not shift during the transfer process or else the turrets will not be aligned properly when installed.

A template can be drawn directly on the board by applying masking tape to the board first and then drawing all layout marks on the tape. The downside with this method is that the template (masking tape) is difficult to remove from the board in one piece for reference during the drilling process.



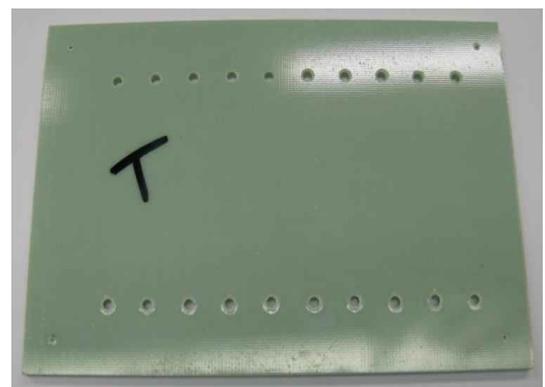
With your template attached to the raw board (whether as a paper template or drawn directly on the board), it is time to transfer the template information to the board. This is done by pressing holes through the template into the surface of the raw board with a sharp item, leaving a small dimple in the board surface.

The common tools used for this are a sharp hobby knife or a center punch. The hobby knife is easy to find and isn't very expensive. By simply placing the hobby knife's sharp blade tip on the appropriate template mark and spinning the hobby knife in the fingers, the resultant dimple made on the board is easily seen.

My preference is the automatic center punch because it is faster and leaves a more drill friendly mark on the board. Again, by simply placing the tool tip on the appropriate template mark and pressing down, the resultant mark is transferred through the template onto the board surface. The dimple generated by a center punch is correctly shaped to properly accept the tip of a drill bit.

Once all marks have been transferred, remove the template. Do not discard the template as you will need it to assist in identifying which holes to drill for turrets and which holes are for board mounting and wire routing.

This next hint is very important! I've messed up many turrets by not paying attention to this next step. Right after you have removed the template, place a sticker or a mark of some kind (a permanent marker or grease pencil works great), **on the top surface of the board that will receive the turrets**. This is very important because with out this mark, once the board is drilled. The two sides will look so similar that you may accidentally install the turrets on the wrong side. Turrets are very difficult to remove once they have been installed and they cannot be reused.



Step 3 - Creating the Holes in the Board

Once the template information has been transferred to the board, it is now time to create the holes in the board to accept the turrets. The turret hole size will be based on whether you want to install the turrets by press fitting or by swage fitting.

Drilling the Holes (press or swage fitting)

Keystone, the manufacturer of the 1540 style turrets we use here, recommends a 3/32" hole for proper swage installation. Swage fitting is where the inserted end of the turret, once installed into the 3/32" hole, is bent outward, tightly holding the turret in place.

Press fitting on the other hand, uses a hole slightly smaller than the diameter of the inserted end of the turret. The 1540 style turrets have a shaft diameter of .09". The nearest drill bit size that is slightly smaller is .089", or a #43 (wire gauge) drill bit. With press fitting, the turret is forced into this slightly smaller hole with friction holding the turret tightly in place.



Either method is acceptable and will hold turrets equally well.

For swage fitting, the 3/32" holes are easy to create as the only tools needed are the 3/32" drill bit and a drill, both of which are easy to locate at most hardware stores. You can use a hand drill or electric drill. However, the best results will be with the drill press as the holes will be straighter and more uniform. For this discussion, swage fitting requires a drill press.

For press fitting, the slightly undersized holes needed are either drilled with a #43 drill bit or they can be punched with a hand punch tool (see below). Drilling the holes is the fastest. However, finding a #43 drill bit locally is usually a challenge so this critical component usually must be special ordered (TubeDepot.com has this bit in stock). Additionally, with hand drilling, the results rarely lead to perfectly uniform mounted turrets. Drill bits often do not drill straight and therefore some level of inconsistencies will be expected.

Hand Punching the Holes (press fitting only)

Another way to create holes for press fitting is to use a hand punch. The hand punch is found in various discount hardware stores and is most often used for metal working. However it can easily be used with the G10 epoxy board. The hand punch makes straighter, more uniform holes than any drilling. Of course, this is contingent on having drawn an accurate layout and accurately transferred that template.



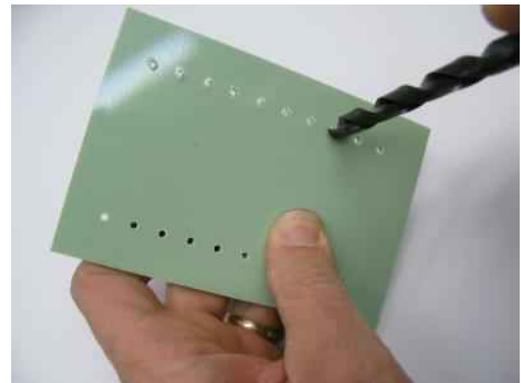
The hand punch is wonderfully easy to store in between uses. The largest downside is the hand punch requires a good bit of physical strength to punch through 1/8" G10 epoxy board. The typical board will have 20+ turrets so that is a lot of work. I admit, after 10 or so turrets, I break into a sweat nearly every time. But for quick construction or when access to a drill is limited, the hand punch tool is a great option.

The hand punch is used with the included 3/32" punch and die. Normally, this would be the hole size for swage fitting. However, when a 3/32" hole is created in the epoxy board with the hand punch, the epoxy G10 material is compressed outward as the tool is pressed through it. Once the punch tool is pulled from the punched hole, the compressed G10 material decompresses and the remaining hole is slightly less than 3/32". This becomes the perfect size hole for press fitting turrets.

Deburring

Finally, after creating the holes in the board with either of the above two methods, the holes should be cleaned up and deburred. This involves removing any excess material around the holes with either a countersink tool or hobby knife or even a large drill bit (as shown). The goal is to have the entrance and exit holes of each turret hole in the board, free from any unnecessary material.

After all the holes are drilled and appropriately deburred, it is time to install the turrets.



deburring by hand with larger drill bit

Step 4 - Installing the Turrets into the Board

Now that you have all the holes drilled, you have your template near by for reference, your board is properly marked which side is the top, it is time to to start inserting turrets.

As mentioned previously, there are two methods for installing turrets into a glass epoxy G10 board:

1. Press Fitting
2. Swage Fitting

The following pages will demonstrate these two methods, starting with press fitting.

Press Fitting

The press fit method requires the least expense in tools. Additionally, it is the method that can be done on just about any surface, including the dining room table. The ease in clean-up is nice too. So let's jump in with what tools will be needed.

Turret Setter (hand made or purchased from TubeDepot.com) – This is the tool that will be placed over the turret and beaten brutally with a hammer. All ending with a perfectly placed turret flush on a G10 board. It can be either hand made (as described in one of the appendixes) or it can be purchased from TubeDepot.com.

Hammer – I recommend a ball pein hammer but any small to medium hammer will work fine.

Rubberized Work mat – A good, soft, thick (min 1/16") work mat is a must when press fitting. It allows the ends of the turrets to extend past the epoxy board without being obstructed by the work surface. As well it protects the work surface (often a valuable dining room table) from damage. A 12" x 12" size is perfect. I found that the smooth rubberized non-adhesive mat material used as kitchen draw liners is quite good. Be sure to get the thicker 1/16" type. A roll can be purchased from hardware stores or the exact size purchased for less money from TubeDepot.com.

TubeDepot.com
Turret Setter



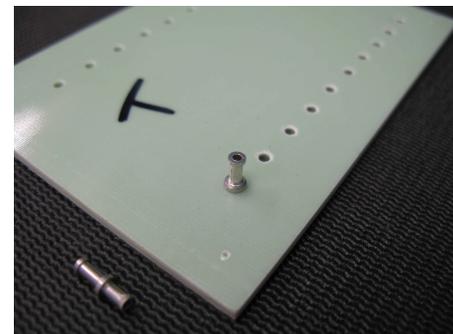
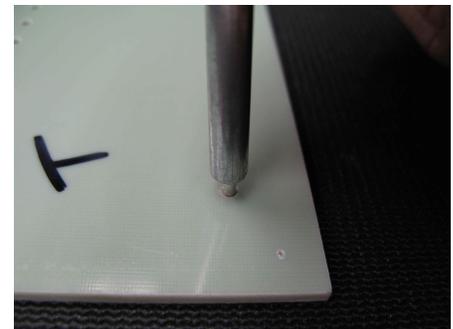
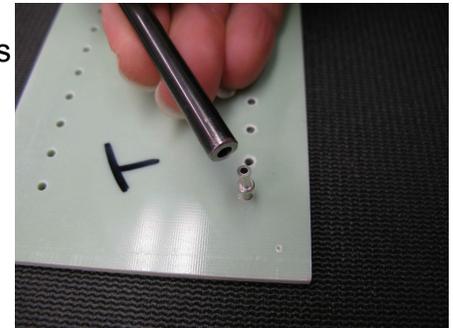
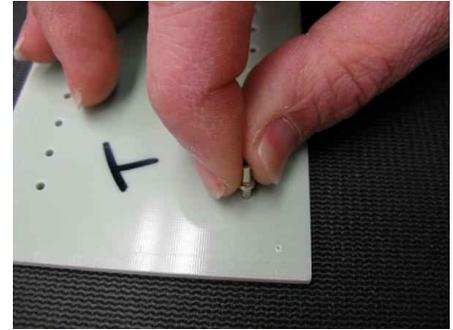
DIY Turret Setter

The steps for press fitting:

1. Place the rubberized work mat on a flat solid surface.
2. Lay the drilled epoxy G10 board on the mat with the side that the turrets are to be installed facing up.
3. Using the fingers, press a turret slightly in to a hole
4. Place the turret setter tool over the turret, holding the tool firmly against the turret.
5. Hammer the turret until it is firmly flush into the board
6. Repeat the above until all turrets are installed

Once all the turrets are inserted, you can use the turret tool to straighten any turrets that are not exactly straight up and down. It is amazing how quickly the turrets go in with this press fit method.

That is all there is to it ... you'll be done in no time.



Swage Fitting

If you have access to a drill press or if you are planning on making several boards, then the swage method is clearly the better choice. With the proper swage tools, putting together a turret board is fast, more accurate, and consistent. The only hurdle is making the specialized tools below.

Tools needed for swage fitting:

DIY anvil and swage tools – hand built from easy to find hardware. The directions are in one of the appendixes at the end of this manual.

Drill press – A small bench top version is just fine. The pressure needed to properly swage the turrets is minimal and easily capable with any drill press.

The steps for swage fitting:

1. Install the anvil and the swage tools into the drill press.
2. Properly align the tools together in the drill press and firmly tighten into place.
3. Insert a turret upside down into the anvil assembly.
4. Place the epoxy board over the turret and into the hole in the board.
5. Lower the swage tool firmly into the exposed turret end.
6. Flare the turret end out into a cone shape with steady pressure from the swage tool.
7. Raise the swage tool and remove the epoxy board with the now installed turret.
8. Repeat for all turrets.

You will find that with the swage method, installation is very quick and efficient. Additionally, the turrets are uniformly inserted making for some great looking boards.



Summary

With this manual, the process behind building a turret board couldn't be easier. We've discussed the press fit and swage methods of creating a turret board as well as the tools involved in each method. We covered the building of the specialized tools as well as secret hints regarding layout and drilling templates.

We showed step-by-step directions on installing the turrets for each method as well as short cuts to making the installations easier.

By using this manual as a guide, your turret boards will be nothing short of beautiful. And even though most people will never see how cool your boards are, you will know they are there. And knowing is half the joy. The other half is how great they sound. I imagine they would survive a thermo-nuclear attack, and keep on playing.

If you have any questions or comments, please send them to:

Robert Hull
tech@tubedepot.com

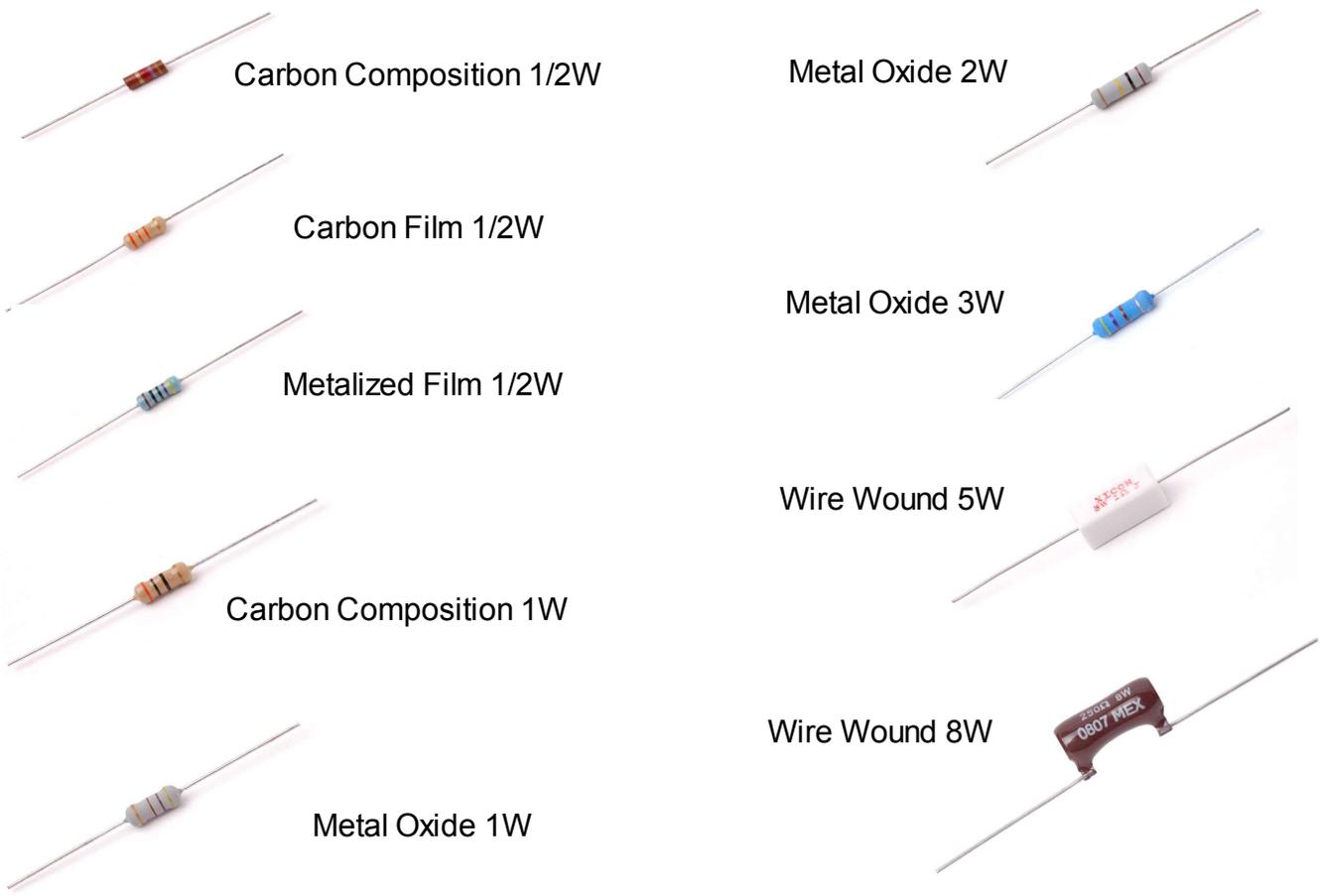
Resistor and Capacitor Codes

Every project uses different types of resistors and capacitors. The diagrams below will assist you in locating and identifying values, tolerances and ratings for the various circuit requirements for your projects.

Resistor Power Ratings

Not only are resistors graded by their values but also by their power ratings. Power ratings are determined by how much heat (power) can be safely dissipated by the resistor. Higher ratings are usually indicated by larger sizes.

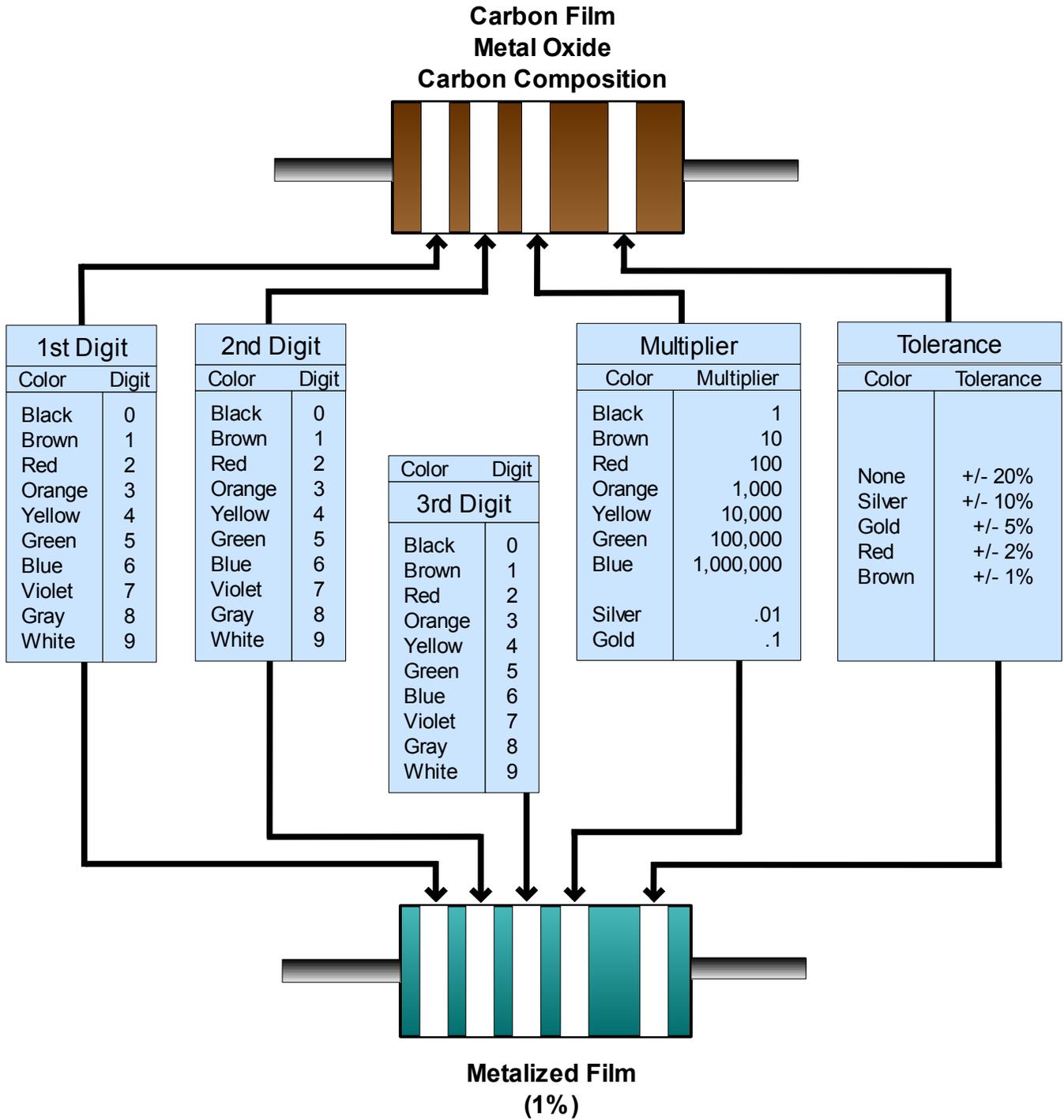
Below are photos and descriptions of various resistors that could be used in your project.



Resistor Value Color Codes

Most electronic components are so small that printing the actual values, ratings and tolerances on the individual component is nearly impossible. Therefore, codes were invented early on in electronic history and were printed on the components to describe what values they were. Many of these codes are still used today.

Below I've listed some of the more common codes that you are likely to come across.



Capacitor Value Codes

This project uses several different kinds of capacitors. Some have their values and voltage ratings printed on them, others use numerical codes. The diagrams below will assist you in locating and identifying capacitor values, tolerances, and voltage ratings for these components.



Cornell-Dubilier Silver Mica – high quality / high accuracy picofarad cap

1st line: 250 +/- %5 = direct value in pfd (250pfd); tolerance 5%
 2nd line: 500V SM = voltage rating (500V); batch code



Sprague "Orange Drop" 715 series – Vintage style film & foil polypropylene capacitor.

1st line: 715P600V = 715 series; rated at 600V
 2nd line: 104J 0821 = value in pfd (104 = 10 and 4 zeros pfd); tolerance (J = +/- 5%); batch code

104 = .1ufd
 103 = .01ufd 223 = .022ufd 473 = .047ufd
 102 = .001ufd 222 = .0022ufd 472 = .0047ufd



Xicon Metalized Polypropylene – Warm tone, small size

1st line: F104K d = value in pfd (104 = 10 and 4 zeros pfd); tolerance (K = +/- 10%)
 2nd line: 630MPP 1 = voltage rating (630V); construction (MPP = metalized polypropylene)

104 = .1ufd
 103 = .01ufd 223 = .022ufd 473 = .047ufd
 102 = .001ufd 222 = .0022ufd 472 = .0047ufd



Sozo and Mallory 150 Film and Foil – Vintage style film & foil polypropylene capacitor, axial leads

1st line: 684K = value in pfd (684 = 68 and 4 zeros pfd); tolerance (K = +/- 10%)
 2nd line: 160V = voltage rating (160V)
 3rd line: 0834R = batch / date code



104 = .1ufd 684 = .68ufd
 103 = .01ufd 223 = .022ufd 473 = .047ufd
 102 = .001ufd 222 = .0022ufd 472 = .0047ufd

Soldering Hints

Anyone working in electronics should make time to learn how to solder well. Thankfully it isn't hard, it just takes practice and having the proper tools. Once you are able to solder well, your projects will be more professional and more reliable.

Refer to our video "How To Solder" for detailed explanations.
http://www.youtube.com/watch?v=cIDydYIVTqU&feature=channel_page

But before you get started, here are a few safety tips that should be followed:

- Fumes from soldering can be harmful therefore it is important to always have adequate ventilation.
- Wear appropriate clothing when working around hot, molten solder. Never wear shorts or open toes shoes.
- protect hands and equipment from burns by using a soldering iron holder. An improperly stored soldering iron is a fire hazard
- Do not eat, drink, or smoke while you are soldering. Limit exposure to lead.
- Wash hands often when soldering.
- Wear safety glasses when soldering.

Purpose of Soldering

Soldering is used to bond two or more metals together. By applying heat to a connection and feeding solder into this connection, the solder will melt and flow around the metals. A small surface amount of each of the metals will additionally melt and inter-mix with the liquid solder forming an alloy. This connection is called an inter-metallic bond and the two metals, when properly soldered together, act as if they were one solid piece.

Importance of Proper Soldering

Proper soldering is the basis for faithful equipment operation. A good solder connection is physically strong and electrically reliable. A poorly soldered connection will have intermittent operation which can cause electrical damage to neighboring components. At the very least, a bad solder connection will create an unpleasant audible experience. Therefore the importance of good soldering skills cannot be over emphasized. Your sound will rely on it.

Basic Soldering Rules

The following are some basic soldering rules that if followed, will result in reliably soldered connections every time:

1. Make sure the surfaces to be soldered are clean and free of corrosion. A dirty, greasy, or oxidized surface will not accept solder properly, creating an intermittent solder connection.
2. Establish a firm mechanical connection of the components prior to soldering. Solder should only be used to develop an electrical connection and not a mechanical one.
3. Insure that the soldering tip is clean prior to any soldering. A clean solder tip is one wiped lightly across a damp sponge to remove oxides prior to use. It is essential for maximum heat transfer that there are few contaminants on the tip.

4. When applying the soldering iron to a connection to be made, it is important to lay the tip in such a position that the maximum surface area of the tip is presented to the connection. In this way, the maximum heat is transferred to the connection in the minimal amount of time.
5. Apply solder to the work and not the iron. In this way, a properly heated connection will readily accept the solder, further reducing the chances for unreliability.
6. Use only clean, good quality, rosin core solder. Poor quality or dirty solder will not melt smoothly and will deposit contaminants into the connection, making it weak.
7. Use only the amount of solder needed to complete the connection. Use too little solder and the connections is compromised where as too much solder runs the risk of accidentally contacting neighboring connections.
8. Finish the connection by removing both the solder and the soldering iron quickly and at the same time. It is important to apply heat only for as long as is needed to properly flow the solder. Any additional heat runs the risk of overheating the parts being soldered.
9. Do not move the parts of the connection while the solder is hardening. It is important that everything stays totally still until the solder has fully set because any movement in the parts while the solder is in a plastic state will result in a weak, unreliable, and cracked connection.
10. Clean any rosin residues from freshly made solder connections. Rosin residues can trap moisture, dirt and dust that could weaken a connection and possibly create arcing conditions. Isopropyl or ethel alcohol and a stiff bristled (acid) brush are good for this.

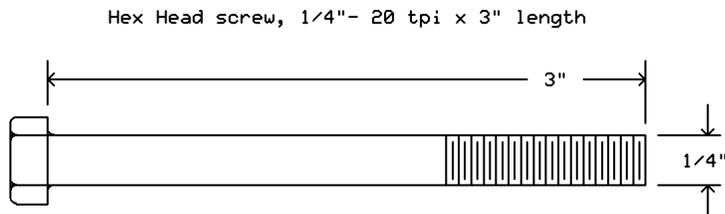
Sequence of Events in Making a Good Connection

1. Make sure all surfaces to be soldered are clean and free of oxides.
2. Establish a good mechanical connection of the components prior to soldering.
3. Place the tip of the iron firmly against the connection to be soldered.
4. Let connection reach soldering temperature (usually within 1 to 2 seconds).
5. Feed solder into the point where the soldering iron tip meets the connection, not on to the tip of the soldering iron.
6. Feed an adequate amount of solder into the connection for the solder to flow around the components to be joined.
7. When adequate amount has been reached, remove solder and iron simultaneously.
8. Do not move connection or components until solder has solidified.
9. Clean rosin residue from connections.
10. Clip off any excess wire lead(s).

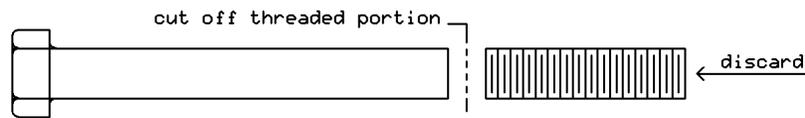
DIY Turret Setter Construction

Here are the directions for building the DIY Turret Setter:

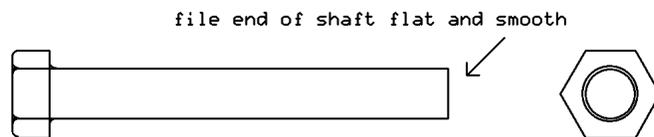
Start with a 1/4" - 20 tpi x 3" hex head bolt:



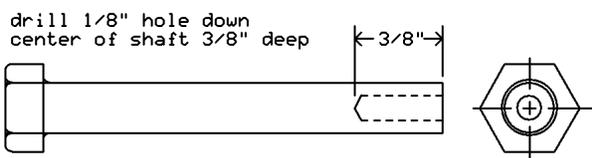
Cut off the threaded portion and discard:



File the cut shaft flat and smooth:



Complete by drilling a 1/8" diameter, 3/8" deep hole in the center of the shaft at the cut end:



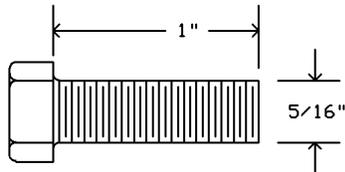
Appendix D

DIY Anvil Construction

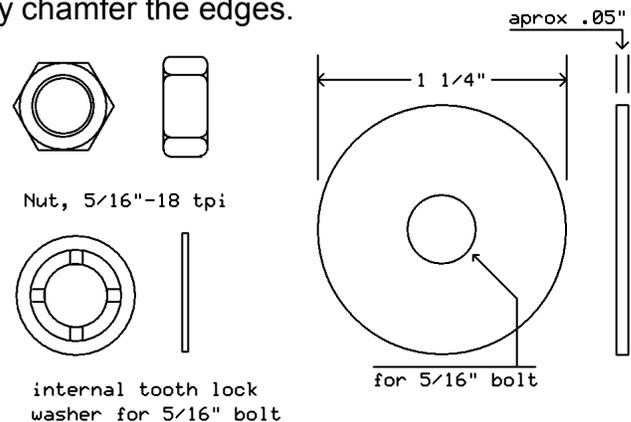
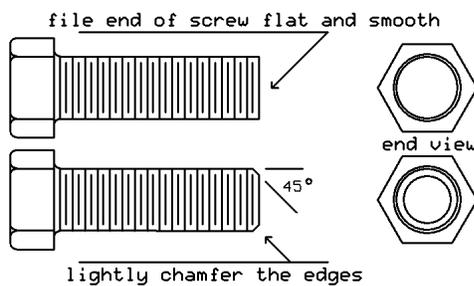
Here are the directions for building the DIY Anvil:

Start with a 5/16" - 18 tpi x 1" hex head screw

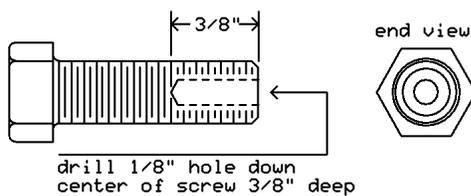
Hex Head screw, 5/16"-18 tpi x 1" length



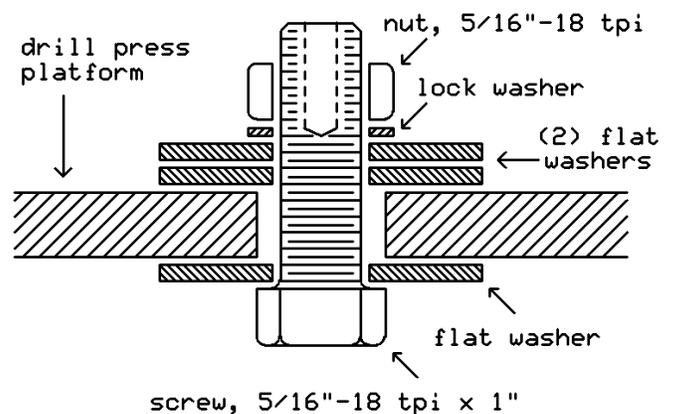
File the threaded end flat and smooth. Then lightly chamfer the edges.



Drill a 1/8" diameter hole, 3/8" deep down the center of this flat and chamfered end.



cross sectional application



Assemble the unit as shown with the three flat washers, the one lock washer and nut.

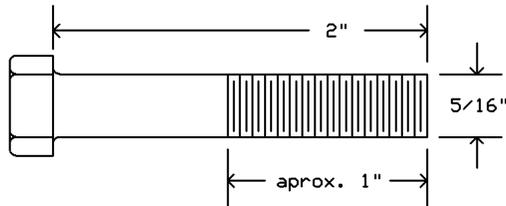
Appendix E

DIY Swage Construction

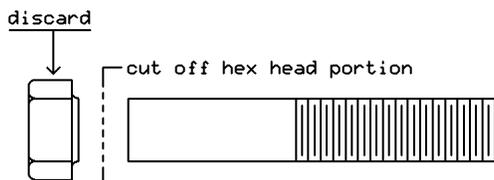
Here are the directions for building the DIY swage:

Start with a 5/16"-18 tpi x 2" hex head screw

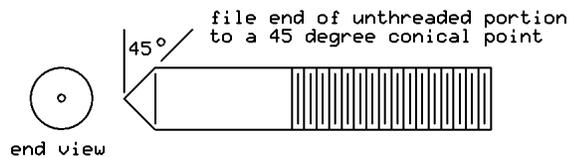
Hex Head screw, 5/16"-18 tpi x 2" length



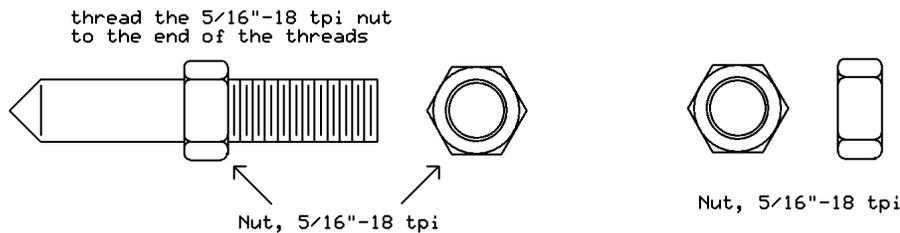
Cut off the hex head portion



File the unthreaded end to a conical point. This can be accomplished by inserting the threaded end into a drill press and with the material spinning, file (or grind) the unthreaded end until it is shaped like below.

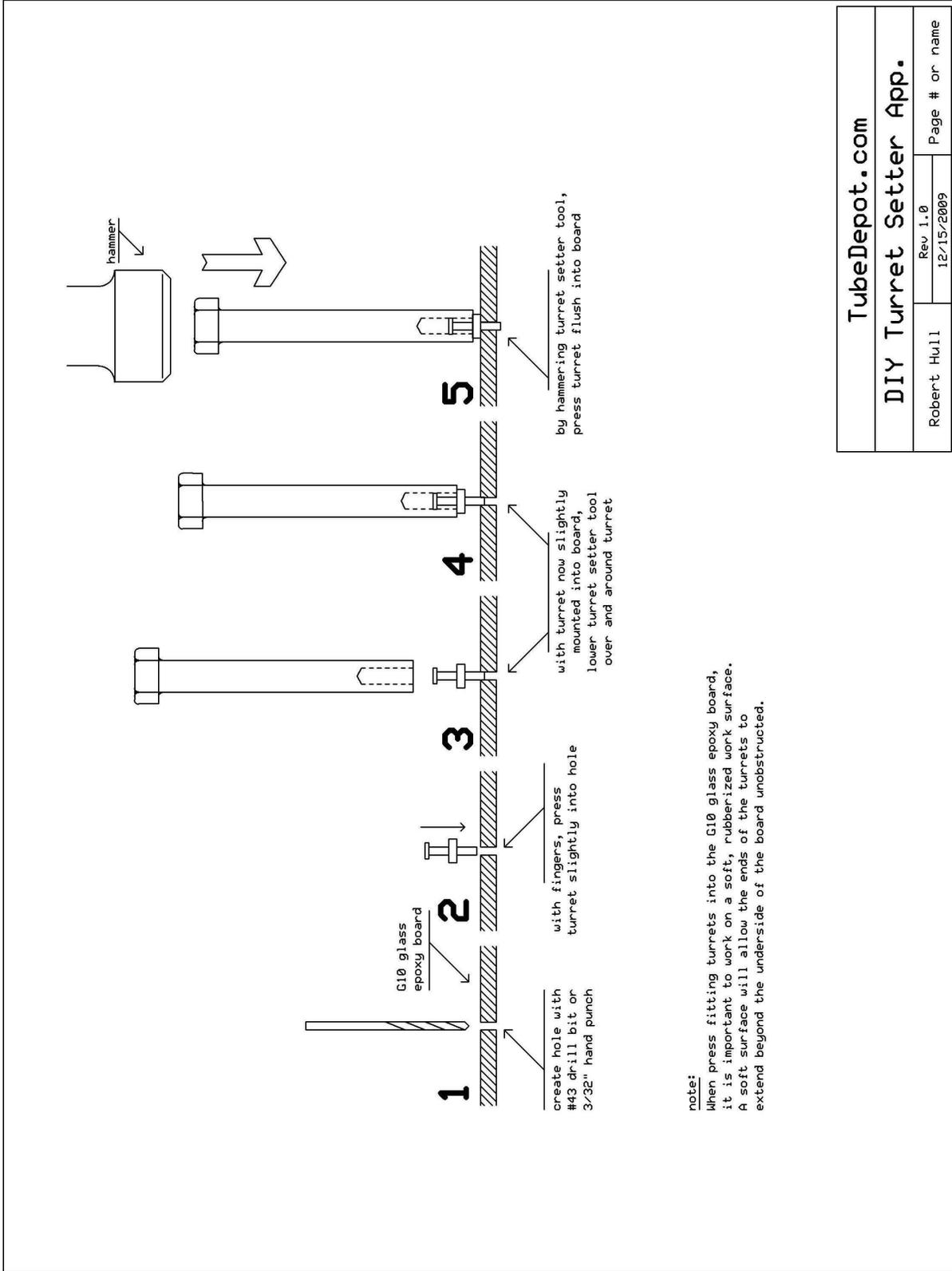


install 5/16"-18 tpi nut to the end of the threads



Appendix F

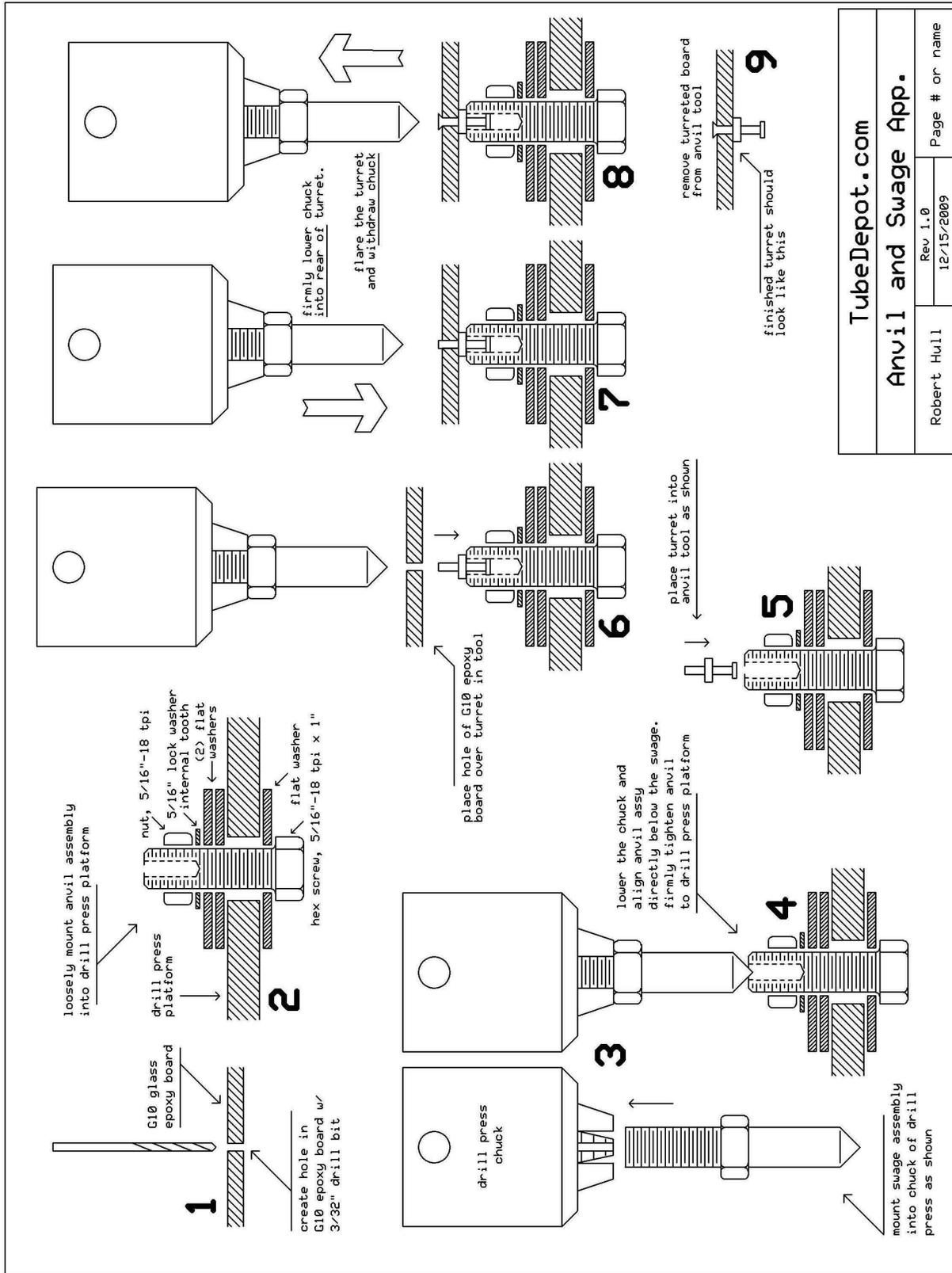
How To Press Fit Turrets



TubeDepot.com	
DIY Turret Setter App.	
Robert Hull	Page # or name
Rev 1.0	12/15/2009

Appendix G

How To Swage Fit Turrets



TubeDepot.com	
Anvil and Swage App.	
Robert Hull	Page # or name
Rev 1.0	12/15/2009