

HORNET

Sport Gyroplane Documentation



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1. Safety Notice

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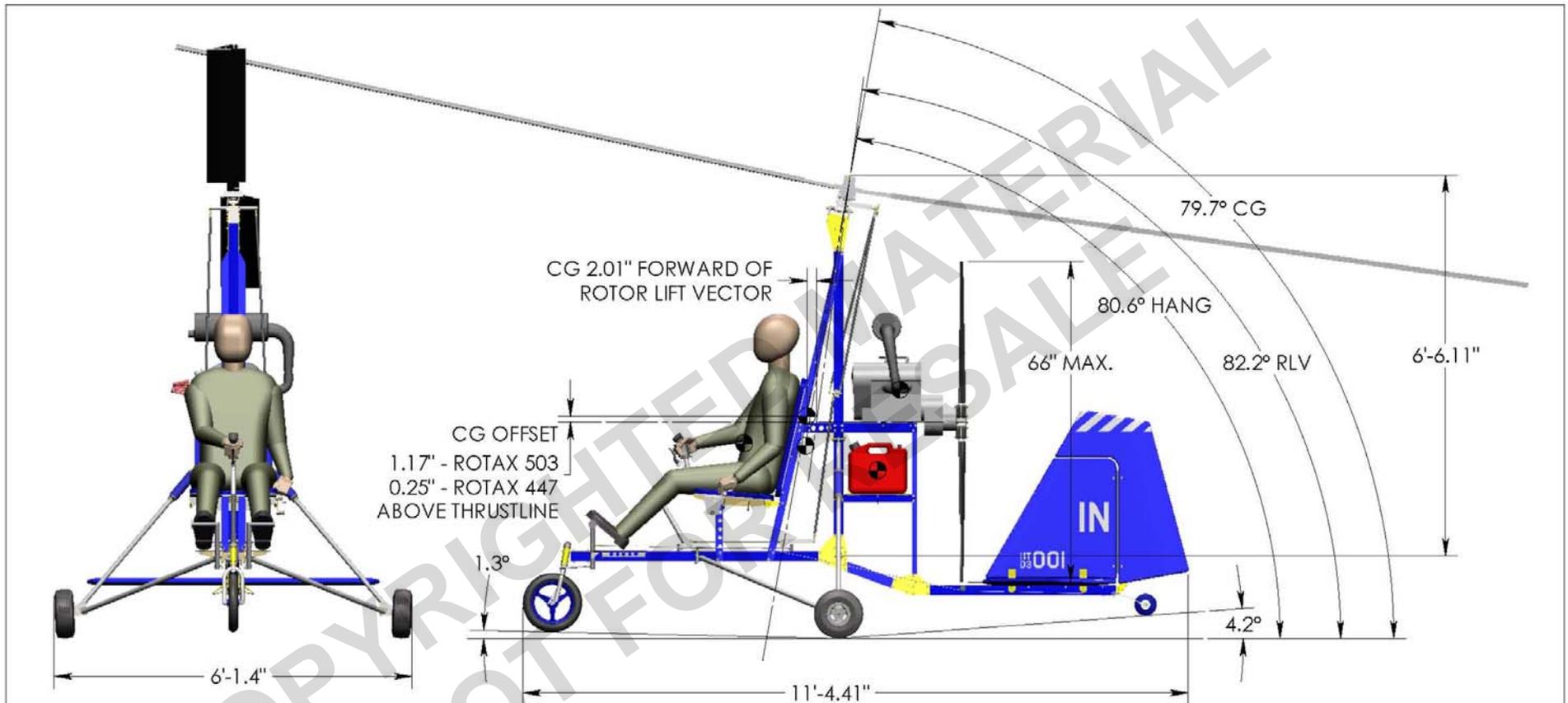
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Note: CG location shown with Rotax 447 engine.
 Max. Empty Weight: 254 Lbs.
 Max. Pilot Weight: 250 Lbs. (CG shown w/ 225 Lbs. pilot)
 Max. Speed: 63 Mph
 Fuel Load: 5 Gallons (CG shown w/ full fuel load)
 Engine: Rotax 447 w/ type "B" gear box, 503DC Max.
 Propellor: 60" to 66" Powerfin
 Range: Approx 45-55 Miles

HORNET

3. Purpose

The purpose of this document is to provide an understanding of what is necessary to build an autogiro. This document is written with the assumption that the reader has a fair degree of experience with rotary winged aircraft, specifically, autogiros. No specific details are provided regarding a rotor head and it's mounting. Also excluded from this document are the necessary instructions regarding the selection and installation of an engine.

4. Acknowledgments And Sources

4.1 The GyroBee

First and foremost, I must thank Ralph E. Taggart (Gyrobee@aol.com), designer of the GyroBee gyroplane. If it were not for his efforts, I would have not had the inspiration to go forward with the design of the Hornet. The GyroBee documentation package, on which the Hornet airframe documentation package is based, can be downloaded for free from Mr. Taggart's GyroBee website at <http://taggart.glg.msu.edu/gyro/>. I strongly suggest that you download a copy to use as a reference when you read this document.

Although specific references to the Hornet are not made in the GyroBee documentation package, almost all of the below mentioned disciplines will translate very easily. Portions of the following information and paragraphs, have been extracted (copied, lifted, stolen, etc.) from the original GyroBee documentation, with Ralph's permission of course. Thanks Ralph!

4.2 Internet Resources

Many of the design considerations and changes made to the Hornet were as a result of various online resources, forums, news groups, and discussion boards. These sources are too numerous to name. A search of the Internet will turn up a number of these sites for more information.

One specific Internet resource is the Hornet Autogiro Group, located within Yahoo (<http://groups.yahoo.com/group/hornet-autogiro/>). The Hornet Yahoo Group is by far the most active Internet site specific to the Hornet. It's worth the time to visit!

5. General

5.1 Events leading up to the Hornet

In Ypsilanti, MI, located on the grounds of Willow Run airport is the Yankee Air Force Museum. This is where I saw my first gyroplane up close. Because I lived so close to the airport, I spent a fair amount of time studying the old Bensen gyro. After several months of poking around this strange little craft, I became active in a local Popular Rotorcraft Association chapter (PRA chapter 63, The Central Michigan Gyroplane Club, Maple Grove Airport, Fowlerville, MI). Shortly after I joined the club, I somehow managed to get “volunteered” as their new Vice President, for 2 terms no less. I didn’t realize being drafted could be so enjoyable. For a time, I was also the Vice Safety Officer and Co-Librarian. Part of my duties as the Vice Safety Officer required me to also be an FAA Aviation Safety Counselor at the Detroit FSDO, which just happened to be located right next door to the YAF.

During my time at PRA 63, I had been exposed to many different gyros - Air Commands, Dick DeGraw’s Gyrhino, the GyroBee, and later on, the HoneyBee. I was immediately drawn to the GyroBee and HoneyBee because of the simple construction techniques used to build these gyros. I had been playing with a number of radically different gyro ideas, but they were all too big and complex to have any hope of ever being completed.

So I decided to start with something smaller and a little less complex. I would use the experience gained from the smaller project as a base for bigger design projects. Even though the GyroBee and HoneyBee are simple aircraft, I determined that an even simpler variation could be designed. This is the reason that I decided to design the Hornet.

5.2 Limitations

It is extremely important to understand that this document should not be used as a construction manual. To fully understand this document, a level of gyro experience and knowledge is required. A general knowledge of gyro flight characteristics, basic aerodynamics, and a good mechanical aptitude are absolute minimums. If you don’t understand these areas, then by no means should you attempt to build a gyro using any part of this document.

If your intention is to build a Hornet, **despite all previous warnings**, you must have a solid understanding of why the aircraft is configured the way it is. If you don't understand some of the critical design choices that were made, it is quite possible that any modifications you make will **result in an aircraft that is dangerous to fly!**

6. Design Considerations

6.1 Flight Controls

Through the unfortunate experiences of others, I've learned a very valuable lesson about flight controls. Flight controls are the most important link between you and the aircraft. They must be reliable! Your life depends on it. Over-killing the design of the flight controls is not a bad thing, so long as they retain freedom of movement and are smooth. Except for a small number of less critical items, all of the components that make up the flight controls on the Hornet are fabricated from 4130 steel. There is a small weight penalty for this, but I figured that the gains in reliability far out weighed any penalty.

6.2 Static Stability

6.2.1 Forces Acting On A Gyro

As with all aircraft, there are four (4) main forces acting upon a gyro - lift, gravity, thrust, and drag. Besides these forces, there are other factors that must be taken into consideration, such as the center-of-gravity (CG), the center-of-drag (CD, or Center-Of-Pressure), and the rotor-lift-vector (RLV).

6.2.1.1 Center Of Gravity

The CG is easy enough to understand. It is the point where there is an equal amount of weight in all directions. Everything with mass has a CG, and if you were to somehow balance a gyro on a post at the CG, the gyro would not move. You could push the gyro around with your finger and (for the purpose of the document) it would not fall off of the post. In other words, a body with mass, has a CG, and that body will attempt to rotate about its CG when a force is applied to the body that is not directed through the CG. If the applied force is not passing directly through the CG, the body will rotate about the CG.

6.2.1.2 Center Of Drag

The CD is a little harder to describe. Every item on a gyro that is in the air stream produces drag. This drag is distributed across the frontal area of the gyro. At some point vertically and horizontally, there is an equal amount of drag above, below, left and right. This point is commonly referred to as the center-of-drag (CD). On a gyro, the CD is almost never in close proximity to the CG vertically. Because most gyro's are controlled through the use of an offset gimble style rotor head, as the pilot pitches the gyro up and down, the location of the CD will also change up and down. Because the CD is rarely on a horizontal plane with the CG, drag can influence the pitch of the gyro.

The drag on a gyro as it fly's through the air is essentially constant, except for the rotor blades because of their rotation. As a general rule of thumb, thrust and drag will cancel each other out at a specific airspeed. Joystick control inputs in pitch influences the angle-of-attack (AOA) on the rotor disk, causing the amount of drag produced by the rotor disk to change. The higher the AOA, the higher the drag, and conversely. Therefore, as rotor drag increases, airspeed will decrease until the total drag of the gyro becomes equal to thrust. If the rotor disk AOA is lowered to zero degrees, causing the blades to become unloaded, drag on the rotor disk and blades becomes virtually nil, and the CD be at a lower position. This lower rotor disk AOA will also allow the gyro's airspeed to increase, which will increase the drag on the remaining portions of the gyro causing the CD to drop even more.

6.2.1.3 Rotor Lift Vector

The RLV is the combination of two (2) forces; the lift created by the rotor blades, and the drag on the rotor blades. The RLV is more theoretical in nature, but often proves to be a simpler method of design and explanation than trying to separate lift and drag forces. Since drag is to the aft, and lift is up, the RLV falls on an angle somewhere between these two (2) forces. The higher the drag on the rotor blades, the more the RLV angle swings forward from the teeter bolt in the rotor head. The greater the lift on the rotor blades, the more the RLV swings aft. The RLV always passes directly through the center of the teeter bolt of the rotor head. A simple way to visualize the RLV is to tape one end of a piece of string to a small weight, like a block of wood. Let the wooden block rest on a table and then pick up on the other end of the string until there is no slack in the string. The string represents the RLV, and your hand is the rotor blades, more specifically, the teeter bolt where the rotor blades are attached. If you move your hand to the right (which represents an increase in drag) but allow the weight to continue to make contact with the table, the string holds a straight line at some angle between the weight and your hand. If you lift your hand (increase in lift) the weight will try and swing under your hand.

On a gyro, the RLV must pass behind the CG to maintain static stability. If the RLV passes through the CG, the gyro becomes very sensitive. If the RLV passes forward of the CG, the gyro becomes unstable, forcing the pilot to constantly make control corrections to keep from crashing. However, this RLV aft of the CG relationship is not the only condition that needs to be maintained.

6.2.2 Lift To Drag Ratio

The RLV is a product of the relationship between the lift and drag characteristics of the rotor blades. This ratio is what engineers refer to as the lift-to-drag (LD) ratio. The more efficient (less drag and higher lift) the rotor blades are, the higher the LD ratio and the more vertical the RLV becomes, and conversely for less efficient blades. The LD ratio of a set of rotor blades can greatly effect the handling characteristics of a gyro because if the RLV is too far behind the CG of the gyro, the gyro will feel nose heavy all of the time. To counter this, a pitch spring is used to apply a pitching-up force to the rotor head so that the pilot doesn't have to hold back-pressure on the joystick during flight. However, if the rotor blade LD ratio is too low, causing the RLV to pass either directly through or in front of the CG, the gyro will be either very sensitive to fly, or even worse, uncontrollable.

6.2.3 Thrust Line

The thrust line is simply the thrust produced by the propeller as the engine spins it. The thrust line passes directly through the center of rotation of the propeller. If you refer back to the paragraph on the CG, if a force is applied to a mass, and that force doesn't pass directly through the CG, a rotation force will result. Conversely, if the force is passing directly through the CG of the mass, it will move in the direction of the force without rotating or spinning. With the gyro, if the thrust line doesn't pass directly through the CG, the gyro will want to rotate about the CG. If the thrust line is above the CG, the gyro will want to pitch nose down.

6.2.4 Centerline Thrust

There has been a great deal of attention surrounding the topic of gyros and Centerline Thrust (CLT) lately. CLT is the condition where the engine thrust line passes directly through the CG. Some will argue that all gyros should have CLT. However, it's difficult to deny that there are a large number of gyros currently flying that do not have CLT.

In the case of the gyro, at low airspeeds where there isn't a great deal of drag, and with the rotor unloaded, any amount that the thrust line is offset from the CG will cause the gyro to pitch and/or yaw. However, seeing how it is difficult to simultaneously have low or zero forward airspeed with an unloaded rotor, this is not a situation that occurs all that often. Again, some will argue that this can and does occur with a high degree of frequency. But if this were true, there would be much fewer gyros flying today because of crashes. Besides, it is impossible to have the thrust line passing directly through the CG at all times anyways. The thrust line is always going to be off a small amount. How much is too much? No one can answer. All that can be done is to get as close as possible and supplement with a horizontal stabilizer.

6.2.5 Horizontal Stabilizer

There are several factors that go into the size and placement of a Horizontal Stabilizer (HS). Many of the same people that have been screaming about the necessity of CLT, have also been screaming about the necessity of having a HS, and for the most part, everyone agrees that an effective HS is a must. I also agree! However, there's a debate that has been raging for some time now about the location of the HS, especially with pusher gyros. Some people feel that the only safe gyro is one that has a HS fully immersed (where the HS is located directly in-line with the centerline of the propeller spinner). I disagree! And here's why.

The job of the propeller is **NOT** to provide airflow like a box fan. The job of the propeller is to move an aircraft, such as a gyro in this case, forward at a speed sufficient to get the aircraft in question flying. That is why a propeller is shaped like a wing, and not like an automotive radiator fan. A propeller is meant to fly just like a wing does. Prop wash is merely a by-product of the propeller's flight, and just like an airplane's wing, there is drag. This drag causes the prop wash to be in the shape of a corkscrew or helix. The severity of the helical shaped prop wash depends on the LD ratio of the propeller itself, engine RPM, pitch, and a few other factors that I'm not going to get into.

This is the cause of the first problem we have with an immersed HS – Dissymmetry of Lift! If the HS in question is mounted directly in-line with the spinner centerline, then the HS is going to see different angles of attack between the left half and the right half. In fact, the AOA is going to be different across the entire HS. Concrete evidence of this can be found by simply feeling the effect that prop wash has on the vertical stabilizer (which is not tall enough to span the entire diameter of the propeller) of a gyro during take off, when the throttle is wide open - the tail of the gyro will be pushed in the direction of the prop wash, requiring the pilot to counter the yaw with rudder pedal input. If this same condition holds true for the HS (and I'll bet you it does), then all that you've made is a good wind straightener.

The second problem with mounting the HS in the prop wash is that the prop wash is pulsating. During the development of the JU-87 Stuka in the 1930's and 1940's, the German military thought that if the radiator was moved to a point right up behind the propeller, that the cooling capacity of the radiator would increase and they could keep the engine cool. What they found is totally opposite. The radiator had to be moved farther away from the propeller, not closer. The reason this problem occurred in the first place is because each time that a propeller blade passed by the radiator, the radiator would see a pulse of high velocity air, but the dwell time between blades, where there was very little flow, negated the high velocity airflow. With limited success, the Germans even tried longer chord length propellers in an attempt to force more air through the radiator. The resultant sum of the prop wash was less than anticipated, and the same is true for an immersed HS. About the time the British were developing the Spitfire fighter, they already had experience with this same type of problem. This is why the radiators for the Spitfire were mounted under the wing outside the arc of the propeller. Other aircraft, such as the P-51 and the P-38, had their oil coolers and radiators located well behind the propeller where the pulses were less pronounced.

The tail feathers and the pilot feel these same pulses. The pilot can usually feel this pulsation because the pulses are being transmitted from the tail feathers to the airframe. It's usually described as a vibration. Therefore, the best location of the HS is as far away from the propeller as possible. This will also provide a greater leveraging force, and will increase the stabilizing effect that the HS has on the gyro. But this becomes a problem with pusher gyros because moving the HS farther aft also places the vertical stabilizer closer the rotor blades, increasing the chances that a rotor blade will strike the vertical stab.

The third problem with an immersed HS is turbulence caused by up-stream clutter – stuff forward of the propeller. Turbulent flow is defined as "...a flow characterized by turbulence, that is, a flow in which the velocity varies erratically in both magnitude and direction with time." Turbulence is caused by an "...abrupt change in direction of the airflow...", which is commonly know as "separation of flow" , or "flow separation". Keep in mind however, that a helical prop wash isn't necessarily classified as a "turbulent" flow. But, if the incoming airflow is turbulent, the prop wash will be as well. Generally, gyro's are fairly noisy aircraft, and this turbulence passing through the propeller is the primary cause for much of the noise, which can be easily heard from the ground.

Airflow separation causes a great deal of turbulence and drag. Turbulence, and the resulting drag, is unwanted and is detrimental to aircraft and many other items that pass through air such as; cars, trucks, golf balls, and bullets, just to name a few. Though it is possible to predict with a certain degree of accuracy when and where flow separation and the resulting turbulence will occur, calculating the magnitude and the effects that turbulence will have on an object is, for the most part, impossible. Especially, after it passes through the propeller.

I would suggest that you read the article posted on my website for more detail on immersed horizontal stabilizers – <http://www.geocities.com/donshoebridge/h-stab.html>.

Since the RLV is behind the CG, the gyro will try and fly in a nose down attitude all of the time. To counter this to some degree, the HS must provide down force to help hold the nose up. This is done by lowering the leading edge of the HS by a small amount, or to have a small control surface on the HS, not unlike an elevator, to provide a degree of pitch trim. The final HS configuration is not completed and will not be for some time. Extensive flight-testing will have to be performed on the prototype aircraft to fully complete the tail feather design.

6.2.6 Final CG Location

The final CG location of the Hornet will depend on several different factors. However, pilot weight and fuel load will have the greatest effect on the CG location. With regard to fuel load, because of the location of the fuel tank, as fuel is burned off, the CG will move forward and up.

It is very important to note that any variation in the Hornet's design will alter the location of the CG. Because gyros of this type are so short coupled with regard to controllability, and the fact that small changes in weight can have large effects in the CG location, it cannot be stressed enough that any design variation of the Hornet from its current configuration would make a completely different aircraft. With any homebuilt aircraft, be it fixed or rotary wing, every time the aircraft is flown, the pilot is a test pilot. Even though every effort will be made to document the flight characteristics of the Hornet, any variations away from the Hornet's original design by builders will make the flight data useless.

7. Fabrication

7.1 Craftsmanship

If you have ever watched experienced pilots examining home-built aircraft at a fly-in, you will notice that they tend to be very picky about craftsmanship. The reason is quite simple. Sloppy work doesn't just impair the appearance of an aircraft, it can render it unsafe. If you were ever an aircraft mechanic in the military, or still are, Uncle Sam makes absolutely sure that you understand this. Building your own aircraft can be immensely satisfying, but you shouldn't even start such a project unless you are committed to doing the job right. This means the highest standards of craftsmanship using the proper tools for the job. Sloppy work can ruin up to \$700 of quality aircraft materials. If you mess things up, you will not even be able to sell what's left, because anyone that knows what they are doing wouldn't touch used material. If you've done this sort of project before, you can skip what follows, otherwise stay with me for some detailed advice.

Just because there are no mandated inspection requirements for Part 103 aircraft, does not mean that we are not dealing with life and death issues. Nature and gravity don't know about the regulations! It's usually best to have several different sets of eyes look over your aircraft prior to its first flight. Make sure you ask for input from others with experience!

7.2 Materials

Only aircraft grade steel and aluminum alloys and hardware should be used to build an aircraft. Materials and hardware available from other sources such as hardware stores are not suitable, and **will eventually fail and kill you!** Legitimate aircraft suppliers such as Aircraft Spruce and Specialty Company, Wickes Aircraft Supply, Leading Edge Airfoils (LEAF), California Power Systems, and other suppliers advertising in magazines such as Kitplanes and Rotorcraft stock the proper materials and should be your only source for materials and hardware unless you really know what you are doing.

7.3 Cutting Tubing and Angle Stock

Although you can cut everything needed with a hacksaw, the job would not be fun and it would also take forever! A powered band saw is the ideal tool for most of the work. Since it doesn't pay to buy such a tool for building one aircraft, see the later section on Getting Help if you don't have a band saw. Be sure to allow for the blade width when cutting the pieces - **the finished size should match the prints!** All cuts should be carefully dressed with a fine file and steel wool since sharp edges can concentrate stress and lead to the formation of cracks.

7.4 Drilling

Drilling tubing, sheet, and angle stock is the most critical operation you will do on an aircraft construction project. Holes must be placed with **absolute precision** or the parts **will not fit** when assembled. You cannot do this job with a hand drill. A good drill press with an adjustable fence is ideal. Holes, particularly those drilled through tubing, must be absolutely true. This is particularly so with holes drilled near the edge of square tubing. These are positioned with only 1/32 clearance from the tubing wall. **If you score the inside wall surface when drilling, the entire piece must be discarded!** If you are not sure about the precision of the drill press, take the time to make some simple drilling jigs to assure proper placement of holes. Alternatively, you can center punch the hole location on both sides of a tube (assuming you do the job very accurately), pilot drill from both sides with a 1/16 bit, and then finish-drill to size from both sides. If you don't have the proper equipment or are unsure about your skills, see the later section on Getting Help. Quality drill bits and how you use them are important. **Be sure of the finished holes size specified on the print.** An investment in half-a-dozen carbide drill bits of each size is a good idea. A good drill index will have most of the sizes required. Drill the holes gently so the bit cuts the metal instead of punching through. Use cutting oil to make for an even cleaner job and the bits will last longer. Once holes are drilled, de-burr them, both to assure a snug fit for the attachment hardware and to avoid concentration of stresses that can lead to cracks.

7.5 Welding

Several of the Hornet's sub-assemblies do require welding. Gas, arc or MIG welding will do just fine for all of the necessary welds. TIG welding, used mainly for welding aluminum, is not required. Even though TIG does provide a stronger weld, nothing on the Hornet is critically important enough to warrant TIG welding. A person that has been welding for several years can only do good TIG welding. A wire fed MIG welder is quick and relatively easy to do. For welding 4130 steel, many people swear by gas welding. The reason for this is that 4130 generally is supplied already heat-treated. High heat welding will anneal the steel and remove the strength gained from the heat-treating process. For this reason, where maximum strength is essential, gas welding is used on flight critical items such as a fuselage and wing attachment points. Gas welding also wins out over MIG and arc welding because of the stresses that are built up by the high heat of MIG and arc.

7.6 Machined Parts

Even though there has been a great deal of time spent trying to reduce the number of parts in the Hornet, the penalty of such an effort is that there is a higher number of machined parts than the GyroBee. Simply removing parts from an aircraft is not possible. Something must take the place of the removed parts. In this case, a single machined part takes the place of several individual parts. This method of parts reduction sometimes increases the complexity of the overall project, but in return, it reduces the final assembly time and makes for a cleaner, lighter weight system.

7.7 Wet Lay-up Composites

There are several sub-assemblies on the Hornet that require the use of composites. Two different composite construction methods are used; 1) Kevlar/fiberglass or plywood, and 2) fiberglass over foam. The techniques used in the fiberglass-over-foam construction method are the same as found in the GyroBee documentation package outlining the construction what has become known as the Watson Tail (reference the section titled Catching A Bee By The Tail, by Mr. Wayne "Doc" Watson). Although the materials used for the Hornet are a little different than those in the GyroBee documentation package, the methods are, for the most part, the same.

There is a very good article about composites that can be found at <http://exp-aircraft.com/library/alexande/composit.html>.

7.7.1 Kevlar/Fiberglass Over Plywood

During the build of 03-001 (Hornet prototype, Don Shoebridge), it was found that dealing with foam as a core material required a very delicate touch. The foam is very soft and can be dinged up very easily, requiring additional steps of filling and sanding before the outer skin can be applied. Another down side to using foam is that there isn't much strength, which requires internal stiffeners, structural members, or several layers of fiberglass to be of much use. Therefore, it was decided that plywood would be a better core material for all of the flat components.

Several of the Hornet's composite components are fabricated from Birch plywood and covered in Kevlar/fiberglass. Boat manufacturers are starting to use a similar technique more-and-more for building strong, light weight boats. Watercraft of this type are very durable and can withstand a great deal of punishment before any kind of a structural failure occurs. A common place to find this form of construction is in kayaks. Some manufacturers use wood as a core material and then cover the entire kayak in Kevlar and epoxy. Kayak constructed in this manner typically weigh less than 35 pounds and are almost bullet proof.

Construction of the Hornet's plywood composite components are very simple. Start with a piece of plywood that is at least 1 inch larger than the finished part. Cut 2 pieces of Kevlar and 2 pieces of fiberglass that are roughly the same size as the plywood panel. Typically, in composite construction, the fabric layers will be orientated at angles to each other (usually 45 degrees) and at angles to where the most stress will be applied. For the Fuel Tank Mount Plate, Seat Bottom, and Floor Plate, this is a good idea since these parts are more critical to safety.

Following the manufactures mixing instructions, prepare at least 4 ounces of epoxy per part. I like to use the 8 ounce size, disposable, plastic drinking cups. **DO NOT USE PAPER DRINKING CUPS FOR MIXING EPOXY!** The wax in paper cups will contaminate the epoxy, making the epoxy useless. If you're using Aeropoxy with 1 ounce pumps on the hardener and resin, 4 ounces is easy – three pumps of resin and one pump of hardener. You will most likely have leftover epoxy if you are making one piece at a time. The best use of materials would be to make one large piece of plywood/composite than cut out the various pieces.

Once the epoxy is mixed, drizzle epoxy over the plywood in a grid pattern. Use a squeegee to spread an even layer over the plywood. You'll notice that the plywood will start to change colors because it is absorbing the epoxy. This is a good thing. Don't worry if you have too much epoxy on the plywood, just spread it out best you can. Try not to allow the epoxy to get too close to the edge of the piece or you'll have a mess as it starts to drip off. Once the entire plywood surface is wet with epoxy, lay one layer of Kevlar on the plywood. Use a squeegee to work the extra epoxy through the Kevlar. If you need more epoxy, pour more in the middle of the plywood panel and squeegee the epoxy from the middle outward. Continue to squeegee the epoxy into the Kevlar until the entire surface is semi-translucent. You should be able to see the grain of the wood. Once the Kevlar is "wetted out", lay one layer of fiberglass over the Kevlar. Add more epoxy and repeat the wetting out process, starting from the middle and working outward.

Once everything is wet and semi-translucent, starting from the middle of the panel, squeegee the panel a little harder to get as much epoxy out of the Kevlar/fiberglass fabrics as you can. Be careful not to slide the layers of fabric around. The strands of the fabric should be as straight as possible and as evenly spaced as possible for the best possible strength. If you did this process correctly, the entire surface should have a semi-rough textured look to it. If you see areas where it is not rough, and it is shiny like a piece of glass, you have too much epoxy. As you squeegee out the fabric, the epoxy that is building up on the squeegee can be scraped back into the mixing cup. If you find areas that are silver in color, this indicates that you do not have enough epoxy. Pour epoxy on those areas and work it in with the squeegee. Remember to remove the excess epoxy. Excess epoxy is added weight and added sanding.

Let the epoxy cure overnight. Flip the panel over and repeat the process using the remaining pieces of fabric that you cut earlier – Kevlar first, then the fiberglass. The reason for applying the fiberglass over the Kevlar allows you to sand the outer layer smooth. The fiberglass is sandable, the Kevlar is not. If you were to try and sand the Kevlar, you would end up with a surface that looks fuzzy. You would not be able to smooth out the Kevlar. However, the fiberglass is sandable and (in this case) acts more as a sacrificial layer that can be sanded to a glass smooth finish.

Now that your plywood panel has been covered on both sides and has been allowed to fully cure, it's time to finish cut the parts. I find that using a jigsaw with a carbide, hacksaw blade works best. Using a permanent marker (Sharpie, extra fine point), trace out the part(s) that you are making. Using a jigsaw, cut out the parts and finish sand the edges.

7.7.2 Elephant Snot

This stuff sounds gross, but actually it's going to be your best friend. Elephant Snot is nothing more than epoxy and cotton flox. The reason for the name is because when I get it mixed correctly, it reminds me of Elephant snot. I'm using Aeropoxy with 1 ounce pumps on each can. The mix ratio is 3:1, 3 parts resin, 1 part hardener. I typically mix a minimum of 4 total ounces at a time, ie, 3 + 1 = 4. To that I add 2 heaping teaspoons of cotton flox and mix thoroughly. I will keep adding flox to the mixture until it starts to stick to the mixing stick. Another indicator that you have it mixed correctly is if you see a very little bit of epoxy between the clumps of cotton, along to the side of the mixing cup.

So what is Elephant snot used for? Cotton flox and epoxy, together, are used for making structural connections in composites. In the case of the Hornet, all of the aluminum mounting brackets and attachment points that are part of the Floor Plate, Fuel Tank Shelf, and Seat Bottom are all attached using Elephant snot. Also, all of the wood/composite cross braces are secured with Elephant snot. When fully cured, this stuff is incredibly strong. To file and/or shape Elephant snot, the best tool I've found to use is an aggressive wood rasp. Sand paper or a metal file just doesn't have enough bite to cut through this stuff in a timely manner.

7.7.3 Micro Balloons

Another name for Micro Balloons is glass bubbles. Balloons are used as a filler material. It sands very easily and will leave a nice finish. Micro balloons are not to be used to make structural connections. They are not strong enough. Balloons and epoxy are used in many different ways depending on how thick or thin the mixture is. If I have a divot to fill in a piece of foam, I will mix in enough balloons to allow the mixture to almost stand up like whipped egg whites. Before I lay fiberglass over my foam cores, I will put down a thin layer of epoxy and balloons to fill in all of the smaller holes where epoxy might soak in, which would make the structure heavier than it needs to be. For this application, I mix in enough balloons to the epoxy to make the mixture look like cake icing that is melting – it needs to be able to flow a little bit so that it will try to self level.

7.8 Getting Help

Your best source of help on a project of this sort is your nearest PRA or EAA chapter. Members will often have the proper shop tools (or the Chapter may be so-equipped), they know how to use them, and they can give you advice at all stages of construction. If that sort of assistance is not available locally, consider checking in with the metal shop at your local high school, vocational center, or community college. You may be able to get training on and use of the equipment. It is also possible that the teachers may think that the project would be a good one for students, so you might end up with some help. You must **get an experienced PRA member or EAA designee to look over your project** prior to test flying. They may be able to spot problems you have overlooked! Even if it is not convenient, arranging for periodic inspections as the project proceeds can usually spot problems early on, where they will take less time and money to fix!

7.9 Finishing

Bare aluminum will oxidize, become dirty, and show fingerprints from handling if not finished prior to assembly. In order of difficulty and cost, the finishing options are;

7.9.1 Clear Urethane

Polish the parts with fine steel wool, degrease, and finish with one or more coats of clear urethane paint. This will provide a natural-metal finish, yet protect the metal surface. Since the finish is clear, this option has the least potential to show defects and therefore, is suited for hand application.

7.9.2 Anodizing

The aluminum parts can be anodized to provide a color finish. With technology advancements, color options are getting better, and the effect is excellent, as is corrosion protection. Several color options are available, but there may be a set-up charge for anything that is not your basic vanilla colors such as black, red, blue, clear, etc.

There is a variation of anodizing called "hard coating" that can also be done. Typically more expensive, it is very durable and generally does not have as much of a metallic transparent look about it, as compared to regular anodizing. Other variations of anodizing can include flat or satin surface textures or Teflon impregnation where surface wear might be a concern.

One final note... Anodizing is not a long term finishing option and the colors will fade over a 3-5 year time span. In extreme cases, almost all of the color will be gone resulting in a very pale metallic finish. Blue and red seems to fade the most, where black fades the least.

7.9.3 Painting

The parts can be painted in any colors desired. Each piece will need to be finished with extra fine sand paper, degreased, primed, and then color-painted. You may be able to arrange for painting at a local auto body shop, which eliminates a lot of work. There is a very wide range of possible color combinations, and auto paints are very durable. If a super smooth finish is desired, sanding with 1000 to 1500 grit wet sand paper, and then use of a automotive rubbing compound will provide a mirror like finish. **WARNING:** Do not use rubbing compound on spray-can enamel paint finishes, because some rubbing compounds will attack the paint and ruin the finish! Rubbing compounds will not attack lacquer, automotive, or epoxy finishes.

7.9.4 Powder Coating

This is probably the most expensive option but will probably provide the best results. There are many excellent colors and textures available. Sometimes it's possible to order free samples of the powder coating material direct from the manufacturer. However, to do so might require the clout of the company that would actually be performing the powder coating service. This is well worth looking into. A search on the Internet for powder coat will generate several big name paint companies such as Sherwin-Williams. Quite often, sites such as this will show samples of the powder coatings available.

7.10 Purchasing Hornet Parts

Currently, there isn't any company or individual that I know of that is producing retail Hornet parts. For most people, some of the more complicated parts in this document will require machinery that is larger and more expensive than just your typical drill press. However, in the near future, I may be a source for some of these components. My primary focus will be on those parts that require milling, turning (lathe), or welding. Right now, simple tube parts are at the bottom of the list. But this can change depending on which parts people request the most. So the more feedback that I get from people, the more motivated I will be. Eventually, I would like to kit the Hornet, complete with all of the standard marketing bells and whistles like custom colors, power plant options, etc.

7.11 Workspace

7.11.1 General Workspace

There are 2 major benefits to having your workspace close to home; 1) it's likely that you will spend more time working on your gyro, and 2) it's more likely that other members of your family will become involved, and help you. Having your workspace located away from home by some 20-30 minutes will take away from the total time that you are able to spend on building. Also, if you know that you have to drive to and from the workspace each time you want to work on your gyro, you're likely to be less motivated to get off the couch. So if at all possible, you should have a workspace at home. A 2-car garage should do nicely.

Typically, gyros don't take up a large amount of space when complete. A space that is 25+ feet deep, 8+ feet high and 7+ feet wide will fit most gyros. By comparison however, during the build process, a larger space is required. But obviously this also depends on how many of the actual parts of the gyro you will fabricate yourself. Lets assume that you have a similar situation to mine. I have an extra 2-car garage that measures 25' x 25'. The garage is un-finished, but at least it does have electricity. There is no heat of any kind, except for what my body gives off, and what Mother Nature can provide in the way of solar heating the roof, which isn't much. But hey, at least I can call it my own cave. Obviously, for the composite work that I need to do, I will need to have some form of heat.

Securely attached to one wall, I've built a workbench that is 24" deep and a little over 14 feet long. This bench will be used for most of my work on the Hornet. I plan on mounting a cut-off saw to this bench at one end. This will provide a large enough surface for cutting the long pieces of tubing for the landing gear and the airframe. Sharing this space will be a drill press and a bench grinder. A lathe or vertical mill would be nice to have, but is well outside of my budget for this project.

7.11.2 Environmental Health And Safety Considerations

There is going to be a degree of sanding, painting, and working with different chemicals, including lubricants, cleaners, primers, epoxies and adhesives. There is also going to be a bit of work with power tools and hand tools. As slight as these seem, they may not kill you outright, but you could easily lose a finger, lose the use of one or both eyes, have an allergic reaction to a solvent, or suffer sometime in the future because of your exposure to a chemical. Planning is the best prevention. Your work area must have adequate ventilation. An exhaust fan is a good investment. When you are working in this area, wearing of safety glasses is a minimum. Good shoes or boots, and a pair of work gloves should also be worn. When handling chemicals, solvents and epoxies, wear latex, rubber or vinyl gloves, and wear some form of a breathing apparatus like a surgical mask or a respirator like the type used in spray painting. If possible, include an eye wash station in your workshop. A well-stocked first aid kit and an approved and serviceable fire extinguisher are a must! Do not use compressed air to clean off work areas as this can cause metal shavings and shards of fiberglass and Kevlar to become projectiles, which can result in serious eye damage even if using eye protection. Instead, use a shop vacuum to prevent loose debris from becoming small missiles. And the one thing I think we are all guilty of... use tools in the manner they were intended. A pair of pliers does not double as a hammer! Just like a car key was not meant to clean your ears.

7.11.3 Composite Fabric Cutting Table

A specific table for cutting your composite fabrics is a nice item to have. I once saw a great homemade, fold-up table on the TV show "A Plane Is Born" (Discovery Wings, DishNetwork channel 195). To make this table, build a frame out of 4-pieces of 2 x 6 lumber. This frame should have an inside measurement of at least 62" wide x 50-60 inches tall. Since most bolts of composite fabric measure 60 inches wide, the frame must be a little larger. Cover one side of this frame with a piece of 1/2" MDF trimmed to the outside of the frame. Lag bolt this frame to the wall of your workshop with the bottom about 30-36 inches up from the floor. The open side of this box should be facing outward. Using another piece of MDF, make a door that is the same size as the first piece of MDF and attach it with hinges along the bottom edge of the 2 x 6 frame. Make sure you add a latch of some kind to the top edge of the door so that you don't have to make an unnecessary trip to the hospital! This door will double as your working surface.

Open the door and lower it down so that it is parallel to the floor. Use a bubble level for this. Support the door in this position with sawhorses or something. Using 2 x 4 lumber cut 2 pieces that will extend from the floor to the door. These will be the legs. Close the door and attach the legs to the door using hinges. With the door in the up and locked position, the legs should hang down against the door. When you open the door, the legs will automatically swing out and support the door, making it your work surface.

Almost all of the fabric that you will be cutting will be at a 45-degree angle. To make this job a little easier, cover the inside surface of the door with a piece of 1/8" thick high-density polyethylene or something similar like Plexiglas. I would suggest using contact cement for this and here's why. Once the plastic is secured to the work surface, using a circular saw with the blade set to a depth 1/8", cut an "X" across the entire surface at 45-degrees from the edges of the work surface. The center of the cross should be somewhere in the middle of the work surface. Then make 2 more cuts across (side-to-side) the work surface – one close to the frame on the wall, and the other farthest from the frame. These cuts in the plastic will allow you to cut your fabric easier and more accurately because the lower blade of a pair of scissors will follow the groove.

Through the 2 x 6 sides, drill a series of holes (2 to 3 per side) large enough for a piece of 1/2" conduit to pass from one side to the other. The holes should be about 7/8" diameter. Make sure that the holes from one side to the other are somewhat lined up with each other. Cut pieces of 1/2" conduit to a length so that there will be about 2 inches protruding out both sides when passed through the frame. These pieces will be used to hang your Kevlar and/or fiberglass fabric. The lowest set of holes should be about a foot or better from the bottom. This will allow a space to store your epoxies and other liquid materials.

Once all of that is done, wire in a 25-watt light bulb into one of the lower corners inside of the frame. When you are not doing any composite work, keep the door closed and the light on. This light will provide enough heat to keep your fabrics from absorbing any moisture and keep your liquid components from crystallizing if the outside air temperature drops significantly. If your shop is not heated, and you live in an area of extreme cold where nighttime winter temps can fall to zero degrees or lower, a minimum of a 60 watt light bulb will be required. With temps this low, a better solution would be to bring your composite materials into your house. As for doing your composites in the house, that's something you and your spouse will have to fight about.

7.11.4 Composites Lay-Up Table

A table will be required for doing your basic lay-ups. The size of the table should be at least 6-12 inches larger in all directions than the largest composite component on the Hornet. A minimum table size should be about 48" X 36". The table should be located in an area that allows access to all sides. In an earlier documentation release, I suggested that the table be large enough for "...dispensing and mixing the epoxies." This is not a good idea. The pumps on the epoxy cans tend to drip a little bit after each use. I try to keep my lay-up table as clear as possible. Besides, there's going to be plenty of opportunity to get your table covered with epoxy, so there's no need to have the cans of epoxy close to the lay-up table. I keep all of my epoxies, floc and micro balloons on a nearby work bench. Also, to keep your bench from being covered with drips of epoxy, cover the table with a plastic sheet. I used the same material that is used for vapor barriers in homes. The epoxy will not stick to this stuff and makes for a very easy clean up.

Dispensing the epoxies in the proper ratios isn't all that difficult. Composite material suppliers usually have simple hand pumps that screw directly onto the top of the epoxy resin and hardener cans. Dispensing this material doesn't require much bench space, and since the size of the composite pieces on the Hornet are small compared to an airplane wing, only small amounts of epoxy will be mixed each time. What this means is that you only need enough space for the cans to sit while you are walking around with a cup of epoxy in one hand and either a stir stick or a squeegee in the other.

Referring back to the Environmental Health And Safety Consideration, I mentioned adequate ventilation. For an extra degree of protection, add a vent/exhaust hood over the table that exhausts to outside. This way, you will not breath any fumes from the epoxy. Also, once epoxies are mixed, they will heat up. In some cases, like when too much hardener is used, the heat can be enough to cause a fire. Also, if you have a large amount of epoxy in a mixing cup, just this large quantity is enough to generate enough heat to melt a plastic mixing cup and burn your hand. You will feel the heat long before this happens, but a large amount of epoxy in a cup can still generate enough heat to start a fire. Follow the manufacturers mix ratios closely and make sure you have a fire extinguisher handy (just in case).

8. The Drawings

8.1 General

All information concerning the fabrication of any components will be on the following drawings. Pay close attention to the material call out in the title block of each sheet in the bottom right hand corner. There will be a list of parts in the top left hand corner of the different assembly drawings, which will provide you with the necessary quantities required for each assembly. The part numbers that appear on all of the drawings are for my own benefit so that I can keep everything organized. If you need to contact me about a part or drawing, please specify the part number. Since this will be the last release of the Hornet Documentation package, if you find a typo or if there are dimensions missing, sorry – but you're on your own.

8.2 SolidWorks

The following drawings were produced using SolidWorks. SolidWorks is a 3D solid model engineering software used by over 250,000 designers and engineers world wide. The base package isn't cheap! Unlike AutoCAD or a paint program, specific dimensional values can be entered which will drive the size and location of parts and features. SolidWorks is a highly automated design package. It can be thought of as a virtual reality design tool – if the parts fit in SolidWorks, then they'll fit in the real world, so long as the parts are made correctly.

8.3 Drop Keel Airframe

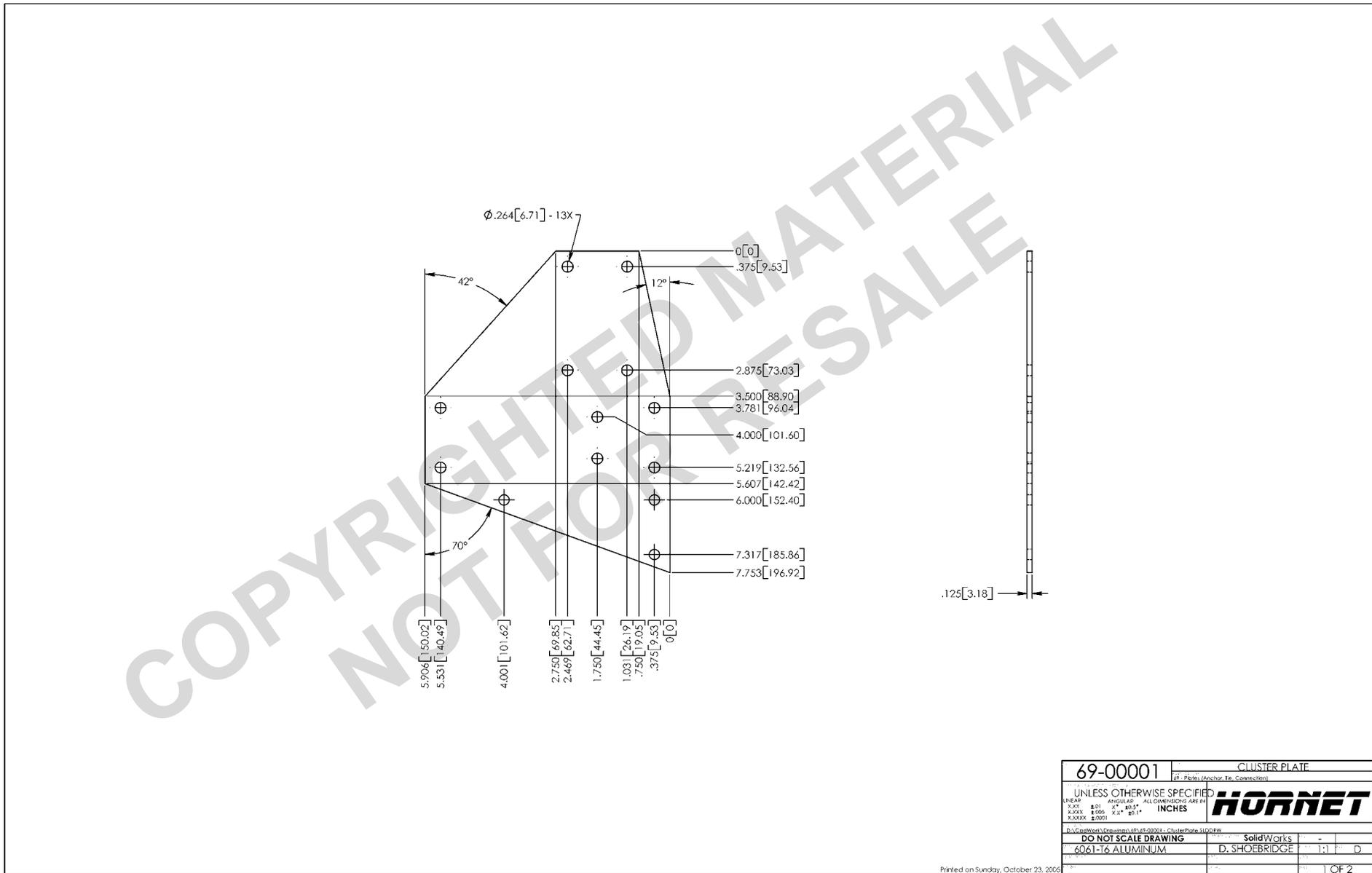
When I started the Hornet design, the keel and tail boom were fabricated as a single piece of 2x2x.125 wall 6061-T6 aluminum tube, which ran from the nose wheel assembly to the tail feathers. After some consideration, I decided to follow the GyroBee/HoneyBee designs a little closer and split the keel into two separate pieces. In doing so, I was able to lower the engine by 2 inches, effectively creating a small “drop keel”. But this also added a small amount of weight – about 1.5 pounds or so. This may not seem like a lot of weight. However, for every pound that I can take off, the more fuel-efficient the Hornet becomes, not to mention better performance.

There is a slight down side to following the design of the Bee family of gyros where separate keel and tail boom tubes are used. Because the tail boom tube and the keel tube overlap, it increases the weight of the aircraft by a small amount. Lowering the engine by the height of the keel tube (2 inches) helps to close the distance between the CG and the thrust line, but it only changed a small amount - some value less than 2 inches. Since the drop in thrust line is so small, I don't believe that the additional aluminum tube or work required to drop the engine by only 2 inches is really worth it. Which brings me to the next point. What about a true drop keel?

Just for the fun of completely changing the Hornet design, I added a gap of 4 inches between the tail boom and the keel tube. To clean up the look of the airframe, I cut the front of the tail boom back to a point just in front of the propeller. I then spanned the area between the cluster plates and the front side of the tail boom with another piece of 2x2x.125 wall 6061-T6 tube, and joined everything together with plate aluminum. Whatever tail boom drop I added to the airframe, I removed the same amount off the height from the mast tube, and added length to the landing gear. When I ran a CG calculation, I found that 4 inches of tail boom drop, does not equal 4 inches of CG/thrust line offset change – it was only about 2.5 inches.

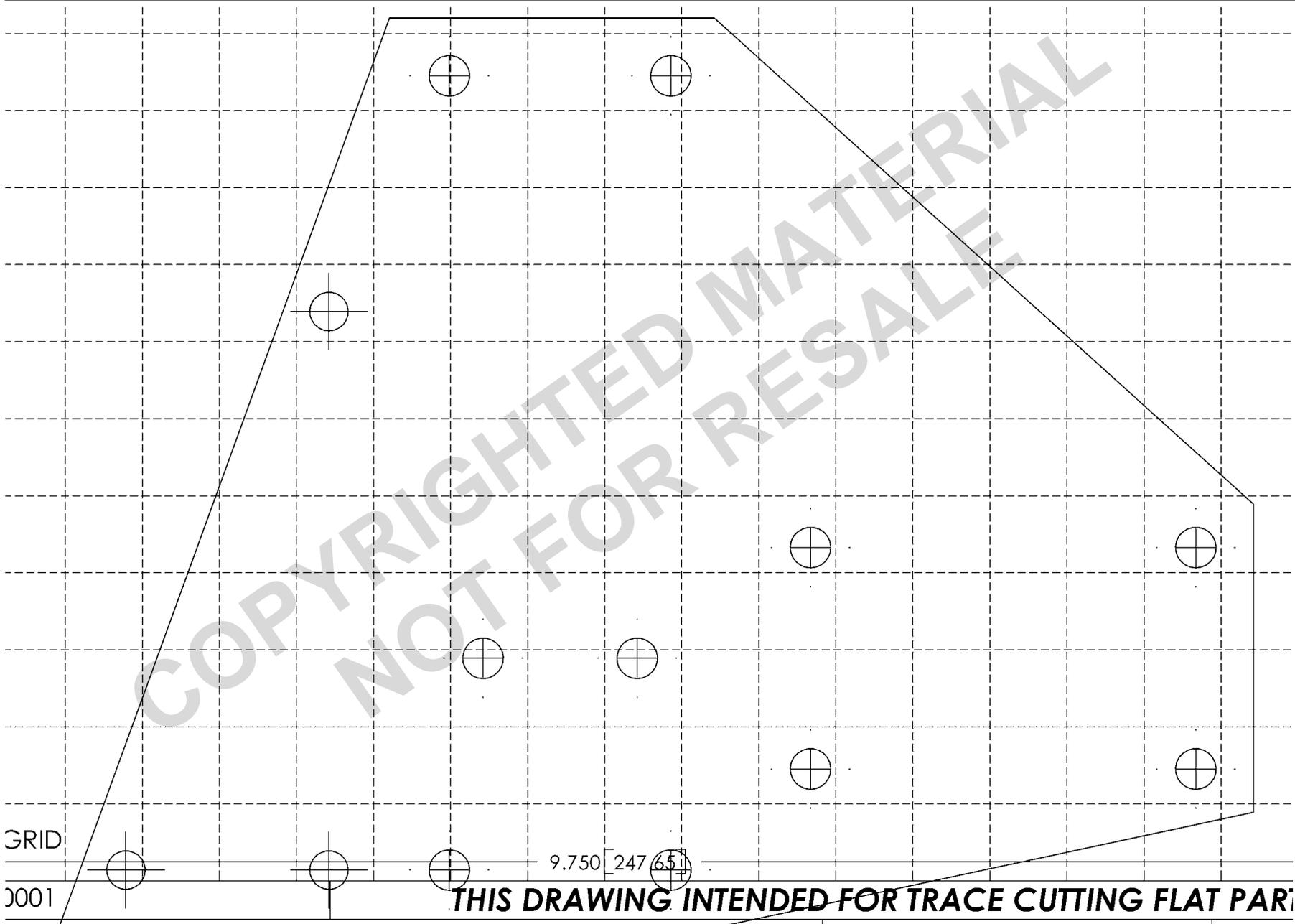
I was worried that by dropping the tail boom and adding the necessary parts to make the drop keel idea work, I would be adding too much weight. In fact, just the opposite was true. The empty weight of the Hornet actually dropped by 2.5 pounds! Therefore, I dropped the tail boom another inch, for a total of 5 inches. As it stands right now, with a 225 pound pilot in the seat and a full tank of fuel (5 gallons), the completed Hornet should have a CG/thrust line offset of less than 1/2 an inch.

NOTE: The engine mounting holes in parts 70-00008 and 70-00009, are specific for mounting a Rotax 447. To facilitate the mounting of a different engine, a different bolt hole pattern will be required. However, since the prototype Hornet has never had a Rotax 447 installed, it is not known if these mounting holes are correctly located or not.



69-00001		CLUSTER PLATE	
UNLESS OTHERWISE SPECIFIED		HORNET	
LINEAR	ANGULAR	ALL DIMENSIONS ARE BY	
XXX .01	X° .015	INCHES	
XXXX .005	X.X° .01		
D:\C:\pwork\Programs\49-00001 - ClusterPlate.110DW			
DO NOT SCALE DRAWING		SolidWorks	
6061-T6 ALUMINUM		D. SHOEBRIDGE	
		1 OF 2	

Printed on Sunday, October 23, 2005



COPYRIGHTED MATERIAL
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GRID

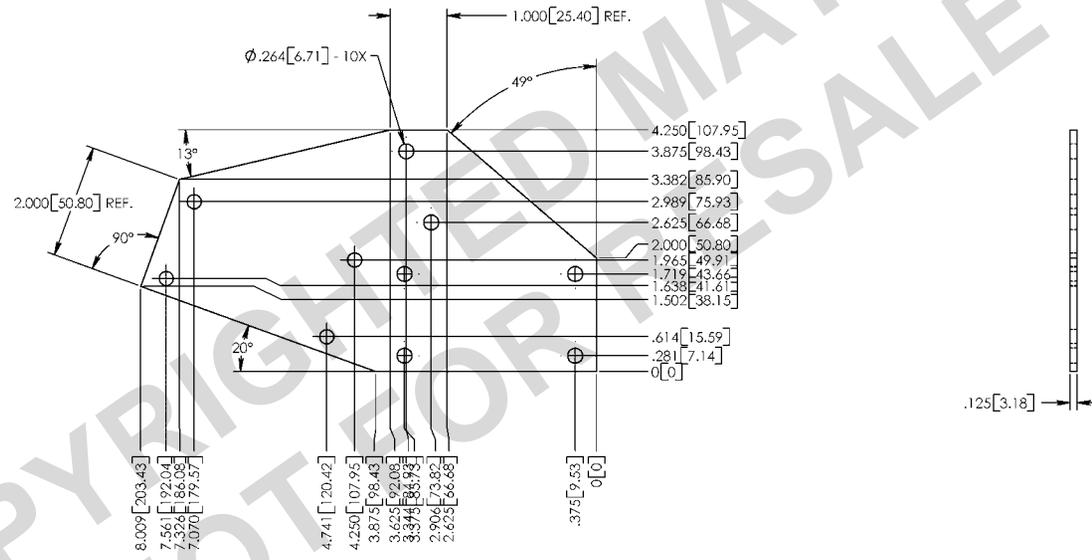
0001

FLAT PART

THIS DRAWING INTENDED FOR TRACE CUTTING FLAT PART

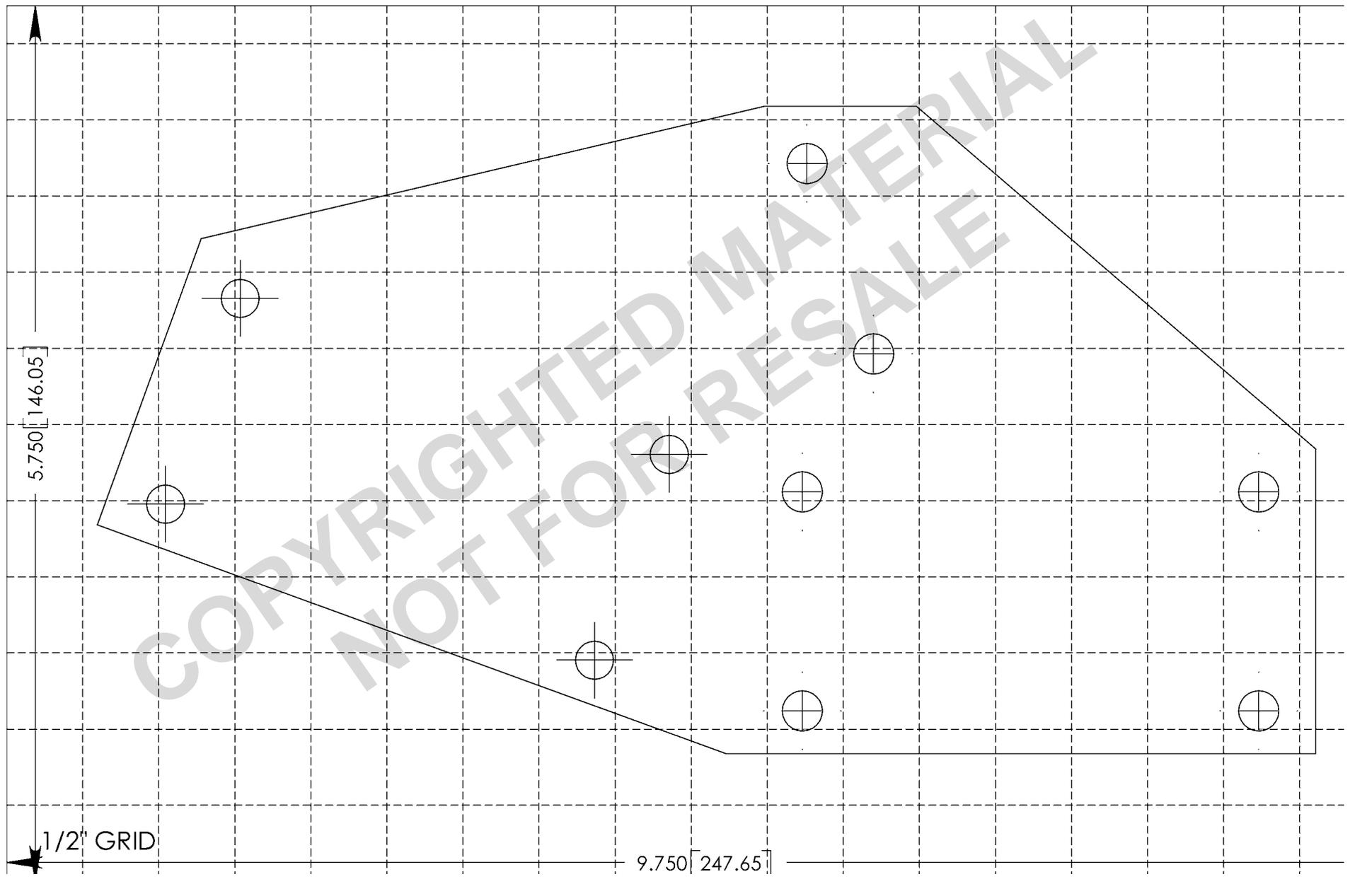
MTRL 6061-T6 ALUMINUM

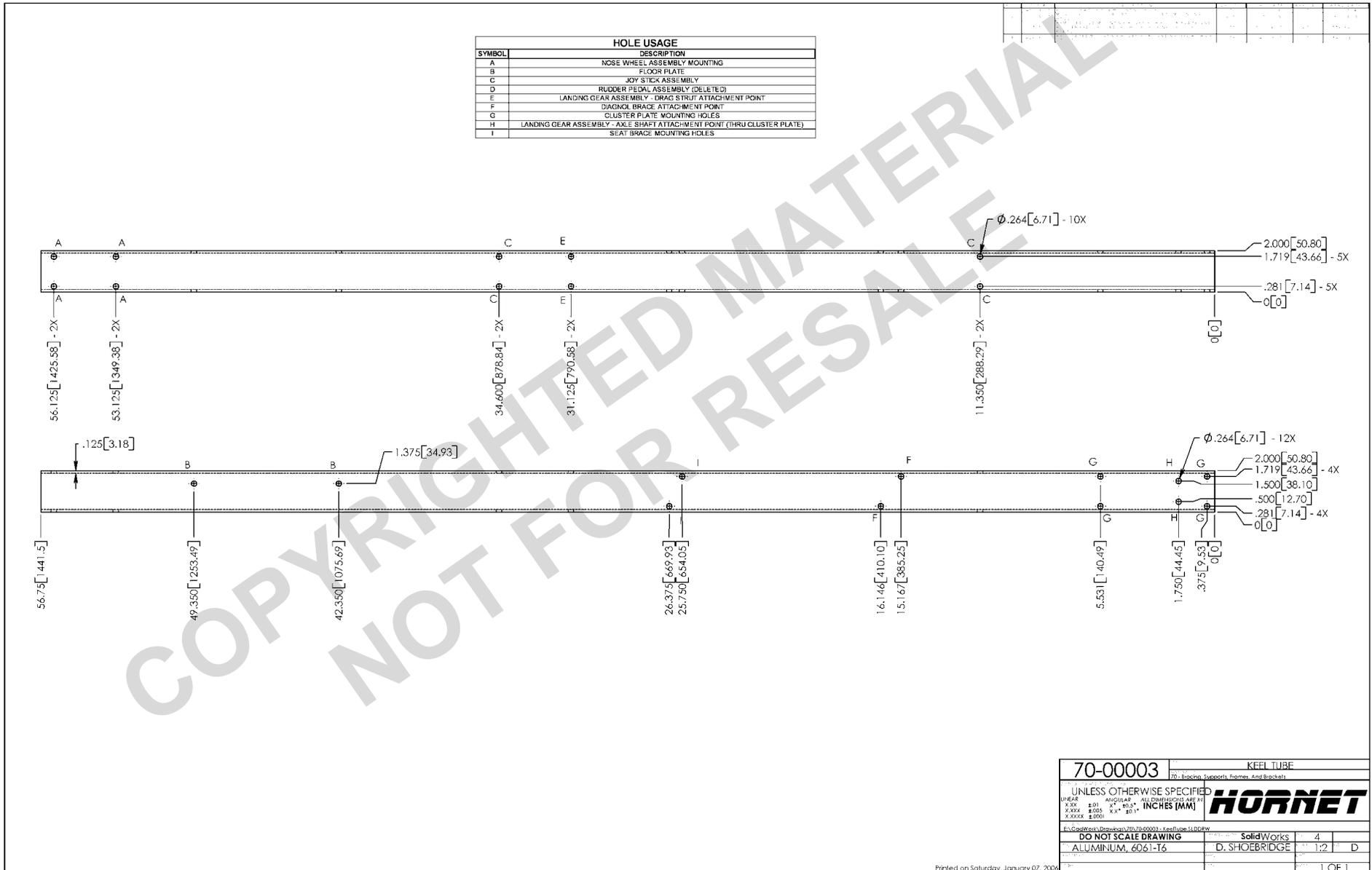




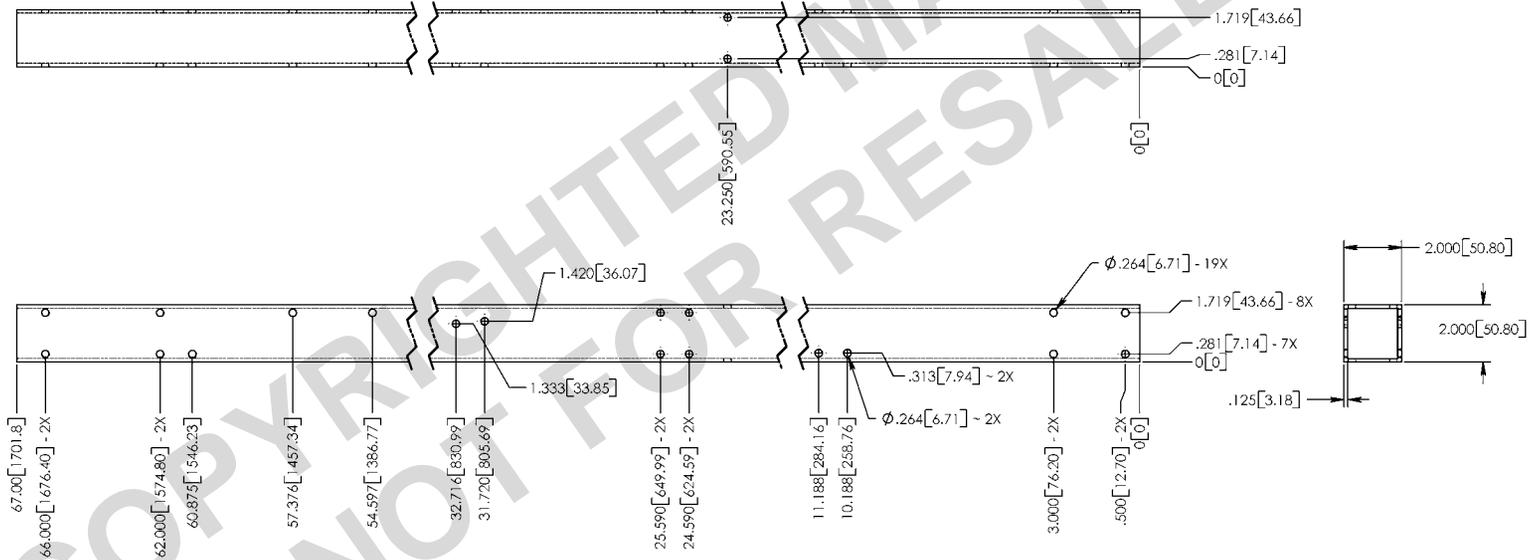
COPYRIGHTED MATERIAL NOT FOR RESALE

69-00002		TAIL BOOM CONNECTION PLATE	
UNLESS OTHERWISE SPECIFIED		HORNET	
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	
XXXX .E01	XX .E01	INCHES [MM]	
XXXX .E02	XX .E01		
XXXX .E03			
P35 Computer Graphics 07/99-09/02 - Tailboom Connection Plate 3/10/02			
DO NOT SCALE DRAWING	SolidWorks	1:1	D
6061-T6 ALUMINUM	D. SHOEBRIDGE		
Printed on Sunday, October 23, 2005		1 OF 2	





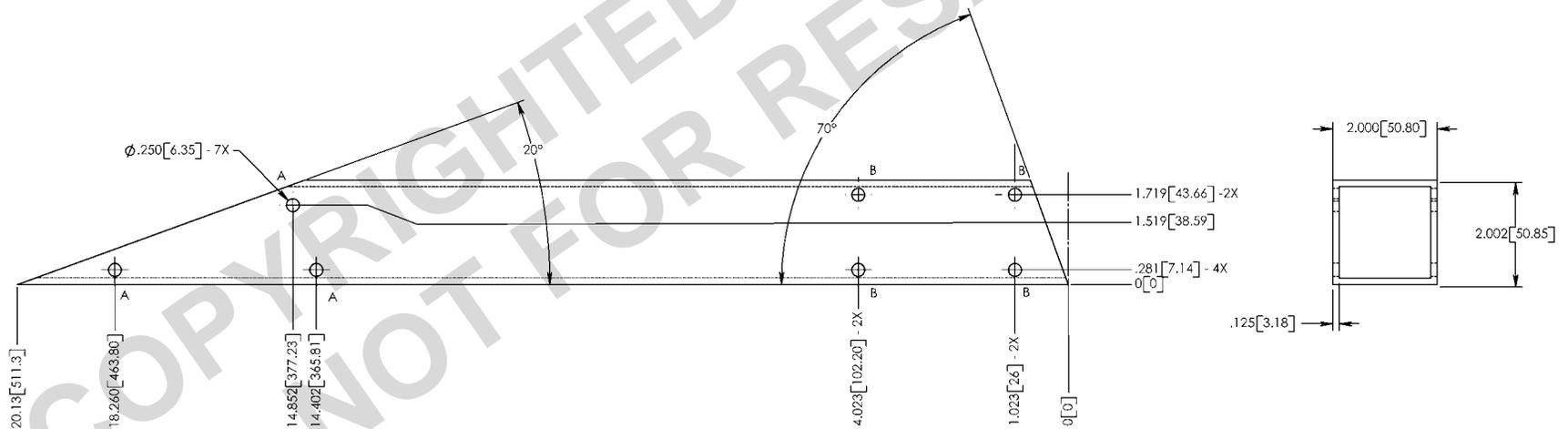
70-00003		KEEL TUBE	
UNLESS OTHERWISE SPECIFIED		HORNET	
UP:AR	ES1	ANGULAR	ALL DIMENSIONS ARE IN
X:XX	X**	INCHES (MM)	
X:XXX	ES5	X**	ES1*
X:XXXX	ES100		
E:\Programs\Drawings\70-00003 - Keel Tube 1.DWG			
DO NOT SCALE DRAWING	SolidWorks	4	
ALUMINUM, 6061-T6	D, SHOE BRIDGE	1:2	D
Printed on Saturday, January 07, 2006		1 OF 1	



70-00004		MAST TUBE	
UNLESS OTHERWISE SPECIFIED		70 - Mast, Supports, Brackets, and Tracets	
UNLESS OTHERWISE SPECIFIED	INCHES	HORNET	
XXXXX #001	XXXXX #001	SolidWorks	
XXXXX #002	XXXXX #002	D. SHOEBRIDGE	
XXXXX #003	XXXXX #003	1:2	
XXXXX #004	XXXXX #004	D	
XXXXX #005	XXXXX #005	1 OF 1	

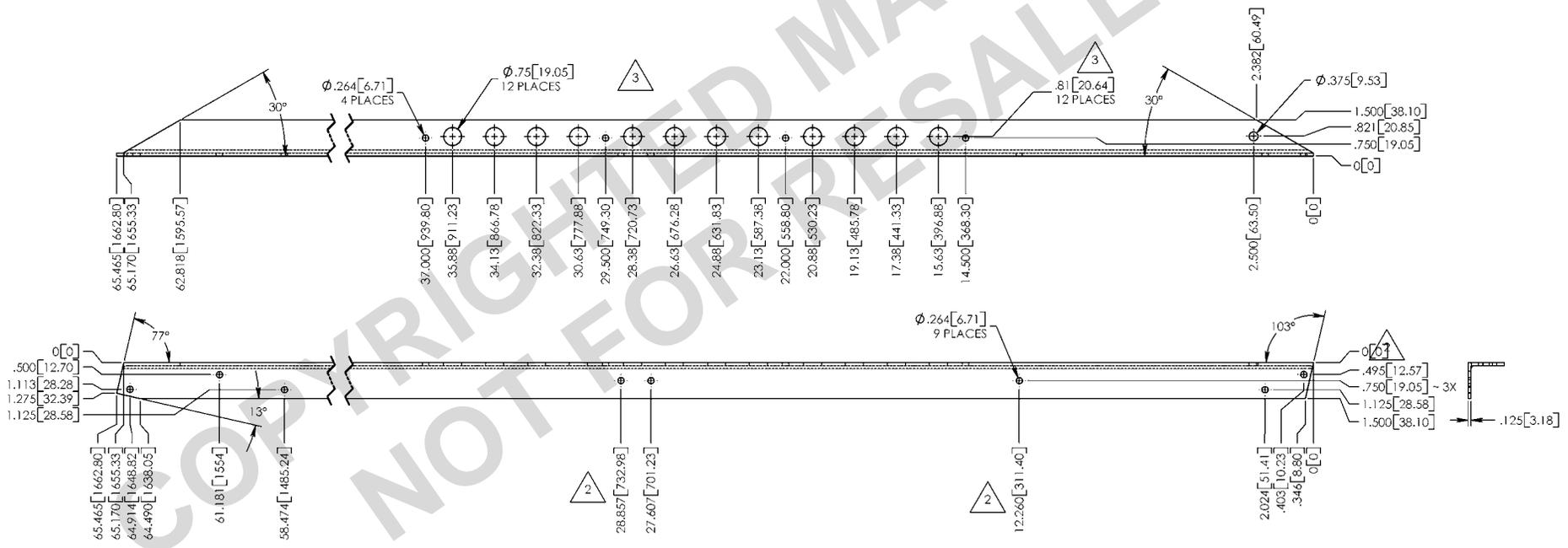
Printed on Tuesday, January 03, 2006

HOLE USAGE	
SYMBOL	DESCRIPTION
A	CLUSTER PLATE MOUNTING HOLES
B	TAIL BOOM CONNECTION PLATE MOUNTING HOLES



70-00005		TRANSITION TUBE	
70 - Brackets, Supports, and Brackets			
UNLESS OTHERWISE SPECIFIED			
LINEAR	ALF 18.0	AS DIMENSIONED UNLESS NOTED	HORNET
XX	01	2" ± .001"	
XXXX	005	XX ± .001"	
D:\Digital\Work\Drawings\70_70-00005 - TransitionTube_SLD.DWG			
DO NOT SCALE DRAWING	SolidWorks	-	
6061-T6 ALUMINUM	D. SHOEBRIDGE	1:1	D
Printed on Friday, October 14, 2005			1 OF 1

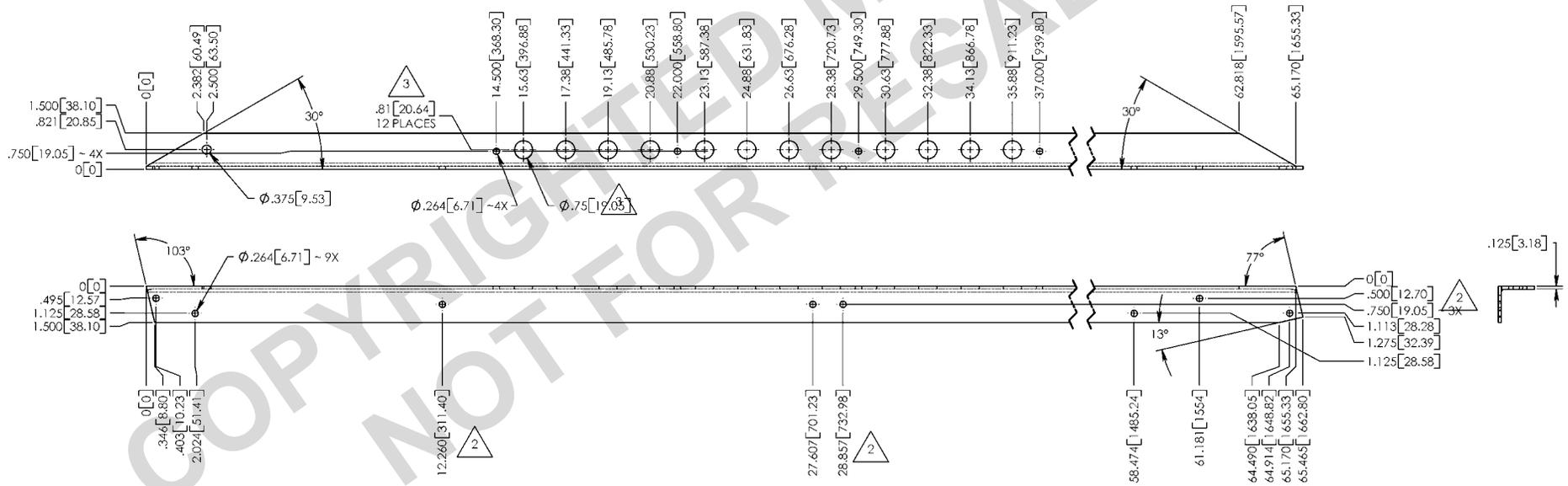
REV.	ECN#	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	14104-01	CHANGED HOLE DIAMETER FROM .284 TO .375	DTS	28-Mar-04	DTS	28-Mar-04
2	41394-01	REMOVED 2 HOLES, ADDED 1 HOLE, MOVED 1 HOLE	DTS	5-Oct-04	DTS	5-Oct-04
3	41305-01	ADDED LIGHTENING HOLES	DTS	4-Oct-05	DTS	4-Oct-05



70-00006		MAIN DIAGONAL BRACE LEFT	
70 - Bracing, Supports, Frames, And Brackets			
UNLESS OTHERWISE SPECIFIED			
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	HORNET
XXXX .XX	° ' " .XX	INCHES (MM)	
XXXX .XXX	° ' " .XXX	INCHES (MM)	
XXXX .XXXX	° ' " .XXXX	INCHES (MM)	
DO NOT SCALE DRAWING			
6061-T6 ALUMINUM	SolidWorks	3	
D, SHOEBRIDGE	1:2	D	
		1 OF 1	

Printed on Friday, October 14, 2005

REV.	ECN#	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	14159-01	CHANGED HOLE DIAMETER FROM .264 TO .375	DTS	28-Mar-04	DTS	28-Mar-04
2	41304-01	REMOVED 2 HOLES; ADDED 1 HOLE; MOVED 1 HOLE	DTS	5-Oct-04	DTS	5-Oct-04
3	41305-01	ADDED LIGHTENING HOLES	DTS	4-Oct-05	DTS	4-Oct-05

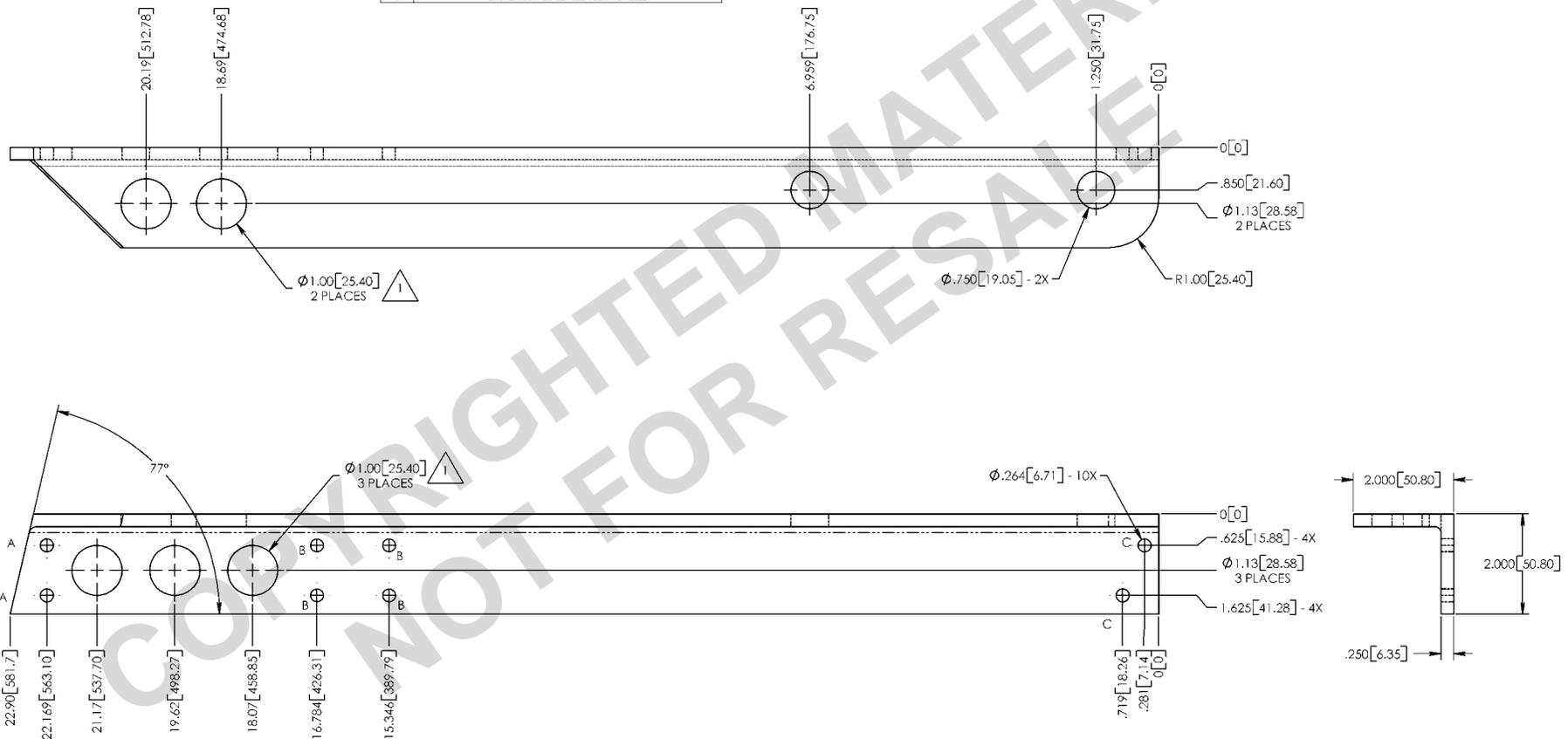


70-00007		MAIN DIAGONAL BRACE RIGHT	
UNLESS OTHERWISE SPECIFIED			
UNIT:	INCHES	AS DIMENSIONS ARE SHOWN	HORNET
XXX	#01	XXX	
XXXX	#05	XXXX	
XXXXX	#001	XXXXX	
D:\Customer\Drawings\70-00007 - Main Diagonal Brace Right 11/10/05.dwg			
DO NOT SCALE DRAWING		SolidWorks	3
6061-T6 ALUMINUM		D. SHOEBRIDGE	1:2 D
		D. SHOEBRIDGE	1 OF 1

Printed on Friday, October 14, 2005

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	41305-01	ADDED LIGHTENING HOLES, REMOVED UNNEEDED MOUNTING HOLES FOR SEAT.	DTS	4-Oct-05	DTS	4-Oct-05

HOLE USAGE	
SYMBOL	DESCRIPTION
A	DRAGROCK CONNECTION TUBE
B	MAST TUBE MOUNT HOLES
C	ENGINE MOUNT BRACE TUBE MOUNTING HOLES

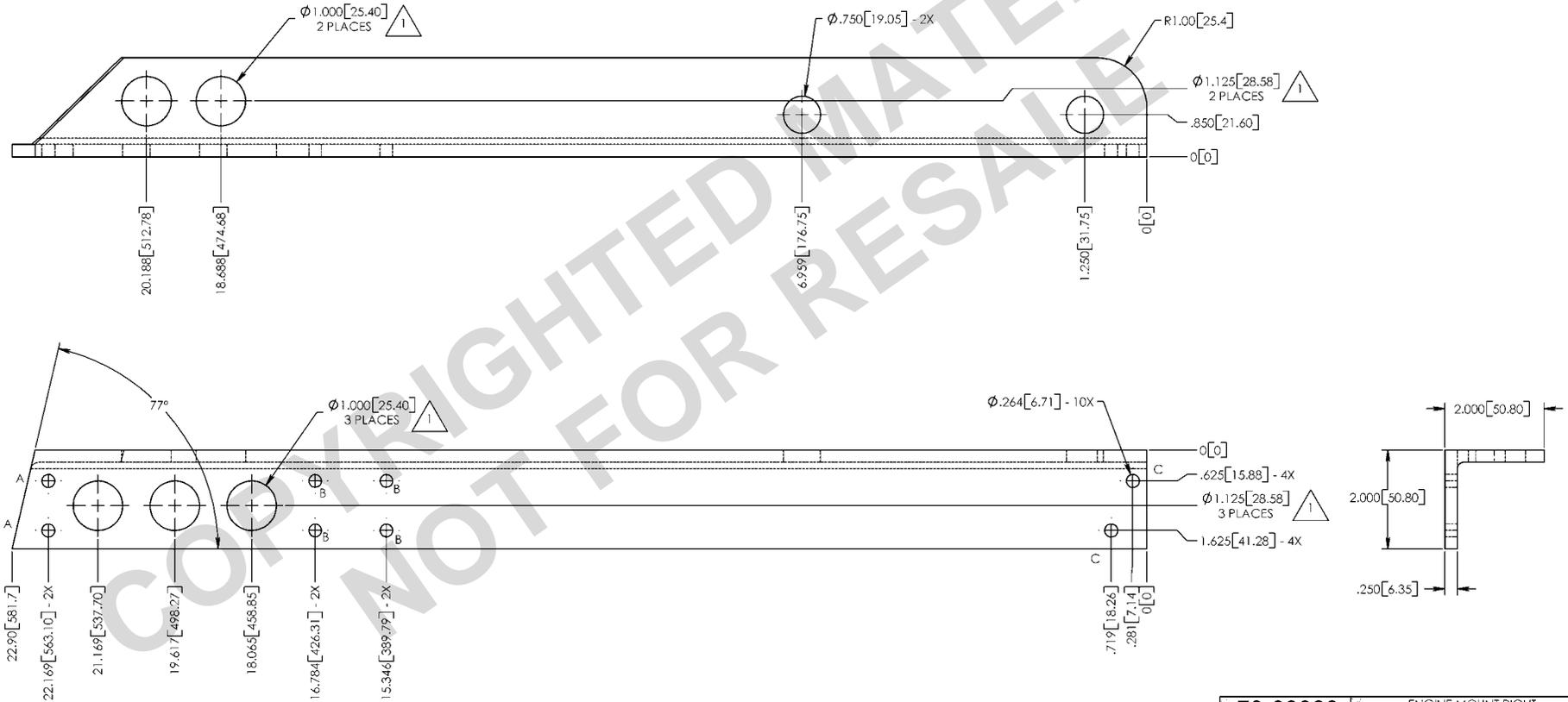


70-00008		ENGINE MOUNT LEFT	
70 - Brackets, Supports, Frames, And Blocks			
UNLESS OTHERWISE SPECIFIED			
UNLESS OTHERWISE SPECIFIED	INCHES	ANGLES	ALL DIMENSIONS ARE IN
X.XX ±.01	X" ±.01"	X° ±5'	INCHES (MM)
X.XXX ±.005	X" ±.005"	X° ±5'	MM
X.XXXX ±.0001	X" ±.0001"		
D:\CaddWork\Drawings\70\70-00008 - EngineMountLeft.dwg			
DO NOT SCALE DRAWING		SolidWorks	1
6061-T6 ALUMINUM	D. SHOEBRIDGE	1:1	D
			1 OF 1

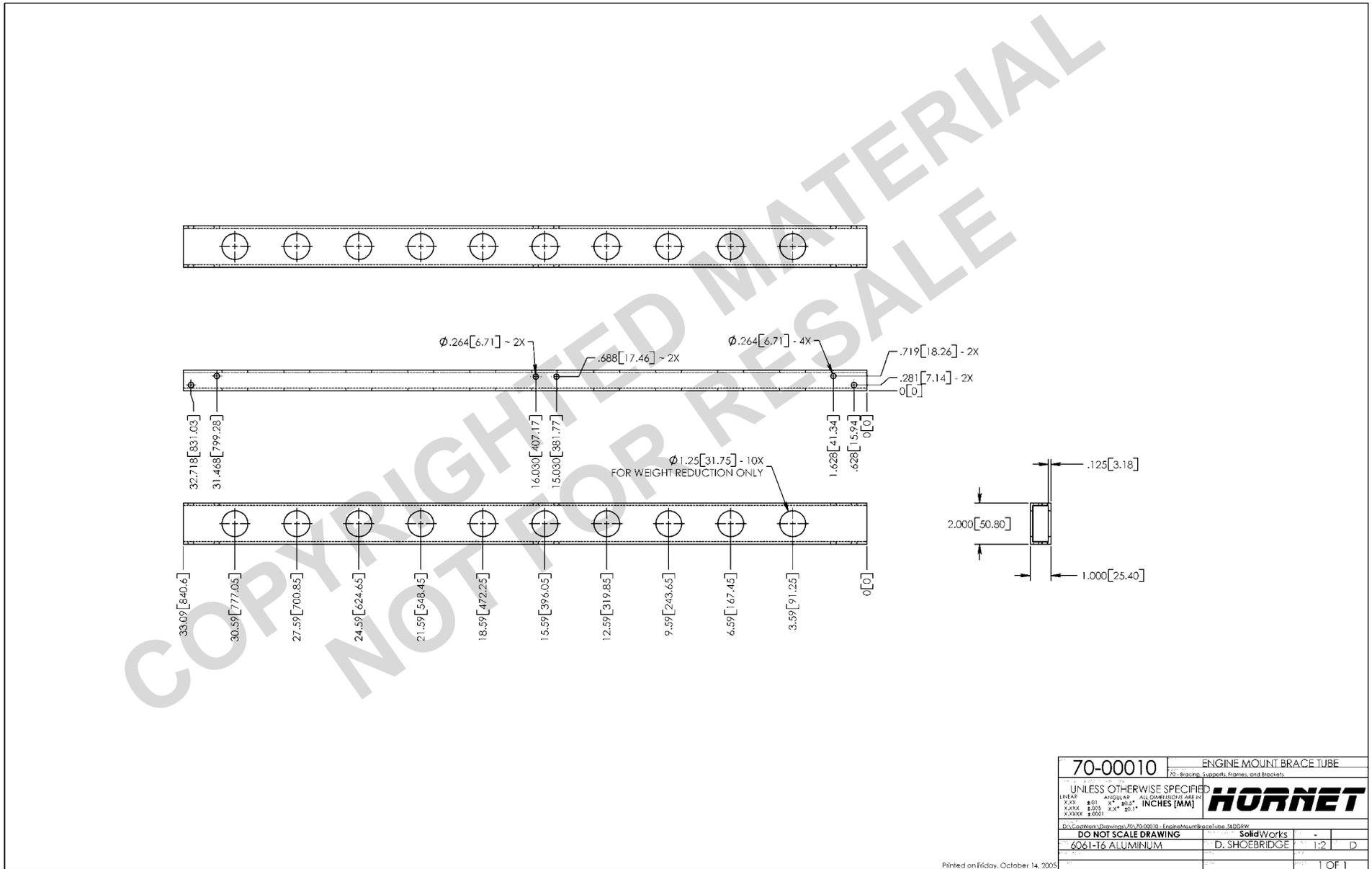
Printed on Friday, October 14, 2005

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	41305-01	ADDED LIGHTENING HOLES. REMOVED UNNEEDED MOUNTING HOLES FOR SEAT.	DTS	4-Oct-05	DTS	4-Oct-05

HOLE USAGE	
SYMBOL	DESCRIPTION
A	DIAGONAL CONNECTION TUBE
B	MAST TUBE MOUNT HOLES
C	ENGINE MOUNT BRACE TUBE MOUNTING HOLES

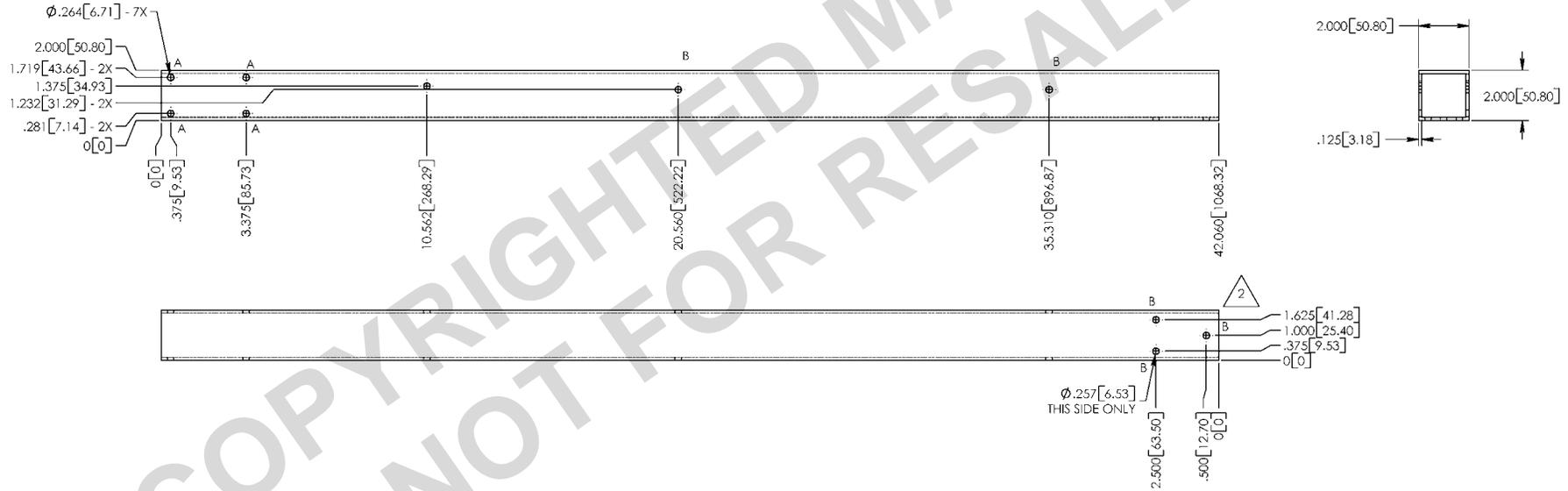


70-00009	ENGINE MOUNT RIGHT
30 - Reaction Supports, Frames, and Brackets	
UNLESS OTHERWISE SPECIFIED	
UNIT: INCHES	ALL DIMENSIONS ARE IN INCHES [MM]
X.XX #01 X".#01"	X.XX #01 X".#01"
X.XXX #005 X".#005"	X.XXX #001 X".#001"
D:\CandWork\Drawings\20_70-00009 - EngineMountRight_SLD.DRW	
DO NOT SCALE DRAWING	SolidWorks 1
6061-T6 ALUMINIUM	D. SHOEBRIDGE 1:1 D
Printed on Friday, October 14, 2005	1 OF 1



REV	ECH #	DESCRIPTION	CHG BY	CHG DATE	APPV BY	APPV DATE
1	13104-1	RELOCATED TAIL FEATHER MOUNTING HOLES	DTS	21-Mar-04	DTS	21-Mar-04
2	41305-01	RELOCATED TAIL WHEEL MOUNTING HOLES CHANGED TAIL FEATHER MOUNTING HOLES	DTS	4-Oct-05	DTS	4-Oct-05

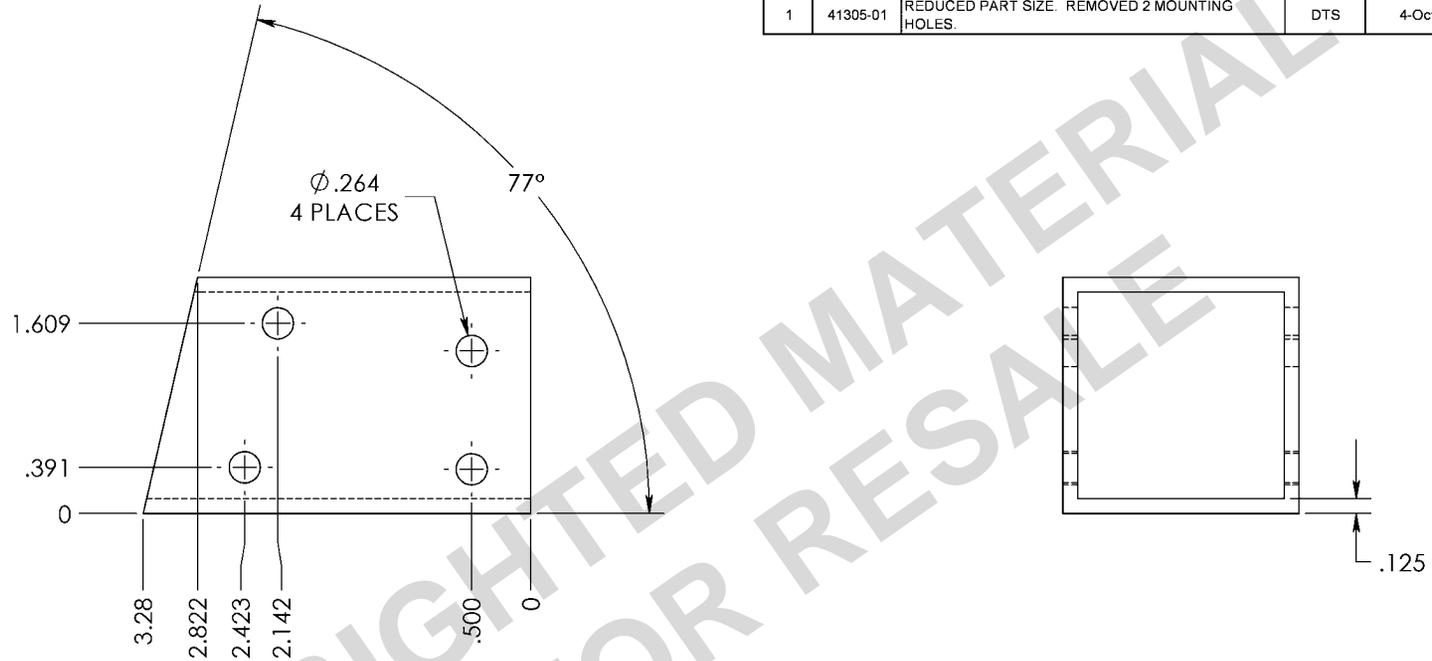
SYMBOL	DESCRIPTION
A	TAIL BOOM CONNECTION FEATHER MOUNTING HOLES
B	TAIL FEATHER MOUNTING HOLES
C	TAIL WHEEL MOUNTING HOLES



70-00011		TAIL BOOM	
UNLESS OTHERWISE SPECIFIED		HORNET	
ALUMINUM, 6061-T6		D. SHOEBRIDGE	
DO NOT SCALE DRAWING		SolidWorks	
ALUMINUM, 6061-T6		D. SHOEBRIDGE	
1:2		D	
1 OF 1			

Printed on Tuesday, October 25, 2005

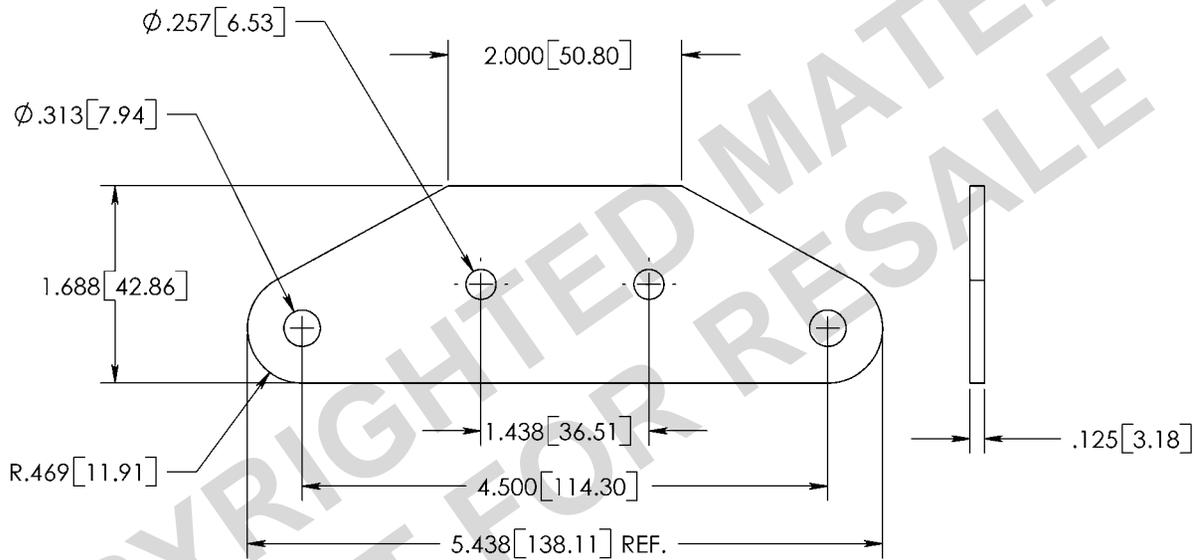
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	41305-01	REDUCED PART SIZE. REMOVED 2 MOUNTING HOLES.	DTS	4-Oct-05	DTS	4-Oct-05



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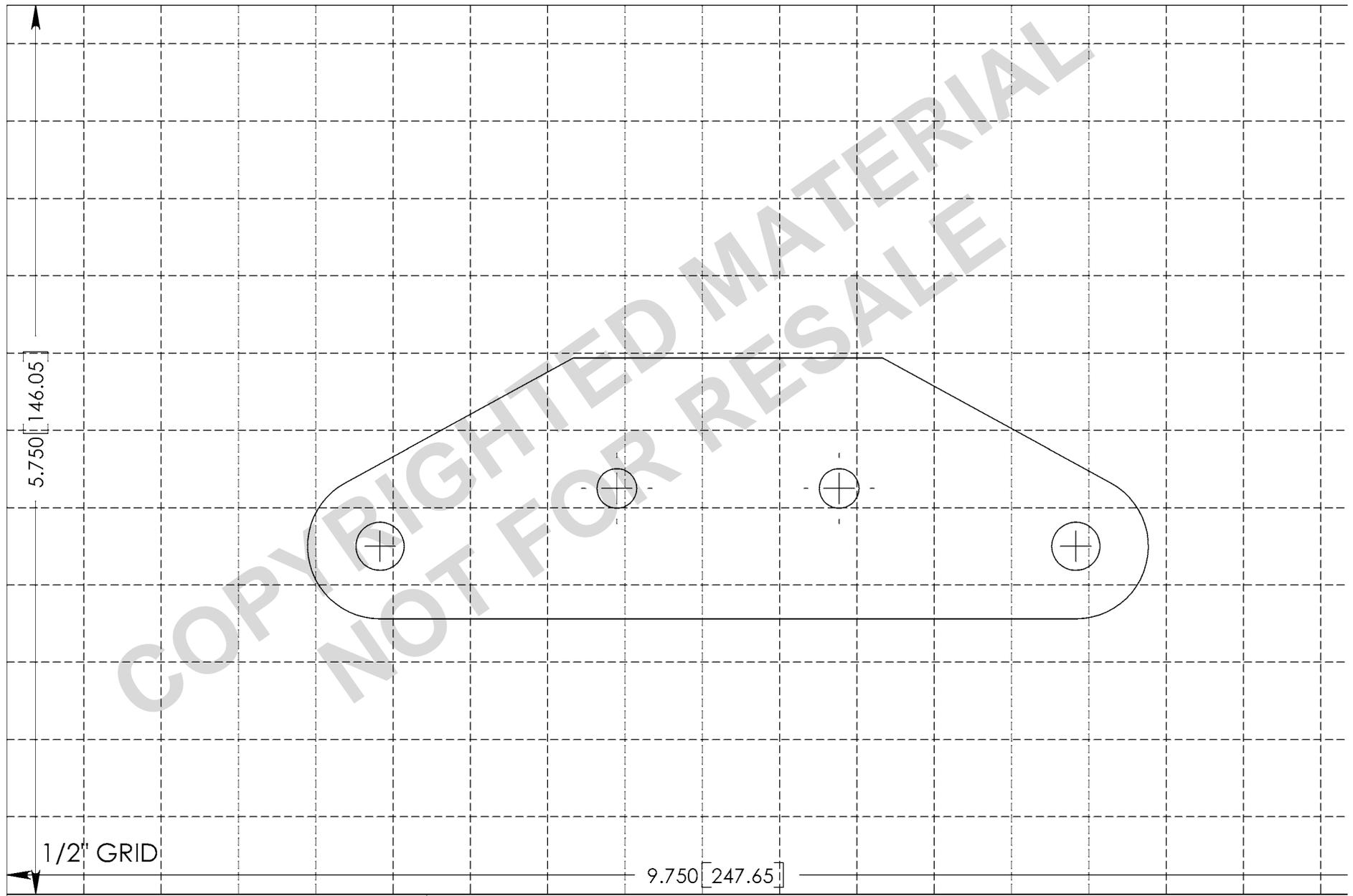
P/N 70-00046		TITLE DIAGONOL CONNECTION TUBE	
PART GROUP 70 - Bracing, Supports, Frames, And Brackets		HORNET	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° INCHES [MM] X.XXX ±.005 X.X° ±0.1° X.XXXX ±.0001			
FILENAME E:\CadWork\Drawings\70\70-00046 - DiagonalConnectionTube.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1 THIRD ANGLE
MTRL ALUMINUM, 6061-T6	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET	1 OF 1

Printed on Saturday, January 07, 2006



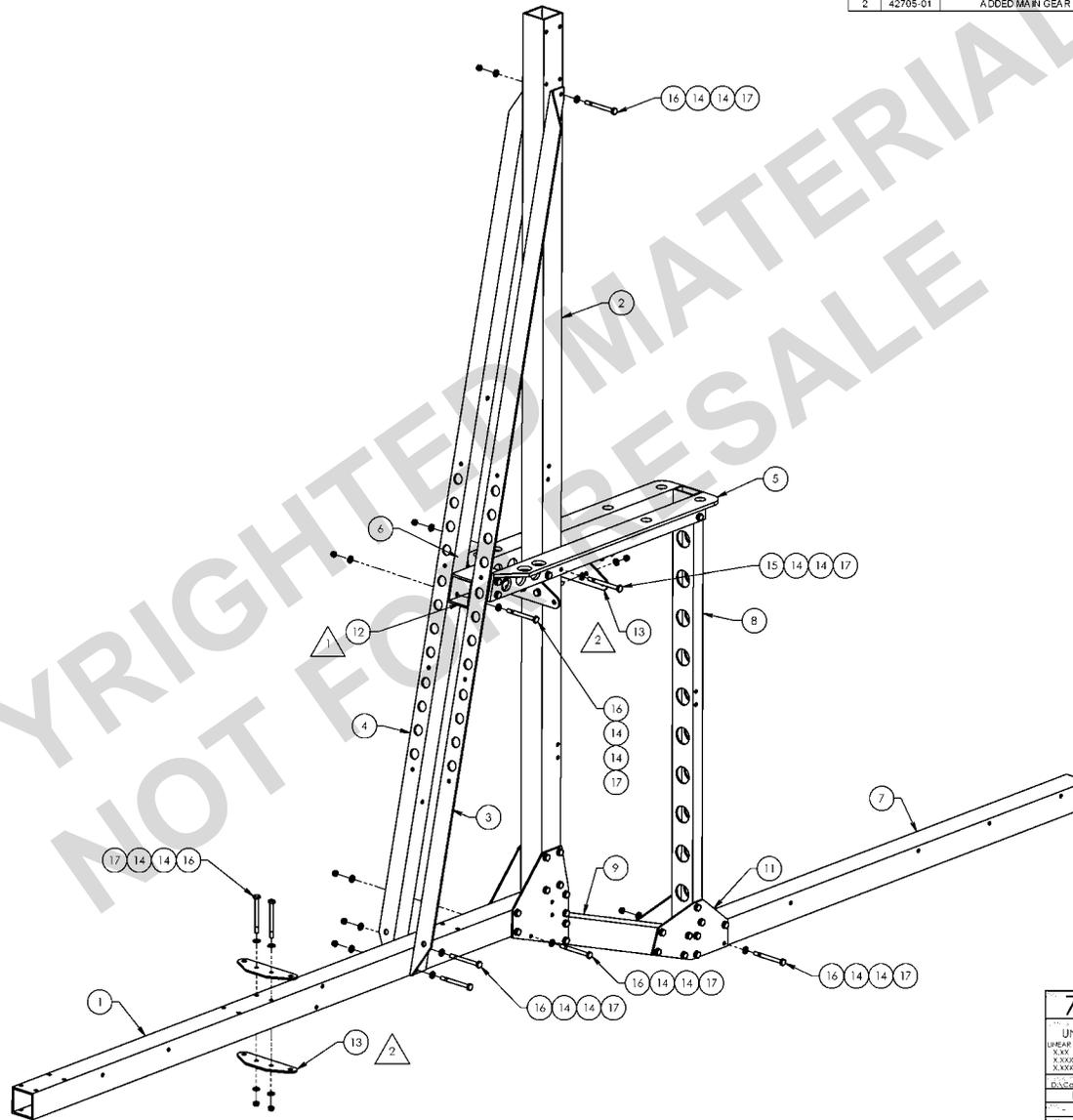
P/N 70-00060		TITLE MAIN GEAR ANCHOR PLATE		
PART GROUP 70 - Bracing, Supports, Frames, And Brackets		HORNET		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED				
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN		
X.XX ±.01	X° ±0.5°	INCHES [MM]		
X.XXX ±.005	X.X° ±0.1°			
X.XXXX ±.0001				
FILENAME D:\CadWork\Drawings\70\70-00060 - MainGearAnchorPlate.SI.DDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -	THIRD ANGLE
MTRL ALUMINUM, 6061-T6	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 2	

Printed on Sunday, October 23, 2005



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	70-00003	KEEL TUBE
2	1	70-00004	MAST TUBE
3	1	70-00006	MAIN DIAGONL BRACE LEFT
4	1	70-00007	MAIN DIAGONL BRACE RIGHT
5	1	70-00008	ENGINE MOUNT LEFT
6	1	70-00009	ENGINE MOUNT RIGHT
7	1	70-00011	TAIL BOOM
8	1	70-00010	ENGINE MOUNT BRACE TUBE
9	1	70-00005	TRANSITION TUBE
10	2	69-00001	CLUSTER PLATE
11	2	69-00002	TAIL BOOM CONNECTION PLATE
12	1	70-00046	DIAGONOL CONNECTION TUBE
13	4	70-00060	MAIN GEAR ANCHOR PLATE
14	80	27-00002	AN960-416 WASHER
15	8	26-00087	AN4-27A BOLT
16	32	26-00086	AN4-25A BOLT
17	40	26-00014	NUT MS21042-4 (1/4-28)

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	41384-01	ADDED CONNECTION TUBE AND UPDATED BOM	DTS	5-Oct-04	DTS	5-Oct-04
2	43705-01	ADDED MAIN GEAR ANCHOR PLATES	DTS	15-Oct-05	DTS	15-Oct-05



70-00012		HORNET - AIRFRAME	
UNLESS OTHERWISE SPECIFIED		70 - Main, Support, Frame, and Bracket	
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	
X.XX #01	X° #0.5°	INCHES (MM)	
X.XXX #000	X.X° #0.1°		
X.XXXX #0001			
D:\Capitol\Design\70-00012 - Airframe.stp			
DO NOT SCALE DRAWING	SolidWorks	2	
	D. SHOEBRIDGE	1:4	D
			1 OF 1

Printed on Saturday, October 15, 2005

8.4 Landing Gear

The first thing that stood out about the Bensen style gyros, to include the GyroBee and HoneyBee, was the stiffness of the landing gear system. The "Bee" family of gyros at least had some form of shock system through the use of bungee cords or fiberglass rods. The Bensen's had nothing - the wheels are hard mounted to the end of aluminum rectangular tubing. Flying these gyros from hard surface runways was no problem. But what about people's back yards, grass strips, etc? Rough surfaces tend to bang these aircraft around quite a bit. All of the systems that I had seen thus far had room for improvement. This is where I started my design efforts.

Designing the landing gear lead me down several different roads. I knew I wanted to have the landing gear flexible up and down by as much as 3-4 inches (full travel being about 3-times the aircraft's maximum gross weight). This would allow for less than perfect landings and rough fields. The biggest challenge in designing a landing gear for an aircraft as light as a gyro is what to use for springs. I looked at a pile of different options – fiberglass leaf springs, coil compression springs, Belleville washers, compressed air, oleo struts, rubber disks, etc. Each one of them had their own special problems to consider, with weight being the biggest problem for each, except for the compressed air design. The biggest problem with air was what do you do if you had an air leak in the system while you are flying, and you didn't know about it? The lack of holding force on the landing gear could cause a serious accident at the time of landing. At the very least, you would have to rebuild your gyro.

By now, you're probably asking yourself, "what does this talk about landing gears have to do with the airframe?" Plenty! The entire time that I was designing the Hornet, my target specifications were those outlining what an ultralight aircraft is. In other words, part 103 of the FAA Federal Aviation Regulations was my target – a single seat aircraft with an empty weight of no greater than 254 pounds, a fuel capacity of no greater than 5 gallons, and a top speed no greater than 63 miles per hour. This specification dictated the forces that the landing gear had to be capable of absorbing.

8.4.1 Mains

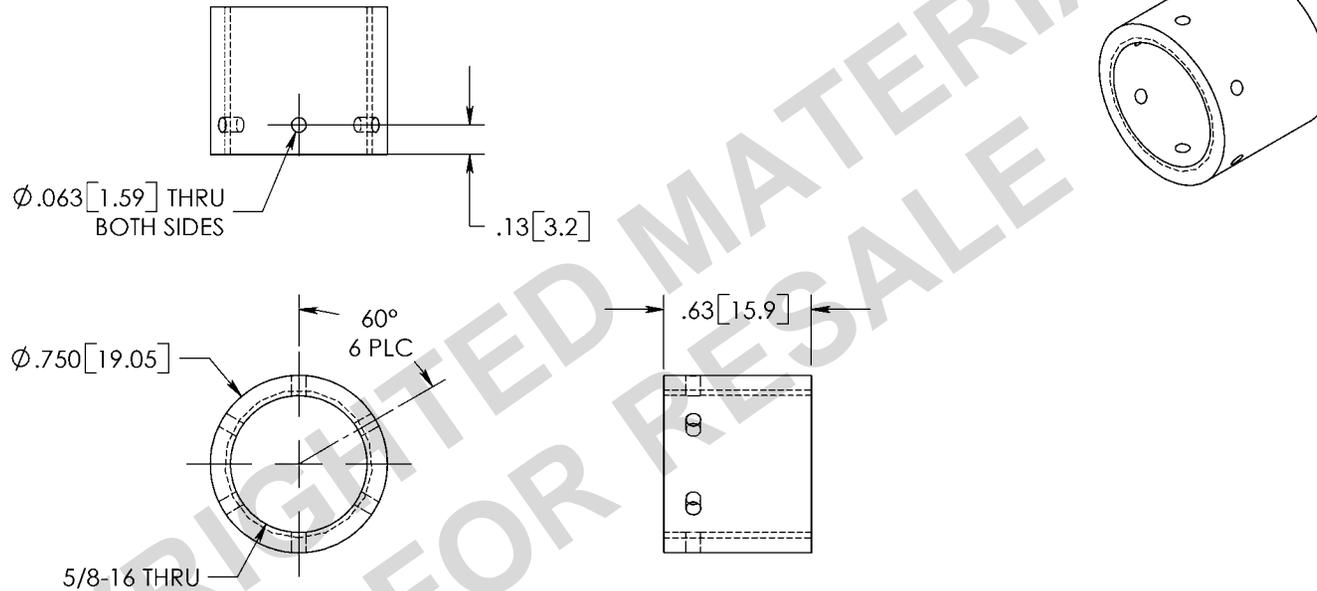
By comparison to most other gyros, the initial design of the main landing gear for the Hornet was quite wide – 7 feet. A narrower stance would have no impact on the flight characteristics. However, it would degrade the ground rollover angle. Most damage in typical gyro accidents occurs when a pilot touches down in a "crabbed" angle, often when executing an off field landing with the engine out. All too often, the gyro will tip over, destroying the blades and severely damaging other parts of the airframe. A wider gear stance can make any gyro more immune to such rollover accidents. But there is a limit as to how wide you should go. At some point in time, you will have to trailer your gyro to a different location. Most trailers are in the 6-7 foot range. However, many of the 7 foot wide trailers have obstructions where the trailers wheels reside. Loading and unloading a gyro with a 7 foot stance is difficult to deal with in this case. Therefore, after a trip to Rotors Over Carolina in October of 2003, and witnessing this problem firsthand, I decided to narrow the landing gear of the Hornet to 6 foot.

Several changes have been made to the original landing gear system. The first prototype landing gear had a few problems with it. Firstly, I had incorrectly located the mounting hole that receives the bolt that contacts the extend cushion. A work around for this problem is to add about 1/2" of length to the polyurethane compression spring. The second issue was that 9 inches of polyurethane compression spring was much more than was really needed. Third was with regard to the wall thickness of the 1 inch diameter tube, which were 2 different sizes. I took care of that by increasing the wall thickness of all of the thinner tubes, making all of the 1 inch tube the same. Fourth, the machined parts that fit into the 1 inch tube were difficult to make and to get aligned correctly with the fittings at the opposite ends of the tube. The fix to this was to change all of the pivot fittings to rod ends, which required additional threaded tube inserts and rod ends. Fifth, the threaded tube inserts were shortened and simplified. The mounting bolts have been eliminated from all of the threaded tube inserts, and had been replaced with Cherry blind rivets. The rivets should have been more than enough for this application since each rivet has a shear strength greater than 400 pounds each, and each threaded tube insert has 8 rivets holding it in-place. This version of the landing gear design was a little heavier, but was much easier to build, much easier to install, was a bit stronger, and had a vertical travel at the wheel of about 6 inches.

There are a few alternative components that can be used on the main gear. One difference is to use larger diameter wheels that can be purchased from a hardware store. Wheel barrow wheels are a good replacement for the Azusalite wheels that I'm using. Larger wheels on the mains will provide greater clearance for the tail boom. These wheels usually have standard 5/8" bearings, however the spacing between the bearings is much greater than the Azusalite's and will require a longer axle shaft. Wheel barrow wheels can be found in sizes as large as 10" and some have split rims which simplifies the addition of brakes. And still others are filled with foam making them flat free. There are many different choices for main wheels. Shop around a little and you'll see what I mean.

Another alternative part is the axle nut. I originally wanted to use a machined nut of my own design because of weight considerations. Currently however, I'm using a reduced height nylon lock nut, which works great. This also eliminates the need for adding the machined slots in the axle shaft. However, a cross hole with an additional safety pin, clip or wire would be a good idea. This way, if by chance the outer bearing on the left wheel locks up and spins the nut loose, the extra safety device going through the end of the axle shaft will prevent the nut from coming completely off, keeping the wheel from departing the aircraft.

On part 67-00006, Guide Tube, it is a good idea to have this part plated with something very smooth since it will be rubbing on one of the 1" tube inner surfaces. Flash chrome or Nickel plating might be a good choice. Another plating option would be some form of a Teflon impregnated coating. The Teflon would be self lubricating and wear resistant at the same time. I will be looking into different plating options.

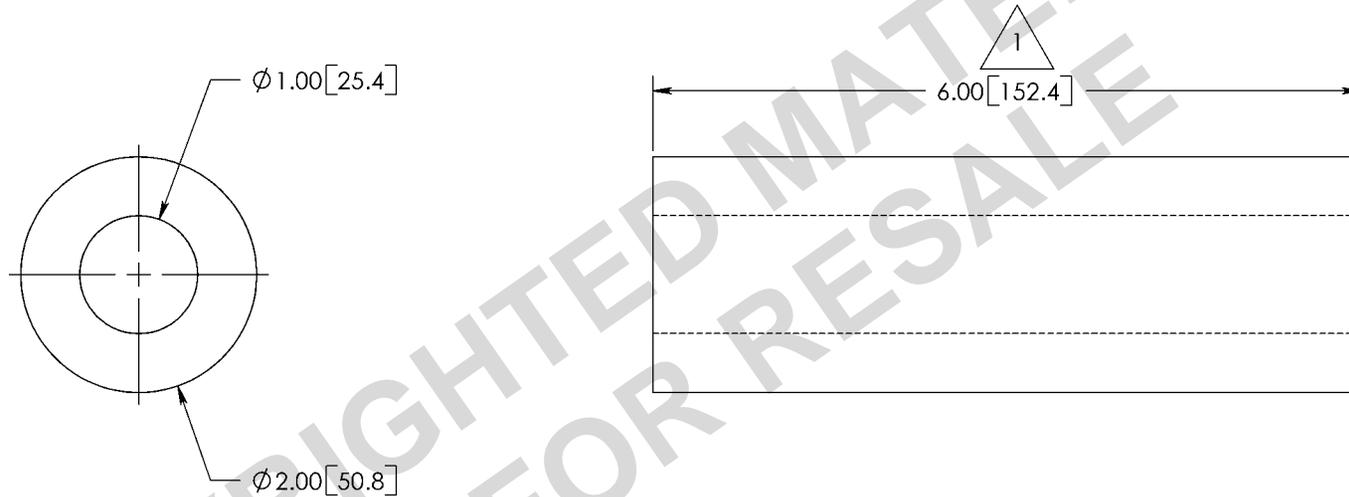


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P/N 26-00079		TITLE AXLE NUT		
PART GROUP 26 - Threaded Fasteners (Screws, Nuts, Bolts, etc.)				
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR X.XX ±.01 X.XXX ±.005 X.XXXX ±.0001 ANGULAR X° ±0.5° X.X° ±0.1° ALL DIMENSIONS ARE IN INCHES [MM]		HORNET		
FILENAME D:\CadWork\Drawings\26\26-00079 - AxleNut.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -	THIRD ANGLE
MTRL 4130 STEEL	ENG D. SHOEBRIDGE	SCALE 2:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET 1 OF 1		

Printed on Saturday, October 15, 2005

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	CHANGED LENGTH OF PART	DTS	29-Sep-04	DTS	29-Sep-04



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P/N 61-00002		TITLE POLYURETHANE TUBE		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 61 - Springs (Compression, Extension, Torsion, Constant Force, Gas Charged, etc)		
LINEAR	ANGULAR	HORNET		
X.XX ±.01	X° ±0.5°			
X.XXX ±.005	X.X° ±0.1°			
X.XXXX ±.0001				
FILENAME D:\CadWork\Drawings\61\61-00002 - PolyurethaneSpring.SLDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1	THIRD ANGLE
MTRL POLYURETHANE 60-70 SHORE A	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET 1 OF 1		

Printed on Saturday, October 15, 2005

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	CHANGED MATERIAL SIZE	DTS	29-Sep-04	DTS	29-Sep-04

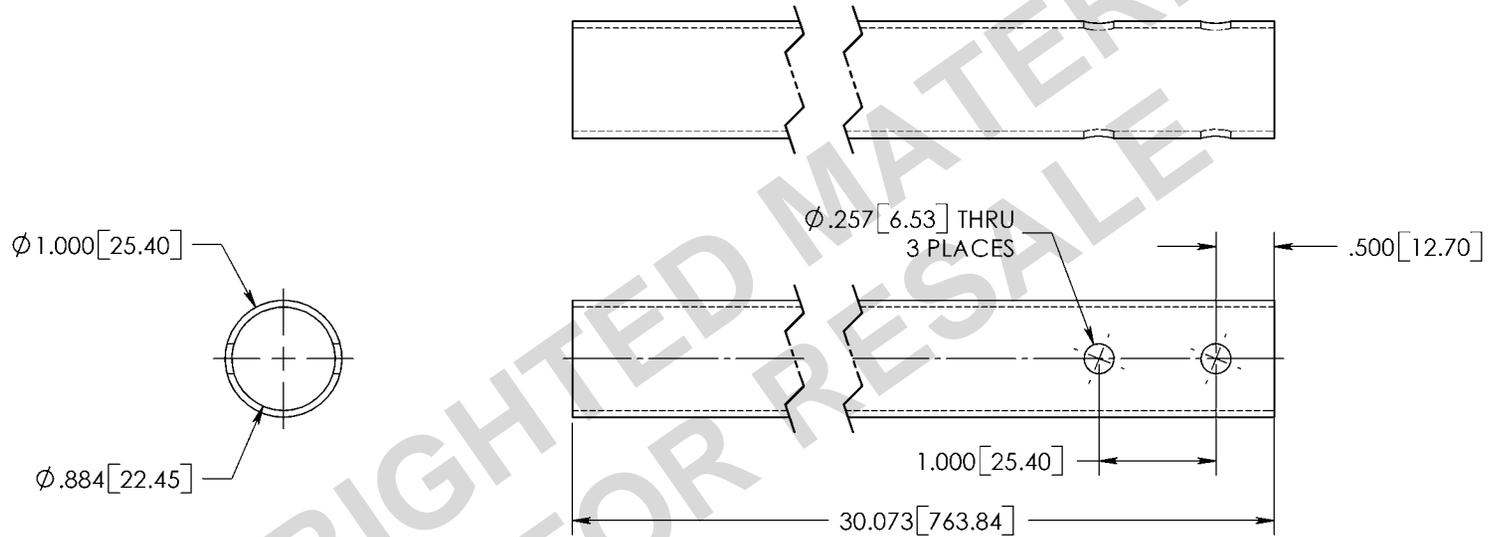


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P/N 61-00003		TITLE EXTEND CUSHION			
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 61 - Springs (Compression, Extension, Torsion, Constant Force, Gas Charged, etc.)			
LINEAR	ANGULAR	HORNET			
X.XX ±.01	X° ±0.5°				
X.XXX ±.005	X.X° ±0.1°				
X.XXXX ±.0001					
ALL DIMENSIONS ARE IN INCHES [MM]					
FILENAME D:\CadWork\Drawings\61\61-00003 - ExtendCushion.SLDDRW					
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1	THIRD ANGLE	
MTRL POLYPURETHANE, 70 SHORE A	ENG D. SHOEBRIDGE	SCALE 2:1	DATE	SIZE B	
HEAT TREAT	APRV	DATE			
FINISH	DETAIL	SHEET		1 OF 1	

Printed on Saturday, October 15, 2005

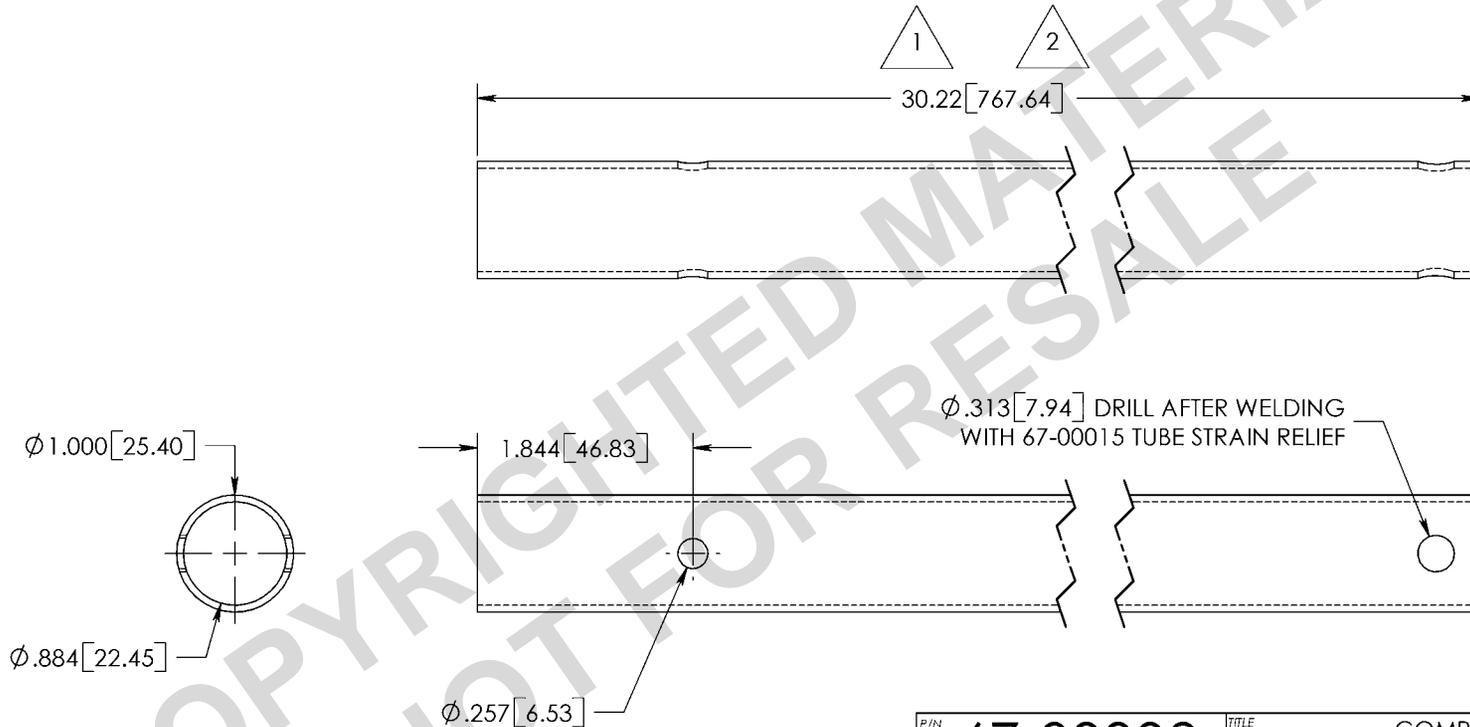
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	CHANGED LENGTH OF TUBE. REMOVED BOLT HOLES.	DTS	29-Sep-04	DTS	29-Sep-04



P/N 67-00001		TITLE AXLE SHAFT	
PART GROUP 67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindels, etc)		HORNET	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED			
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	
X.XX ±.01	X° ±0.5°	INCHES [MM]	
X.XXX ±.005	X.X° ±0.1°		
X.XXXX ±.0001			
FILENAME D:\CadWork\Drawings\67\67-00001 - AxleShaft.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1
MTRL 4130 STEEL TUBE	ENG D. SHOEBRIDGE	SCALE 1:1	THIRD ANGLE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL D. SHOEBRIDGE	SHEET	1 OF 1

Printed on Saturday, October 15, 2005

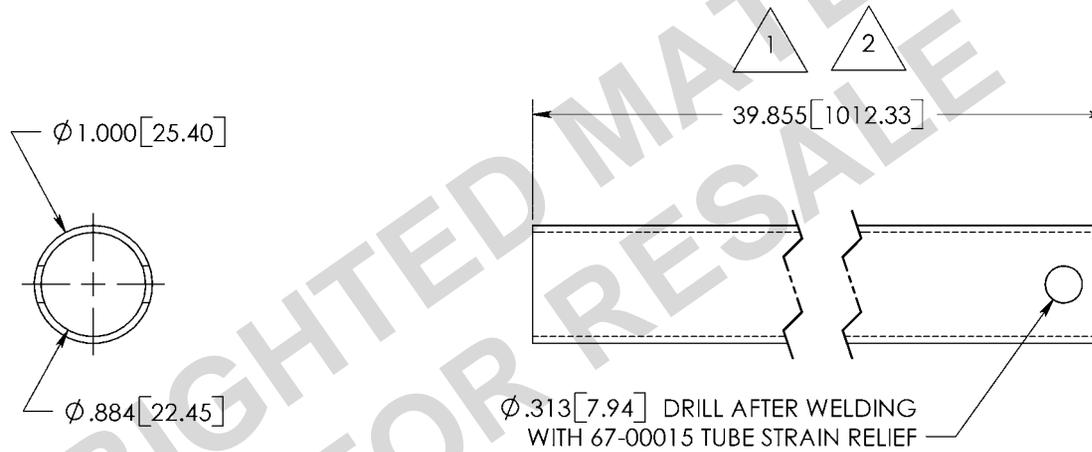
REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	CHANGED PART LENGTH. REMOVED BOLT HOLES.	DTS	29-Sep-04	DTS	29-Sep-04
2	33205-02	CHANGED TUBE LENGTH TO ALLOW FOR WELDING. ADDED HOLE.	DTS	8-A ug-05	DTS	8-A ug-05



P/IN	67-00002	TITLE	COMPRESSION STRUT		
DIMENSIONS AND TOLERANCES		PART GROUP	67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindels, etc)		
UNLESS OTHERWISE SPECIFIED		HORNET			
LINEAR	ANGULAR				
X.XX ±.01	X° ±0.5°	INCHES [MM]			
X.XXX ±.005	X.X° ±0.1°				
X.XXXX ±.0001					
FILENAME	D:\CadWork\Drawings\67\67-00002 - CompressionStrut.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH	SolidWorks	REV	2
MTRL	4130 STEEL	ENG	D. SHOEBRIDGE	SCALE	1:1
HEAT TREAT		APRV		DATE	
FINISH		DETAIL		SHEET	1 OF 1

Printed on Saturday, October 15, 2005

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	CHANGED LENGTH OF PART. REMOVED BOLT HOLES	DTS	29-Sep-04	DTS	29-Sep-04
2	33205-01	CHANGED LENGTH TO ALLOW FOR WELDING	DTS	8-Aug-05	DTS	8-Aug-05

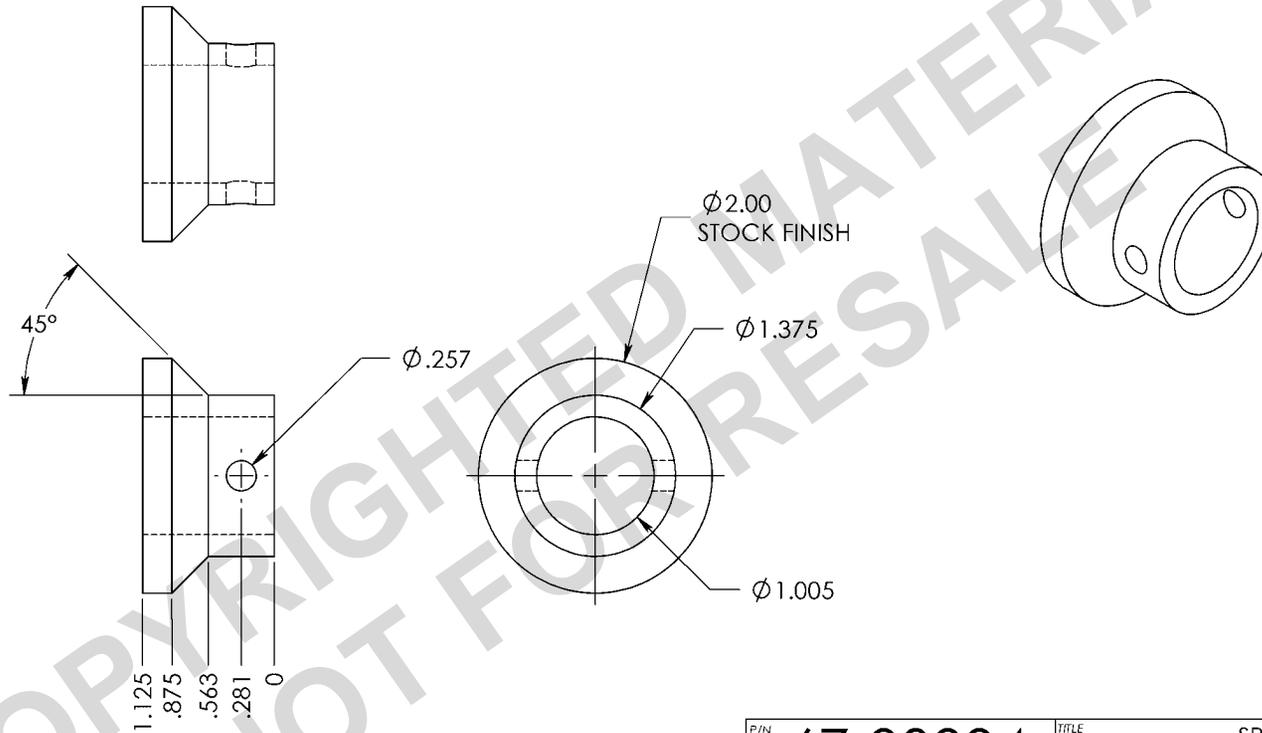


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P/N 67-00003		TITLE DRAG STRUT	
PART GROUP 67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindles, etc)		HORNET	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° X.XXX ±.005 X.X° ±0.1° X.XXXX ±.0001 INCHES [MM]			
FILENAME D:\CadWork\Drawings\67\67-00003 - DragStrut.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 2 THIRD ANGLE
MTRL STEEL, 4130	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET 1 OF 1	

Printed on Saturday, October 15, 2005

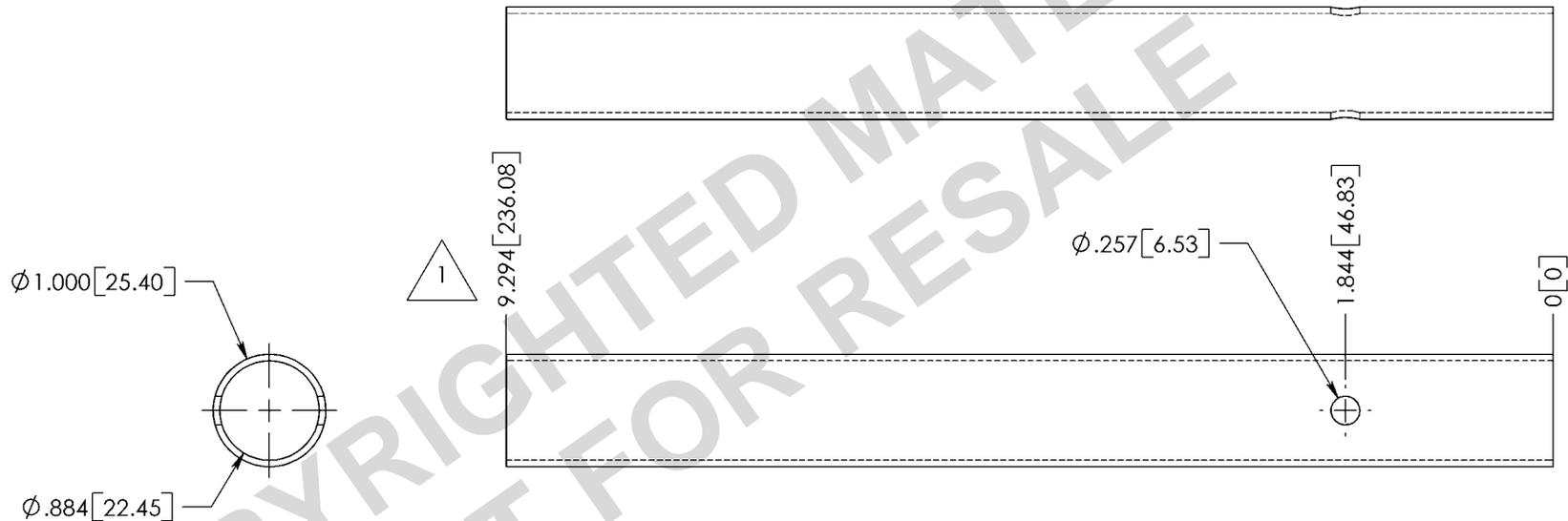
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	SIMPLIFIED PART DESIGN. SEVERAL DIMENSIONS CHANGED. CHANGED MATERIAL.	DTS	29-Sep-04	DTS	29-Sep-04



P/N	67-00004	TITLE	SPRING STURT CAP		
DIMENSIONS AND TOLERANCES		PART GROUP			
UNLESS OTHERWISE SPECIFIED		67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindels, etc)			
LINEAR	±.01	ANGULAR	X° ±0.5°	ALL DIMENSIONS ARE IN INCHES	
X.XX	±.005	X.X°	±0.1°	HORNET	
X.XXX	±.0001	FILENAME			
X.XXXX	±.0001	D:\CaddWork\Drawings\67\67-00004 - SpringSturtCap.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH	SolidWorks	REV	1
MTRL	ACETAL (POM, DELRIN)	ENG	D. SHOEBRIDGE	SCALE	1:1
HEAT TREAT		APRV		DATE	
FINISH		DETAIL		SHEET	1 OF 1
THIRD ANGLE		SIZE B			

Printed on Saturday, October 15, 2005

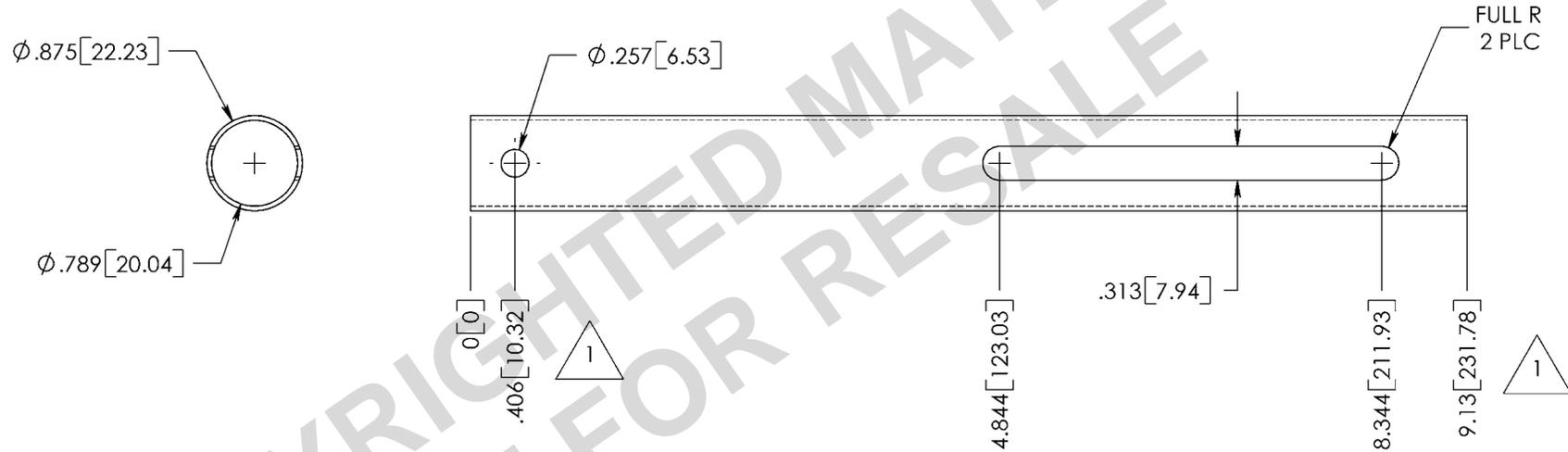
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	REMOVED BOLT HOLES. CHANGED PART LENGTH.	DTS	29-Sep-04	DTS	29-Sep-04



P/N 67-00005		TITLE MOUNT TUBE		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindels, etc)		
LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° X.XXX ±.005 X.X° ±0.1° INCHES [MM] X.XXXX ±.0001		HORNET		
FILENAME D:\CadWork\Drawings\67\67-00005 - SpringStrutMountTube.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1	THIRD ANGLE
MTRL 4130 STEEL	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 1	

Printed on Saturday, October 15, 2005

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	CHANGED PART LENGTH. MOVED SLOT AND HOLE.	DTS	29-Sep-04	DTS	29-Sep-04

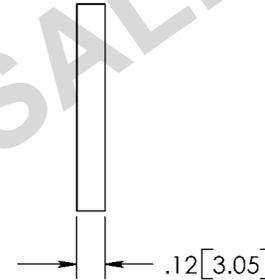
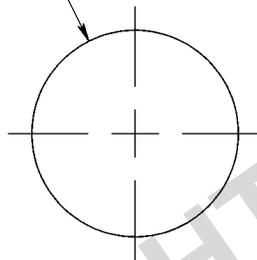


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NOT FOR RESALE

P/N 67-00006		TITLE GUIDE TUBE		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindles, etc)		
LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° X.XXX ±.005 X.X° ±0.1° INCHES [MM] X.XXXX ±.0001		HORNET		
FILENAME D:\CadWork\Drawings\67\67-00006 - SpringStrutGuideTube.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1	THIRD ANGLE
MTRL 4130 STEEL		ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT		APRV	DATE	
FINISH		DETAIL	SHEET	1 OF 1

Printed on Saturday, October 15, 2005

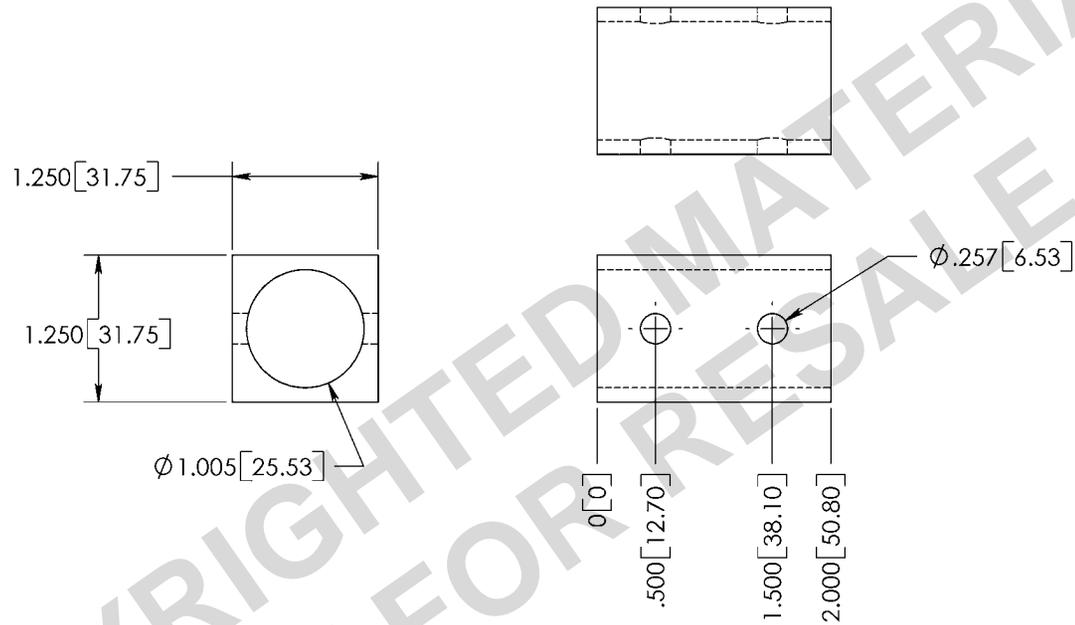
Ø.875 [22.23]



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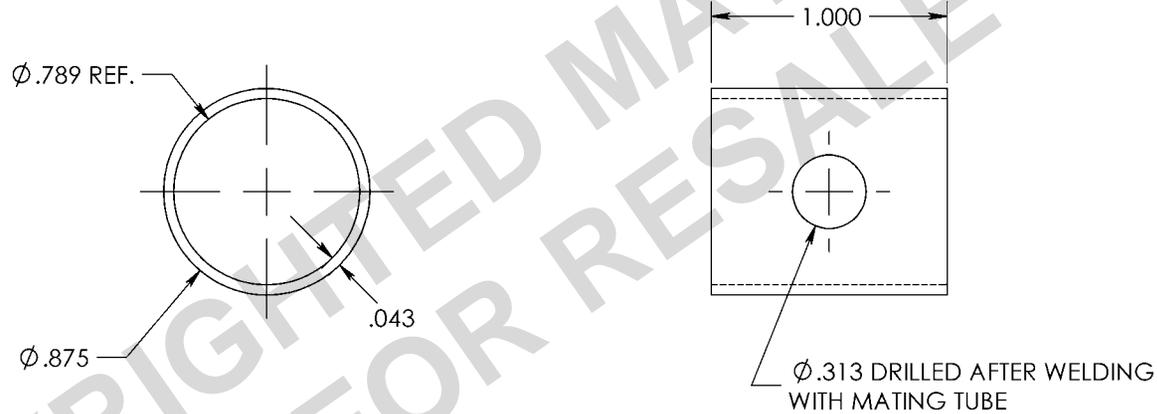
P/N 67-00007		TITLE INNER END CAP		
PART GROUP 67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindels, etc				
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° INCHES [MM] X.XXX ±.005 X.X° ±0.1° X.XXXX ±.0001		HORNET		
FILENAME D:\CadWork\Drawings\67\67-00007 - InnerEndCap.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -	THIRD ANGLE
MTRL 4130 STEEL	ENG D. SHOEBRIDGE	SCALE 2:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET 1 OF 1		

Printed on Saturday, October 15, 2005



P/N 67-00012		TITLE AXLE SHAFT MOUNT BLOCK	
PART GROUP 67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindels, etc)			
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° INCHES [MM] X.XXX ±.005 X.X° ±0.1° X.XXXX ±.0001		HORNET	
FILENAME D:\CadWork\Drawings\67\67-00012 - AxleShaftMountBlock.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV - THIRD ANGLE
MTRL NYLON 6 (PA 6)	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET	1 OF 1

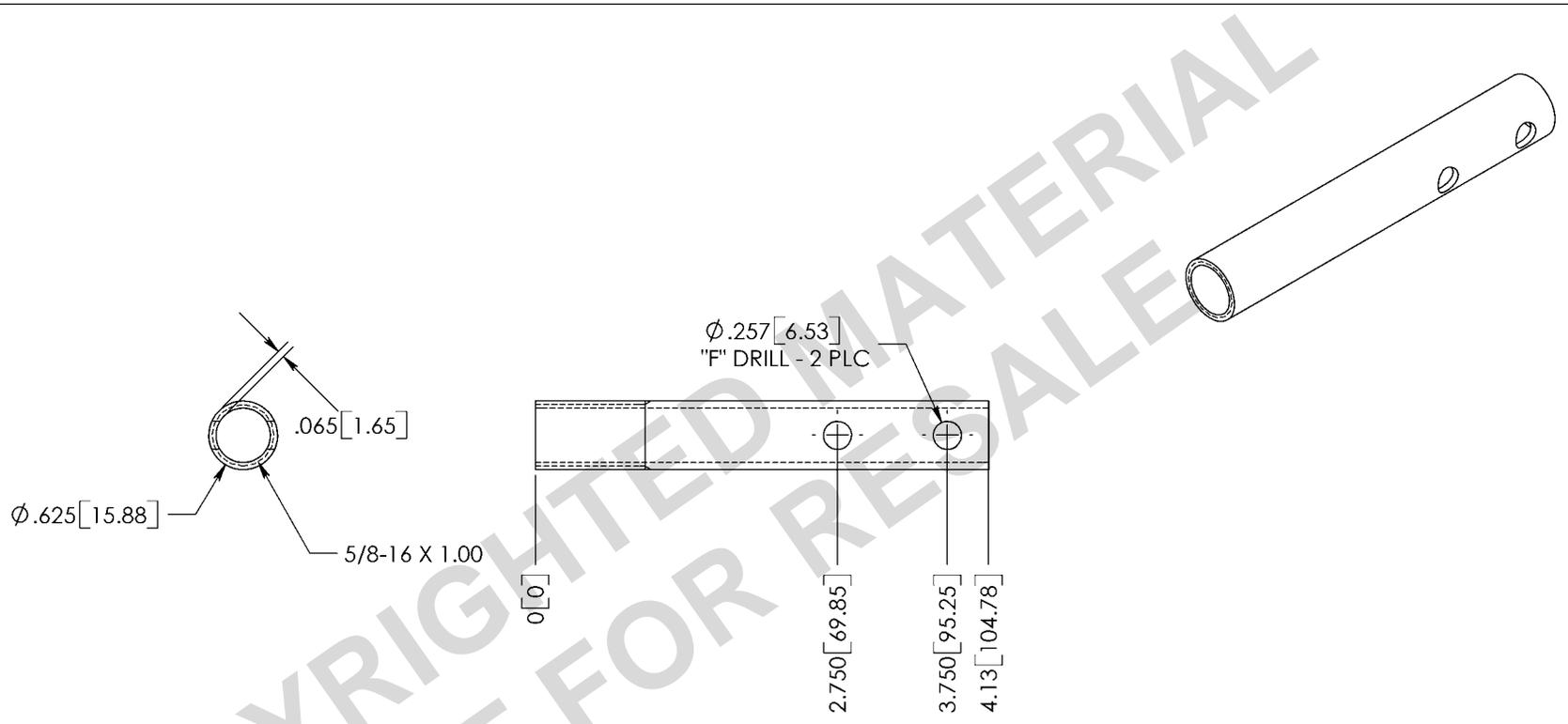
Printed on Saturday, October 15, 2005



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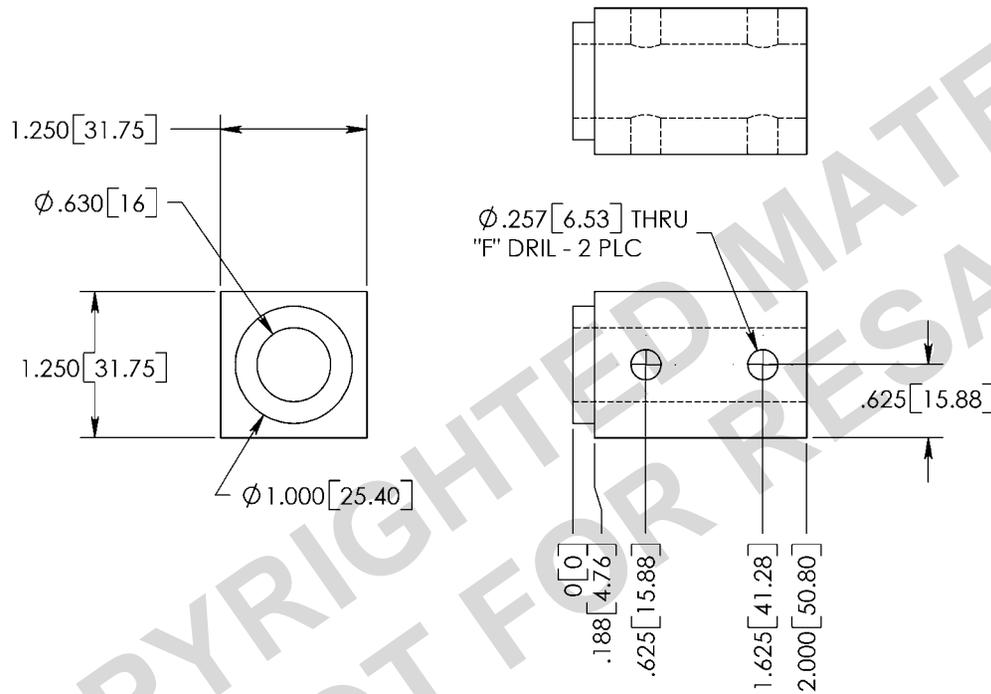
P/N 67-00015		TITLE TUBE STRAIN RELIEF		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindels, etc		
LINEAR	ANGULAR	HORNET		
X.XX ±.01	X° ±0.5°			
X.XXX ±.005	X.X° ±0.1°			
X.XXXX ±.0001				
ALL DIMENSIONS ARE IN INCHES [MM]				
FILENAME D:\CadWork\Drawings\67\67-00015 - TubeStrainRelief.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -	THIRD ANGLE
MTRL ACETAL (POM, DELRIN)	ENG D. SHOEBRIDGE	SCALE 2:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 1	

Printed on Saturday, October 15, 2005



P/N 68-00003		TITLE MAIN GEAR AXLE	
PART GROUP 68 - Shifting, Axles, and Rollers			
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° X.XXX ±.005 X.X° ±0.1° X.XXXX ±.0001 INCHES [MM]			
FILENAME D:\CadWork\Drawings\68\68-00003 - MainGearAxle.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV - THIRD ANGLE
MTRL 4130 STEEL	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET	1 OF 1

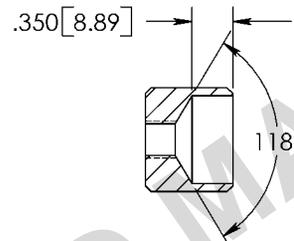
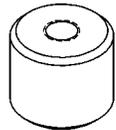
Printed on Saturday, October 15, 2005



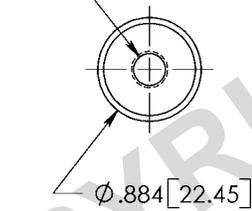
P/N 70-00014		TITLE AXLE MOUNT BLOCK	
PART GROUP 70 - Bracing, Supports, Frames, And Brackets		HORNET	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED			
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN INCHES [MM]	
X.XX ±.01	X° ±0.5°		
X.XXX ±.005	X.X° ±0.1°		
X.XXXX ±.0001			
FILENAME D:\CadWork\Drawings\70\70-00014 - AxleMountBlock.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV - THIRD ANGLE
MTRL 6061-T6 ALUMINUM	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT	APRV D. SHOEBRIDGE	DATE 31 MAY 03	
FINISH	DETAIL D. SHOEBRIDGE	SHEET 1 OF 1	

Printed on Saturday, October 15, 2005

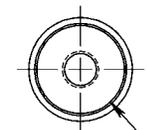
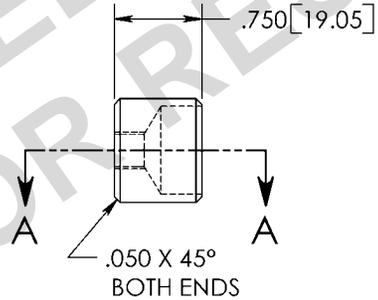
REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	40404-01	SHORTENED PART. REMOVED DRILLED BOLT HOLES.	DTS	29-Sep-04	DTS	29-Sep-04
2	20705-01	SIMPLIFIED PART. CHANGED MATERIAL TO 4130.	DTS	14-May-05	DTS	14-May-05



ϕ .272[6.91] THRU ALL
5/16-24 UNF - 2B THRU ALL



SECTION A-A

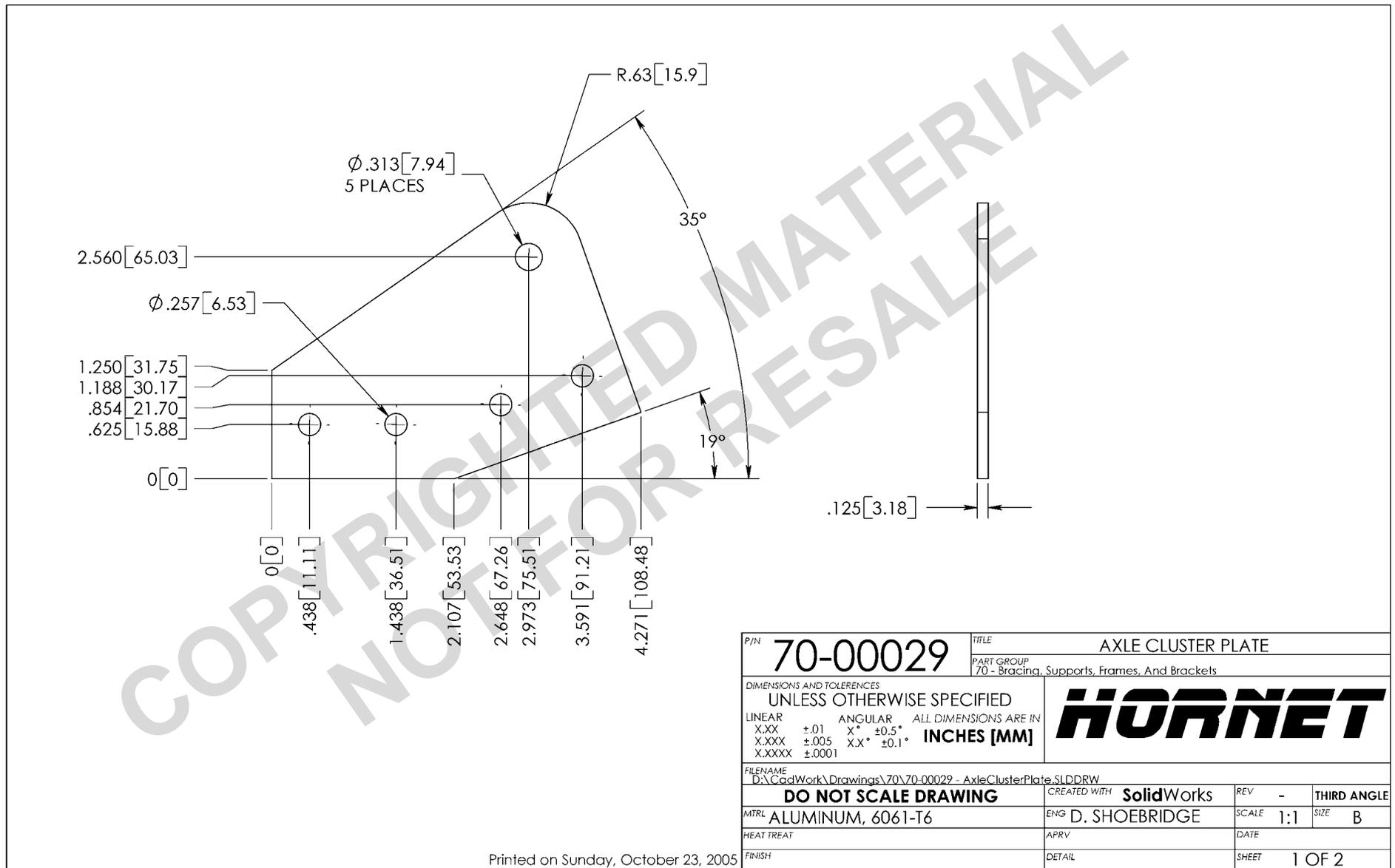


ϕ .750 [19.05]

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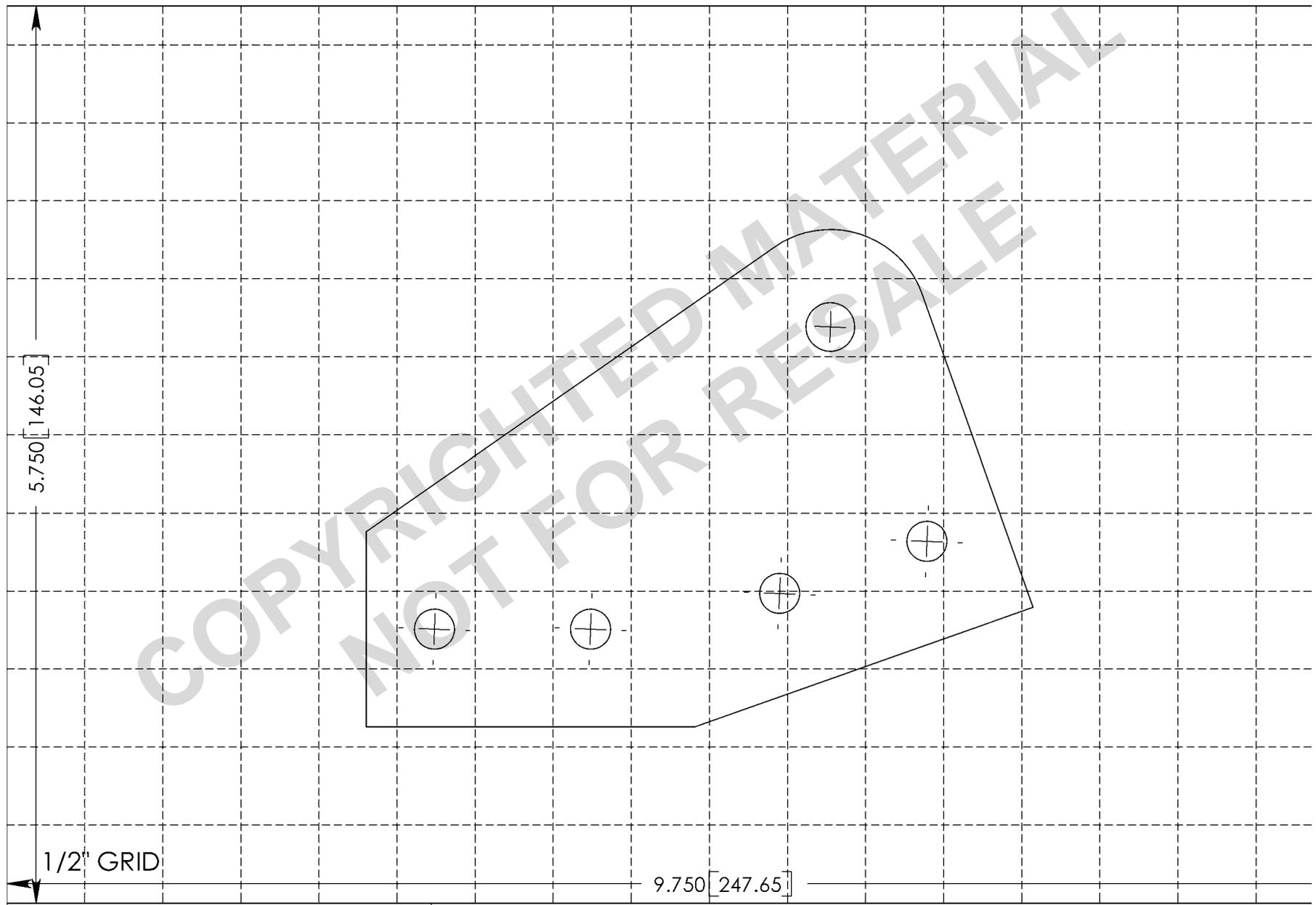
P/N 70-00015		TITLE TUBE THREADED INSERT	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		HORNET	
LINEAR	ANGULAR		
X.XX ±.01	X° ±0.5°	INCHES [MM]	
X.XXX ±.005	X.X° ±0.1°		
X.XXXX ±.0001			
FILENAME D:\CadWork\Drawings\70\70-00015 - TubeThreadedInsert.SLDDRW		CREATED WITH SolidWorks	REV 2
DO NOT SCALE DRAWING		ENG D. SHOEBRIDGE	SCALE 1:1
MTRL STEEL, 4130		APRV	SIZE B
HEAT TREAT		DATE	
FINISH	DETAIL	SHEET	1 OF 1

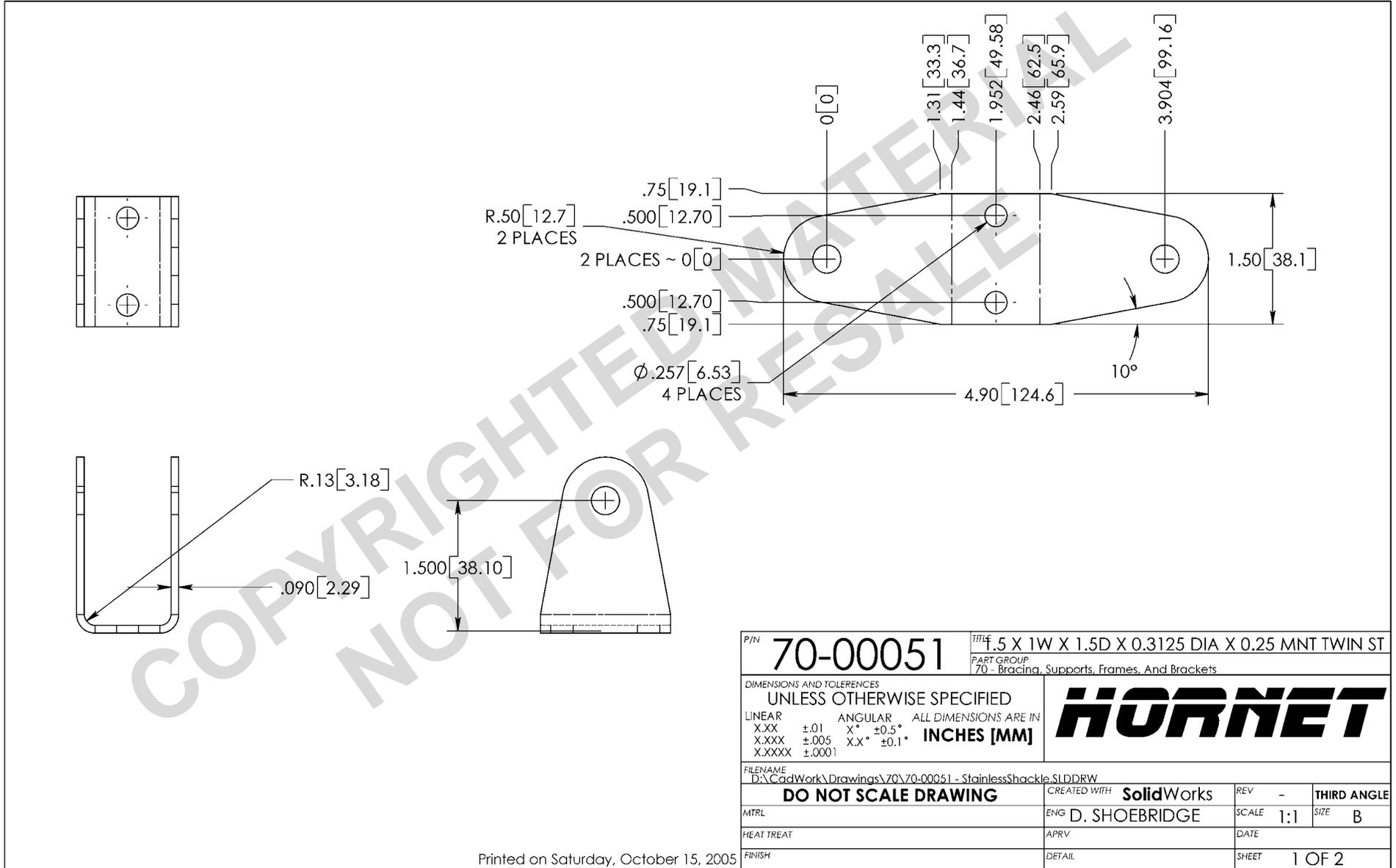
Printed on Saturday, October 15, 2005



P/N	70-00029			TITLE	AXLE CLUSTER PLATE					
				PART GROUP	70 - Bracing, Supports, Frames, And Brackets					
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED				HORNET						
LINEAR	X.XX ±.01	ANGULAR	X° ±0.5°					ALL DIMENSIONS ARE IN INCHES [MM]		
	X.XXX ±.005		X.X° ±0.1°							
	X.XXXX ±.0001									
FILENAME	D:\CadWork\Drawings\70\70-00029 - AxleClusterPlate.SLDDRW									
	DO NOT SCALE DRAWING			CREATED WITH	SolidWorks	REV	-			
MTRL	ALUMINUM, 6061-T6			ENG	D. SHOEBRIDGE	SCALE	1:1			
HEAT TREAT				APRV	DATE		SIZE			
FINISH	DETAIL			SHEET		1 OF 2				

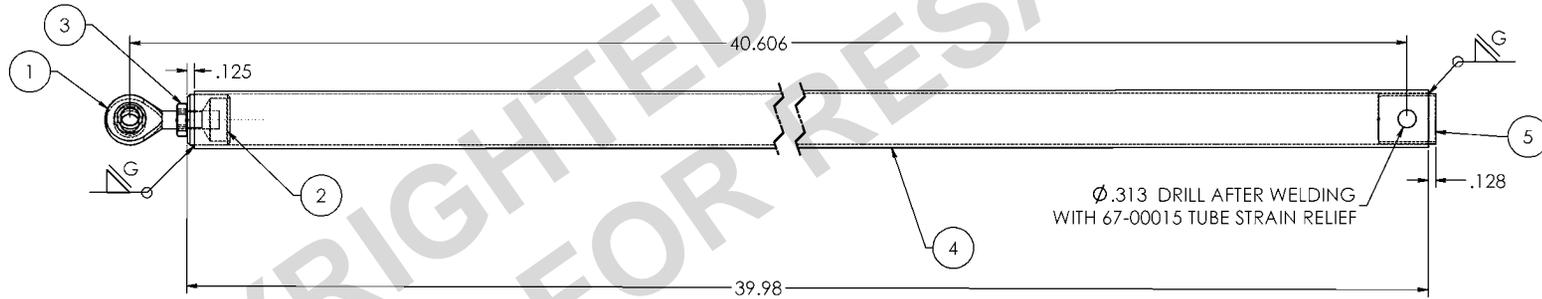
Printed on Sunday, October 23, 2005





ITEM NO.	QTY.	PART NO.	PART NO.	DESCRIPTION
1	1	MaleRodEnd	08-00015	ROD END, 5/16-24, .3125 BORE
2	1	TubeThreadedInsert	70-00015	TUBE THREADED INSERT
3	1	Hex Jam Nut	26-00101	HEX JAM NUT, 5/16-24 DRILLED, NAS509-5
4	1	DragStrut	67-00003	DRAG STRUT
5	1	TubeStrainRelief	67-00015	TUBE STRAIN RELIEF

REV.	ECN#	DESCRIPTION	CHG BY	CHG DATE	APPRV BY	APPRV DATE
1	33205-01	ADDED TUBE STRAIN RELIEF TO ASSEMBLY	DTS	8-Aug-05	DTS	8-Aug-05

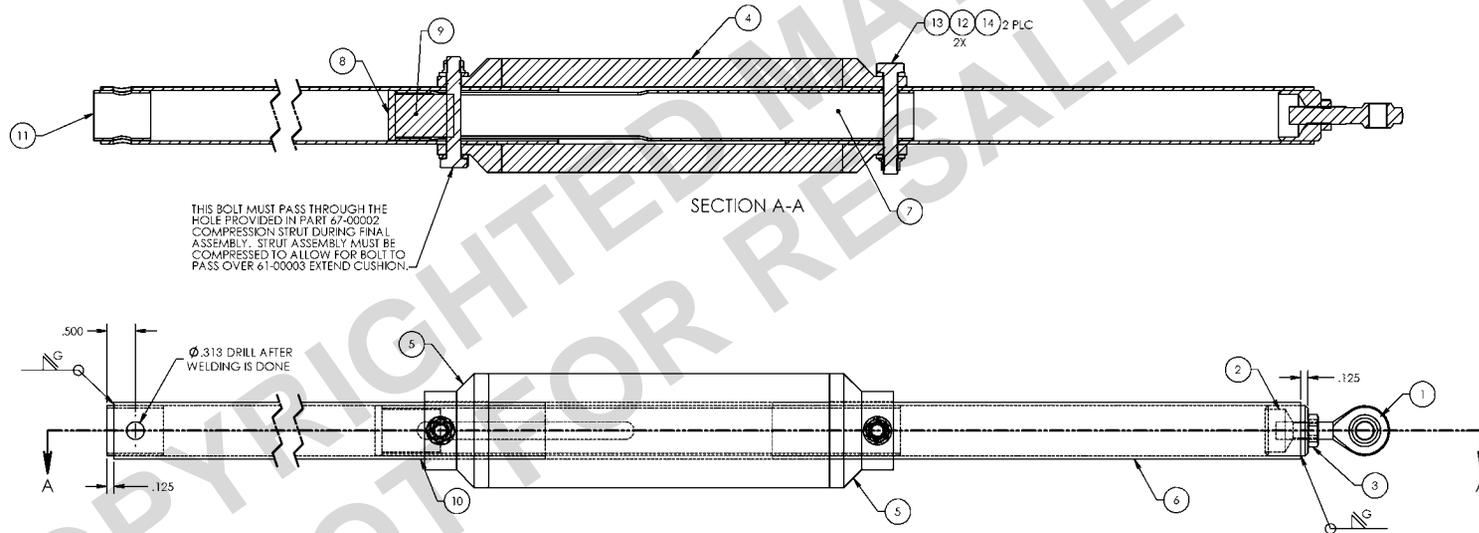


67-00014	DRAG STRUT
67 - Suspension Components (Bushing Arms, Tension Rod, Drag Links, Spindles, etc.)	
UNLESS OTHERWISE SPECIFIED	
XXXX #01	XXXXX #0001
XXXX #005	XXXXX #0001
XXXX #001	XXXXX #0001
INCHES (MM)	
HORNET	
D:\V\shoebr\Drawings\67-00014 - DragStrut Assembly.SI.DWG	
DO NOT SCALE DRAWING	SolidWorks
D. SHOEBRIDGE	D
1	1 OF 1

Printed on Saturday, October 15, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	08-00015	ROD END, 5/16-24, .3125 BORE
2	1	70-00015	TUBE THREADED INSERT
3	1	26-00101	HEX JAM NUT, 5/16-24 DRILLED, NASS09-5
4	1	61-00002	POLYURETHANE TUBE
5	2	67-00004	SPRING STRUT CAP
6	1	67-00005	MOUNT TUBE
7	1	67-00006	GUIDE TUBE
8	1	67-00007	INNER END CAP
9	1	61-00003	EXTEND CUSHION
10	1	67-00002	COMPRESSION STRUT
11	1	67-00015	TUBE STRAIN RELIEF
12	4	27-00002	AN960-416 WASHER
13	2	26-00094	ANA-16A BOLT
14	2	26-00014	NUT MS21042-4 (1/4-28)

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	28704-02	ADDED PIVOT BUSHING	DTS	10-Jul-04	DTS	10-Jul-04
2	40404-01	REVISED ASSEMBLY. ADDED ADDITIONAL PARTS. UPDATED BOM.	DTS	29-Sep-04	DTS	29-Sep-04
3	33205-01	REMOVED LOWER ROD END. ADDED TUBE STRAIN RELIEF.	DTS	8-Aug-05	DTS	8-Aug-05

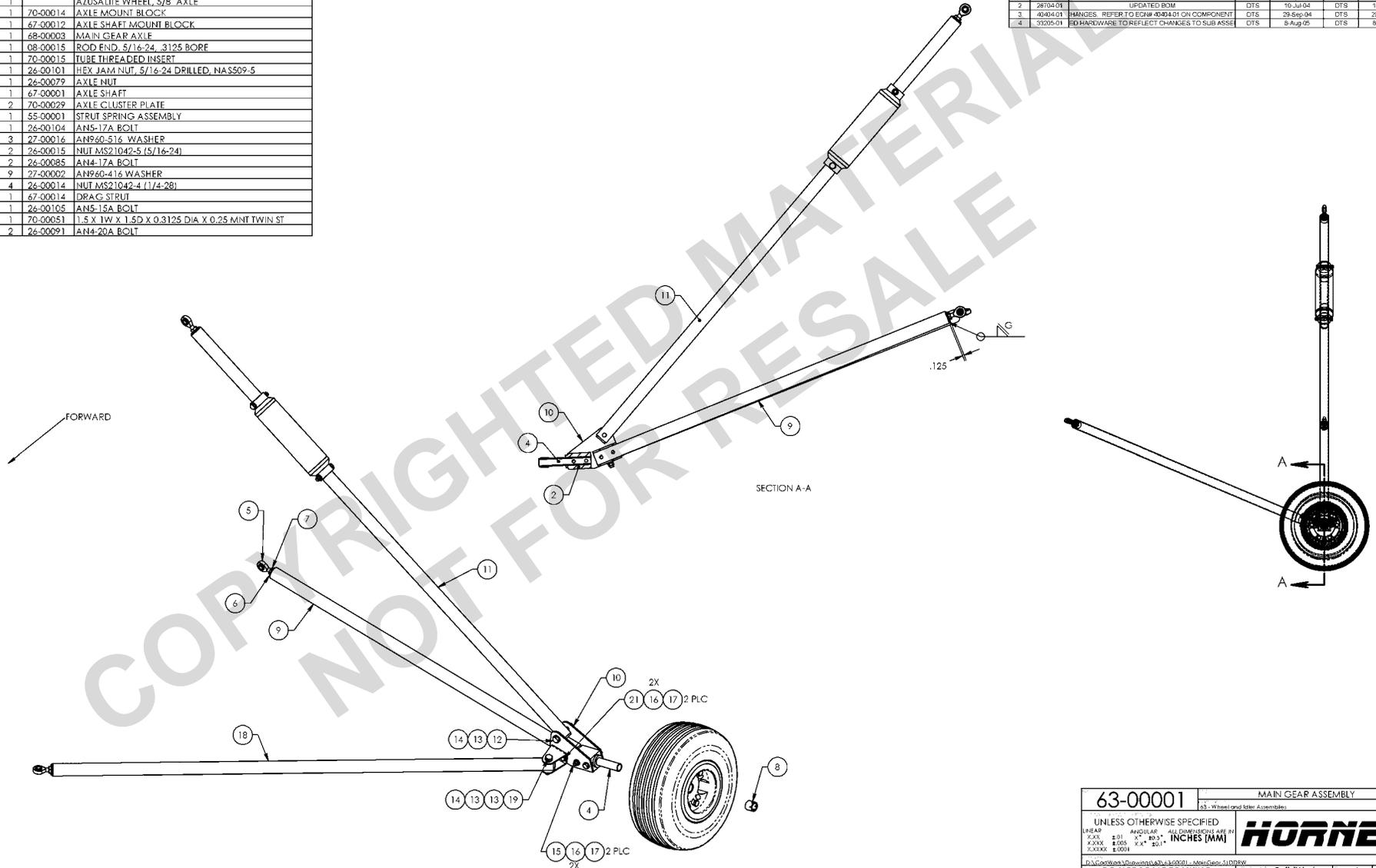


55-00001		STRUT SPRING ASSEMBLY	
UNLESS OTHERWISE SPECIFIED		ALL DIMENSIONS ARE IN	
IN/16"	ANGULAR	INCHES [MM]	
0.001	±0.1°	0.001	
0.005	±0.1°	0.001	
D:\C:\Programs\Drawings\55-00001 - Strut Spring.SLDGW			
DO NOT SCALE DRAWING		SolidWorks	3
D. SHOEBRIDGE		1:1	D
1 OF 1			

Printed on Saturday, October 15, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1		AZULALITE WHEEL, 5/8" AXLE
2	1	70-00014	AXLE MOUNT BLOCK
3	1	67-00012	AXLE SHAFT MOUNT BLOCK
4	1	68-00003	MAIN GEAR AXLE
5	1	08-00015	ROD END, 5/16-24, .3125 BORE
6	1	70-00015	TUBE THREADED INSERT
7	1	26-00101	HEX JAM NUT, 5/16-24 DRILLED, NAS509-5
8	1	26-00079	AXLE NUT
9	1	67-00001	AXLE SHAFT
10	2	70-00029	AXLE CLUSTER PLATE
11	1	55-00001	STRUT SPRING ASSEMBLY
12	1	26-00104	AN5-17A BOLT
13	3	27-00016	AN9-60-516 WASHER
14	2	26-00015	NUT MS21042-5 (5/16-24)
15	2	26-00085	AN4-17A BOLT
16	9	27-00002	AN9-60-416 WASHER
17	4	26-00014	NUT MS21042-4 (1/4-28)
18	1	67-00014	DRAG STRUT
19	1	26-00105	AN5-15A BOLT
20	1	70-00051	1.5 X 1W X 1.5D X 0.3125 DIA X 0.25 MNT TWIN ST
21	2	26-00091	AN4-20A BOLT

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	1450481	ADDED DRILLED JAM NUT	DTS	1 Apr 04	DTS	1 Apr 04
2	26704 01	UPDATED BOM	DTS	10 Jul 04	DTS	10 Jul 04
3	40604 01	CHANGES REFER TO ECN# 40604 01 ON COMPONENT	DTS	29 Sep 04	DTS	29 Sep 04
4	33205 01	ED HARDWARE TO REFLECT CHANGES TO SUB ASSE	DTS	8 Aug 05	DTS	8 Aug 05



NOTE: LEFT SIDE SHOWN, RIGHT SIDE OPPOSITE

Printed on Saturday, October 15, 2005

63-00001		MAIN GEAR ASSEMBLY	
UNLESS OTHERWISE SPECIFIED		SOLIDWORKS	
LINEAR	±.01	ANGULAR	±.005°
SCALE	1" = 1"	ALL DIMENSIONS ARE IN	
FINISH	AS MANUFACTURED	INCHES [MM]	
DO NOT SCALE DRAWING		D. SHOEBRIDGE	4
			1:3.5 D
			1 OF 1

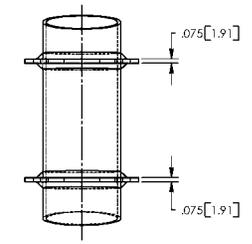
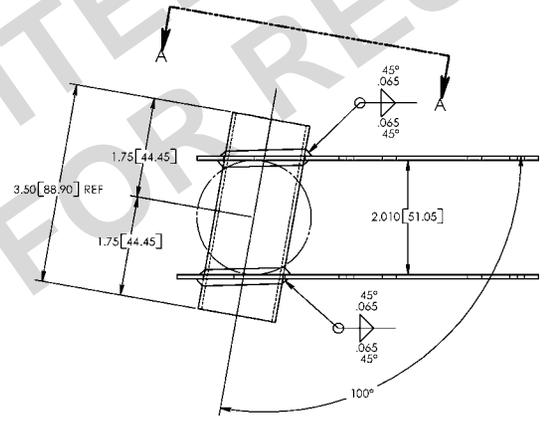
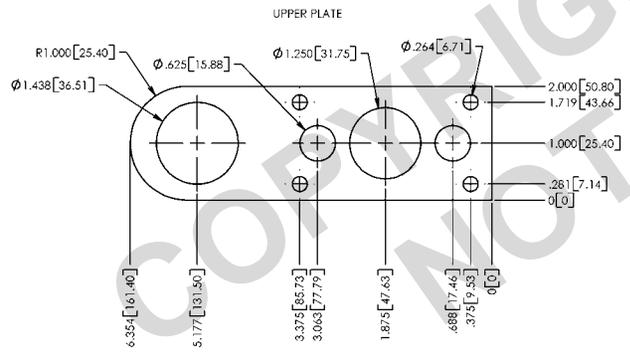
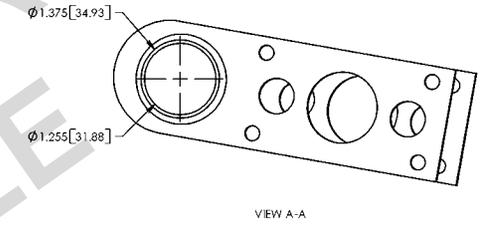
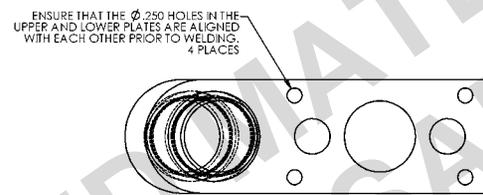
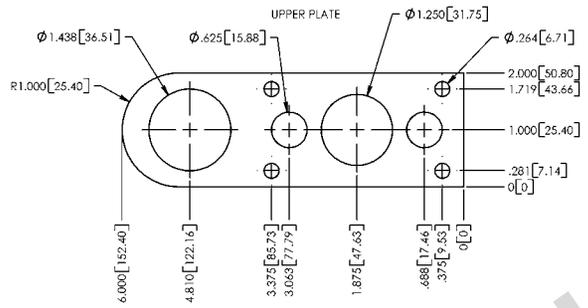
8.4.2 Nose Wheel Assembly

The majority of the nose wheel assembly is made from 4130 steel. As you can see in the drawings, the nose wheel assembly resembles a child's 12" bicycle front fork and wheel assembly. You are correct. If you feel that steeling the front-end from your child's bike will be well received by your spouse, then by all means, have at it. You will have to make some small modifications that will allow you to connect the nose wheel steering push rods to the forks, but that shouldn't be too much of a problem.

All of the headset components on a bicycle will work in the nose wheel assembly, including a front brake and wheel. All of these components can be purchased from a local bike shop, or even a large retail outlet such as K-Mart and Walmart. There are different sizes of headset bearings, so make sure you buy the right size.

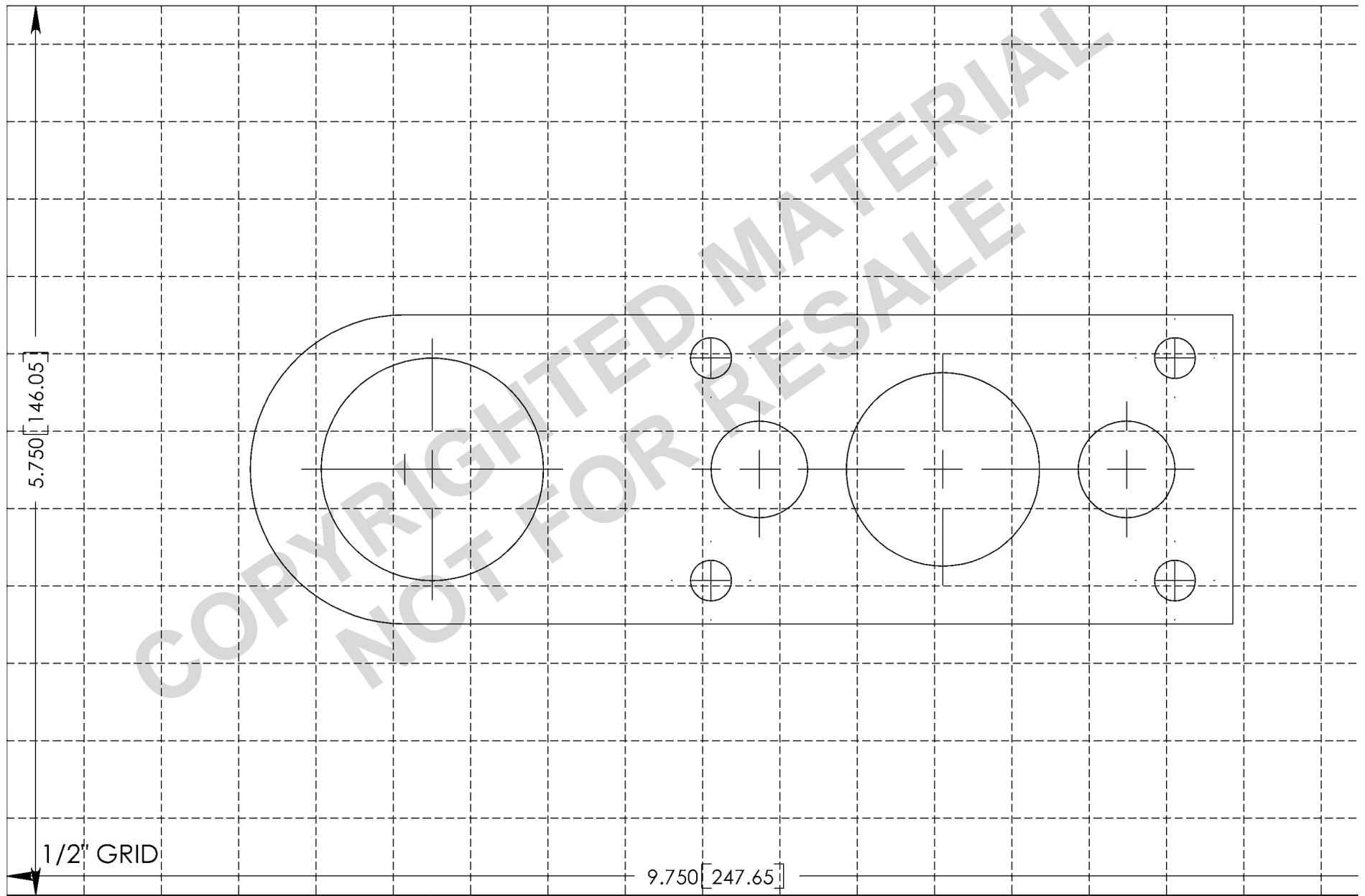
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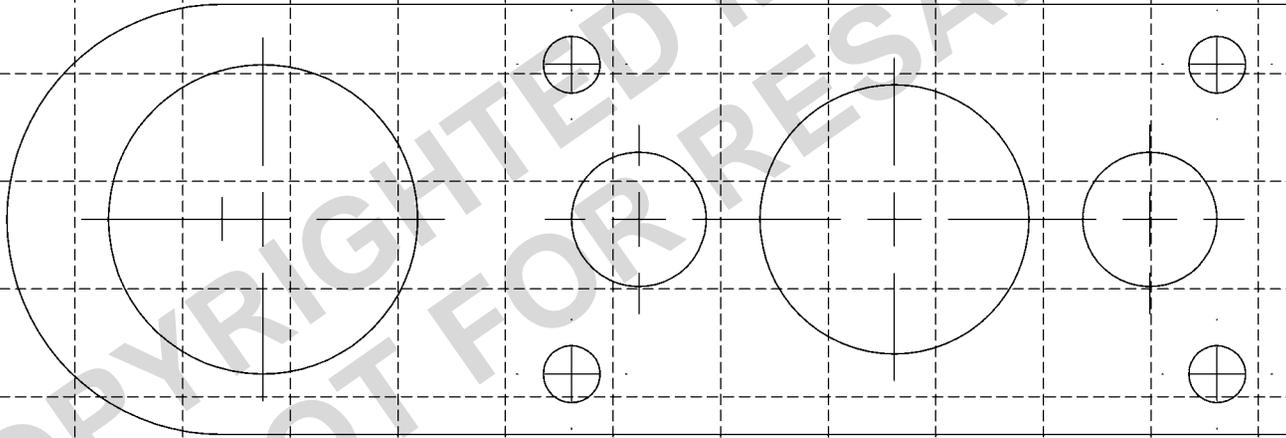
REV	REV #	DESCRIPTION	CHG BY	CHG DATE	APPR BY	APPR DATE
1	22104-01	1. INCREASE TUBE LENGTH 2. INCREASE LENGTH OF UPPER AND LOWER PLATES TO SPACE WELD BEAD AWAY FROM TUBE 3. INCREASE DISTANCE BETWEEN PLATES TO ALLOW FOR POWDER COAT	DTS	30 May 04	DTS	30 May 04



67-00008		NOSE BLOCK	
UNLESS OTHERWISE SPECIFIED		D. SHOEBRIDGE	
LINEAR	ANGULAR	ALL DIMENSIONS ARE BY	
XXXX .01	X° .01	INCHES [MM]	
XXXX .005	X'X" .01		
XXXX .0001	XXXX .0001		
D:\Cognit\work\Design\67-00008 - NoseBlock.sldprt			
DO NOT SCALE DRAWING	SolidWorks	1	
4130 STEEL	D. SHOEBRIDGE	1:1	D
	D. SHOEBRIDGE	3 JUN 03	
	D. SHOEBRIDGE	1 OF 3	

Printed on Friday, October 28, 2005





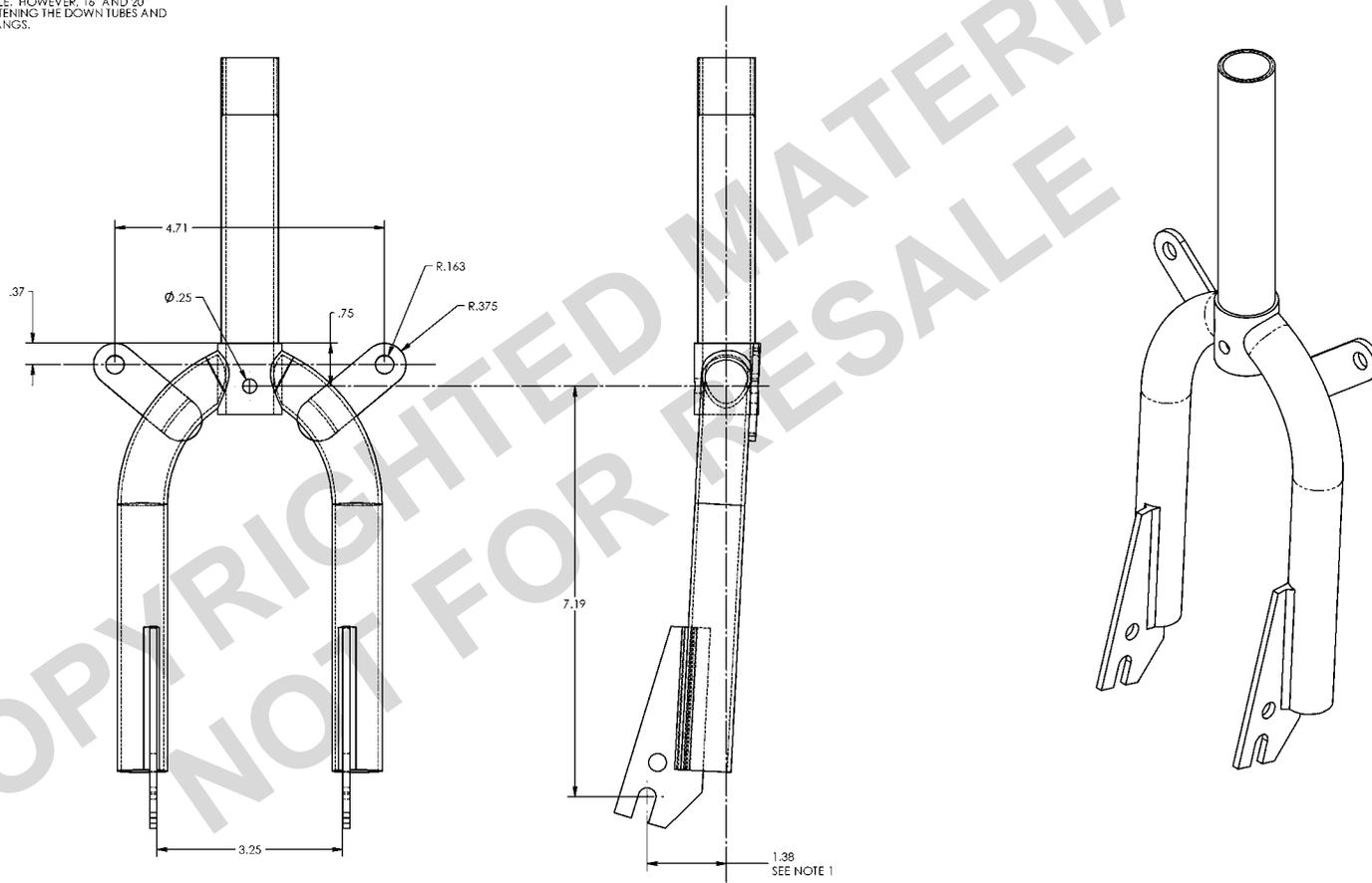
1/2" GRID

9.750 [247.65]

THIS DRAWING INTENDED FOR TRACE CUTTING FLAT PARTS

NOTES: UNLESS OTHERWISE SPECIFIED

1. WARNING: IT IS VERY IMPORTANT THAT THE ATTACHMENT HOLE FOR THE FRONT WHEEL BE AT A MINIMUM OF THE DIMENSION SHOWN OTHERWISE THE FRONT WHEEL WILL NOT BE STABLE DURING GROUND OPERATIONS SUCH AS TAXI, TAKEOFF AND LANDING.
2. USE OF A MODIFIED BICYCLE FRONT FORK IS APPROVED. USE OF A 12" BIKE FORK IS PREFERRED BECAUSE OF THE REDUCED NUMBER OF STEPS REQUIRED TO MAKE THE FORK SERVICEABLE. HOWEVER, 16" AND 20" BIKE FORKS CAN ALSO BE USED BY SHORTENING THE DOWN TUBES AND WELDING ON NEW WHEEL MOUNTING TANGS.

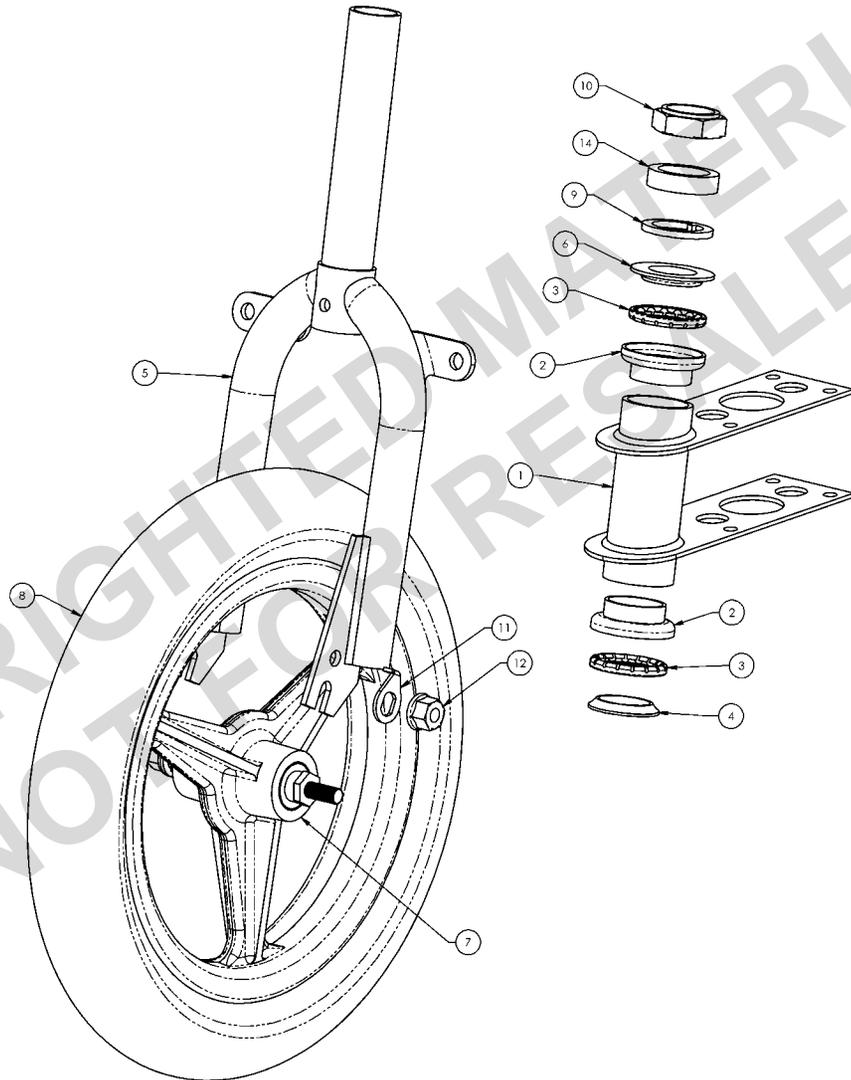


67-00009		NOSE WHEEL FORK	
UNLESS OTHERWISE SPECIFIED		22 - Suspension Components (Swing Arms, Torion Bars, Drag Links, Sprockets, etc.)	
LINE#	QUANTITY	ALL DIMENSIONS ARE IN	HORNET
X XX	#01	INCHES (MM)	
X XXX	#001	INCHES (MM)	
D:\cag\pesh\Drawings\67-00009 - Nose Wheel Fork 510D2W			
DO NOT SCALE DRAWING		SolidWorks	
4130 STEEL		D. SHOEBRIDGE	1:1 D
		1 OF 1	

Printed on Wednesday, September 21, 2005

ITEM NO.	QTY	PART NO.	DESCRIPTION
1	1	67-00008	NOSE BLOCK
2	2	08-00010	BEARING CUP, BICYCLE
3	2		HEAD SET BEARING, BICYCLE
4	1		LOWER BEARING RACE
5	1	67-00009	NOSE WHEEL FORK
6	1		UPPER BEARING RACE
7	1		SKYWAY TUFFWHEEL 12"
8	1		TIRE 12" BICYCLE
9	1	62-00001	FORK INDEX WASHER
10	1	26-00097	FORK RETAINING NUT
11	2		WHEEL RETAINING CLIP
12	2		WHEEL RETAINING NUT, BICYCLE
13	1		BICYCLE BRAKE CALIPER
14	1	27-00004	FRONT FORK SPACER

REV.	ECN #	DESCRIPTION	CHG. BY	CHG. DATE	APPR. BY	APPR. DATE
1	52604-01	MOVED MOUNTING HARDWARE TO NEXT HIGHER LEVEL	DTS	24-Dec-04	DTS	24-Dec-04



67-00010		NOSE WHEEL ASSEMBLY	
UNLESS OTHERWISE SPECIFIED		67 - Suspension Components (Forking Arms, Torison Bars, Drag Links, Spindles) etc.	
LINEAR	±.01	ANGULAR	ALL DIMENSIONS ARE IN INCHES (MM)
X.XXX	±.001	X°.XXX	±.01
X.XXX	±.0005	X'X" ±.01	
X.XXXXX	±.0001	X'X"X" ±.001	
D:\Cp\Work\Sig\sig\67-00010 - Nose Wheel Assembly.SLDRAW			
DO NOT SCALE DRAWING		SolidWorks	1
D. SHOEBRIDGE		1:1	D
			1 OF 1

Printed on Friday, December 24, 2004

8.4.3 Tail Wheel Assembly

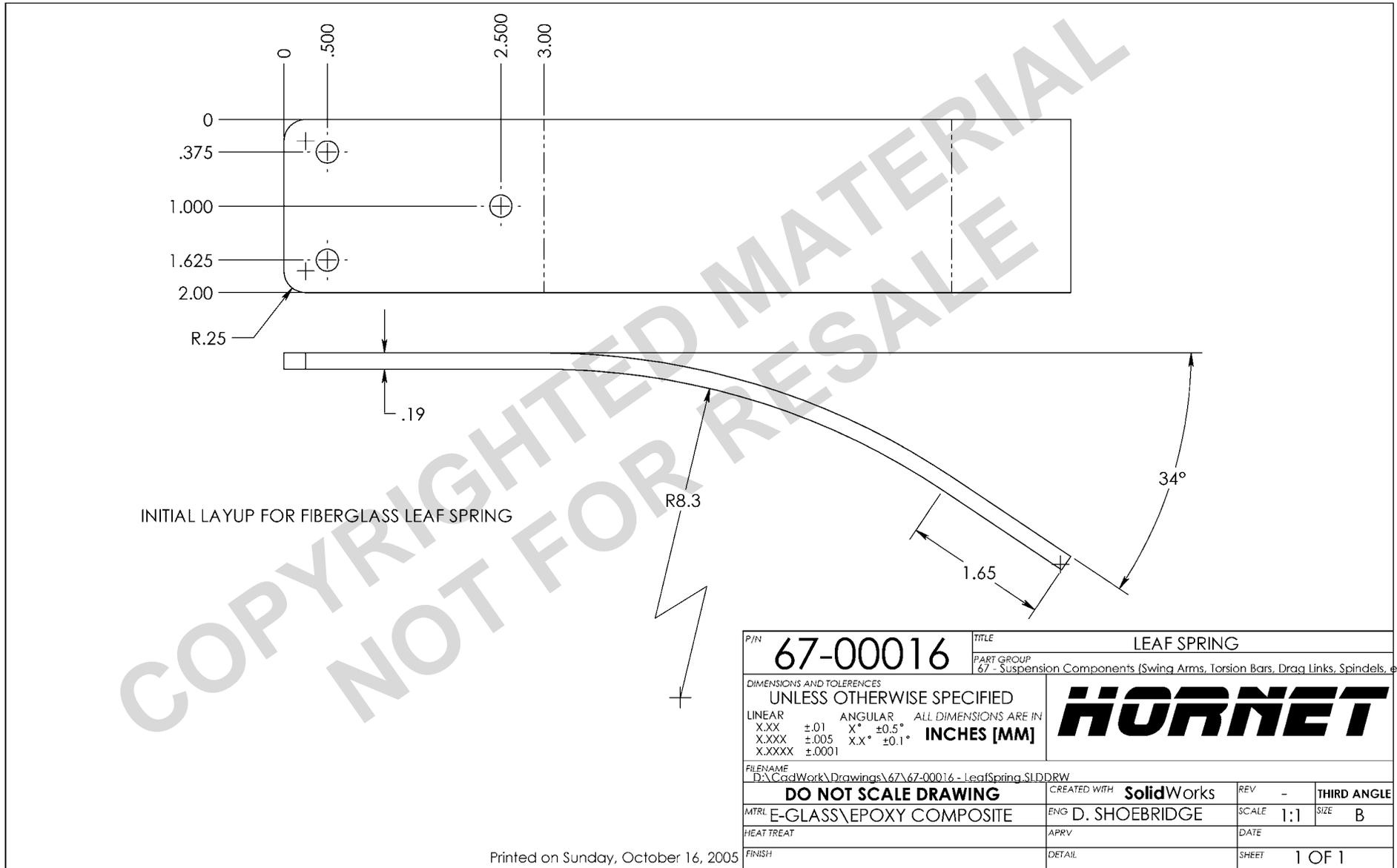
The origin of the Hornet tail wheel assembly came from an uncomfortable sound that I once heard coming from a Honeybee gyro. The sound came from the area of the cluster plates when the pilot climbed out of the seat and the tail wheel came to rest on the ground. The sound resembled that which comes from a well-used, steel tube swing set when a child is swinging on it. Kind of a metallic creaking sound.

Now I don't know about you, but I value highly the aluminum plates that connect all of the square and rectangle aluminum tubing together, as well as the tubing itself. This creaking sound tells me that something is moving, and upon visual observation of the tail boom as the gyro settled back on the tail wheel, you could see the tail boom pivot at the cluster plates a small amount – at least an inch at the tail wheel. Considering the close tolerance holes in the aluminum plates and tubes, I'd bet that the holes on this particular Honeybee were oval in shape from all of the pounding that the tail wheel received.

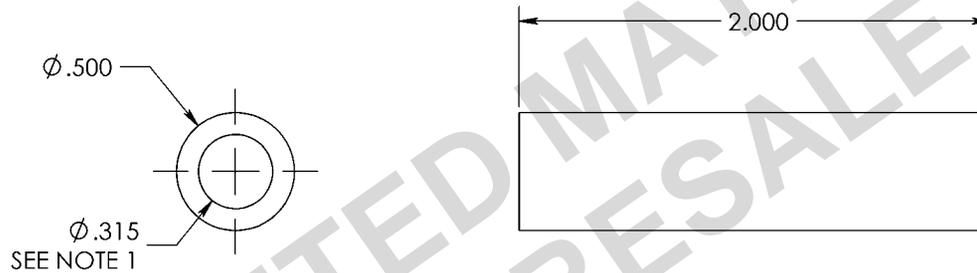
After that little eye opening encounter, I was visiting a friend of mine in Richmond, Indiana. There were a few other people visiting that had brought their gyros. One custom built gyro there was an all welded steel tube design that had a spring loaded tail wheel. I talked to the pilot briefly about his tail wheel and he stated that it was well worth having. That clinched it! The Hornet was going to have a spring loaded tail wheel.

Early on in the design of the Hornet, I started to design the tail wheel assembly first. My hopes were that the GyroBee and Honeybee owners would build (or buy) the Hornet tail wheel for use on their own gyros. I posted the drawings on my website for a short time, but didn't receive any feedback as to if anyone had actually built one. So I gave up on pushing the tail wheel design by itself and continued on with the remainder of the Hornet design.

The current Hornet tail wheel assembly is completely different from the past designs. I realized that the effort required to build the original design wasn't worth the time or money. Also, in an effort to lighten up and simplify the Hornet, I totally redesigned the tail wheel assembly. I've become a real fan of composites, and this new tail wheel design reflects that.



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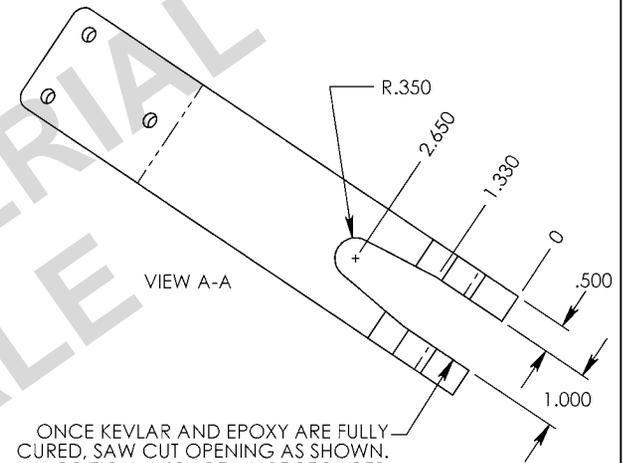
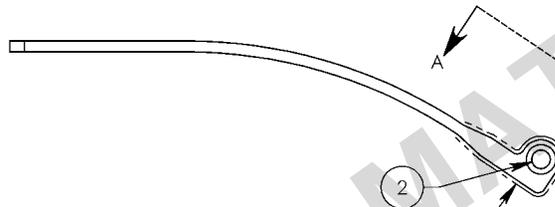
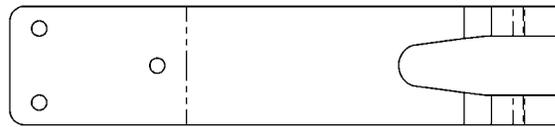


NOTES: UNLESS OTHERWISE SPECIFIED
 1. CAN BE FABRICATED FROM TUBE WHERE THE INSIDE DIAMETER OF RAW MATERIAL IS SMALLER THEN FINISHED DIAMETER.

P/N 67-00017		TITLE TAIL WHEEL ANCHOR TUBE				
DIMENSIONS AND TOLERANCES		PART GROUP 67 - Suspension Components (Swing Arms, Torsion Bars, Drag Links, Spindels, etc)				
UNLESS OTHERWISE SPECIFIED		HORNET				
LINEAR	ANGULAR				ALL DIMENSIONS ARE IN	
X.XX ±.01	X° ±0.5°				INCHES [MM]	
X.XXX ±.005	X.X° ±0.1°					
X.XXXX ±.0001		FILENAME				
D:\CadWork\Drawings\67\67-00017 - TailWheelAnchorTube.SLDDRW						
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -	THIRD ANGLE		
MTRL STEEL, 4130	ENG D. SHOEBRIDGE	SCALE 2:1	SIZE B			
HEAT TREAT	APRV	DATE				
FINISH	DETAIL	SHEET 1 OF 1				

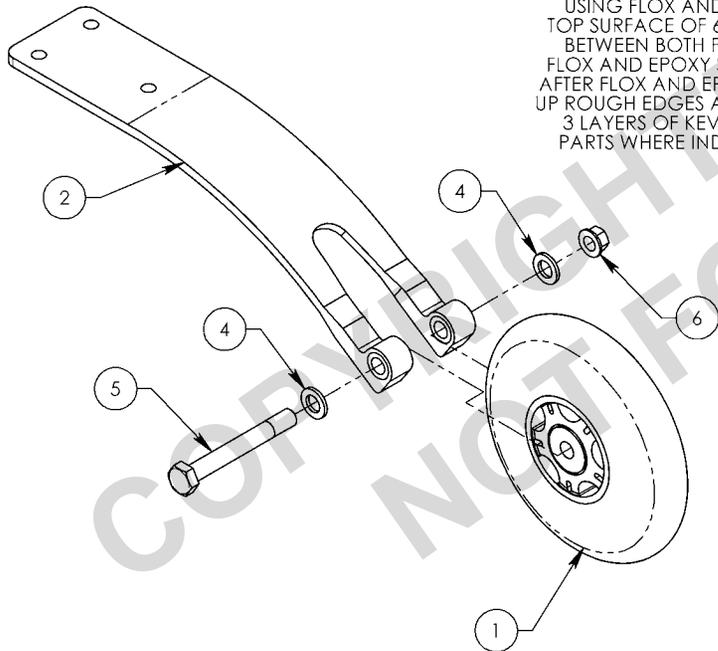
Printed on Sunday, October 16, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1		SCOOTER WHEEL
2	1	67-00016	LEAF SPRING
3	1	67-00017	TAIL WHEEL ANCHOR TUBE
4	2	27-00016	AN960-516 WASHER
5	1	26-00106	AN5-23A BOLT
6	1	26-00015	NUT MS21042-5 (5/16-24)



USING FLOX AND EPOXY, BOND 67-00017 TO TOP SURFACE OF 67-00016. IMPORTANT: SPACES BETWEEN BOTH PARTS MUST BE FILLED IN WITH FLOX AND EPOXY SO THAT THERE ARE NO VOIDS. AFTER FLOX AND EPOXY ARE FULLY CURED, CLEAN UP ROUGH EDGES AND SURFACES. APPLY AT LEAST 3 LAYERS OF KEVLAR AND EPOXY OVER BOTH PARTS WHERE INDICATED BY DASHED OUTLINE.

ONCE KEVLAR AND EPOXY ARE FULLY CURED, SAW CUT OPENING AS SHOWN. ADDITIONAL SPACE MAY BE REQUIRED DEPENDING ON WHEEL SELECTION. SAW CUT AS NECESSARY.



P/N	63-00002	TITLE	TAIL WHEEL ASSEMBLY					
		PART GROUP	63 - Wheel and Idler Assemblies					
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		HORNET						
LINEAR	ANGULAR					ALL DIMENSIONS ARE IN		INCHES
X.XX ±.01	X° ±0.5°							
X.XXX ±.005	X.X° ±0.1°							
X.XXXX ±.0001								
FILENAME	D:\CadWork\Drawings\63\63-00002 - TailWheelAssembly.SLDRW							
DO NOT SCALE DRAWING		CREATED WITH	SolidWorks	REV	-			
MTRL		ENG	D. SHOEBRIDGE	SCALE	1:2			
HEAT TREAT		APRV		DATE				
FINISH		DETAIL		SHEET	1 OF 1			

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8.5 Composite Seat

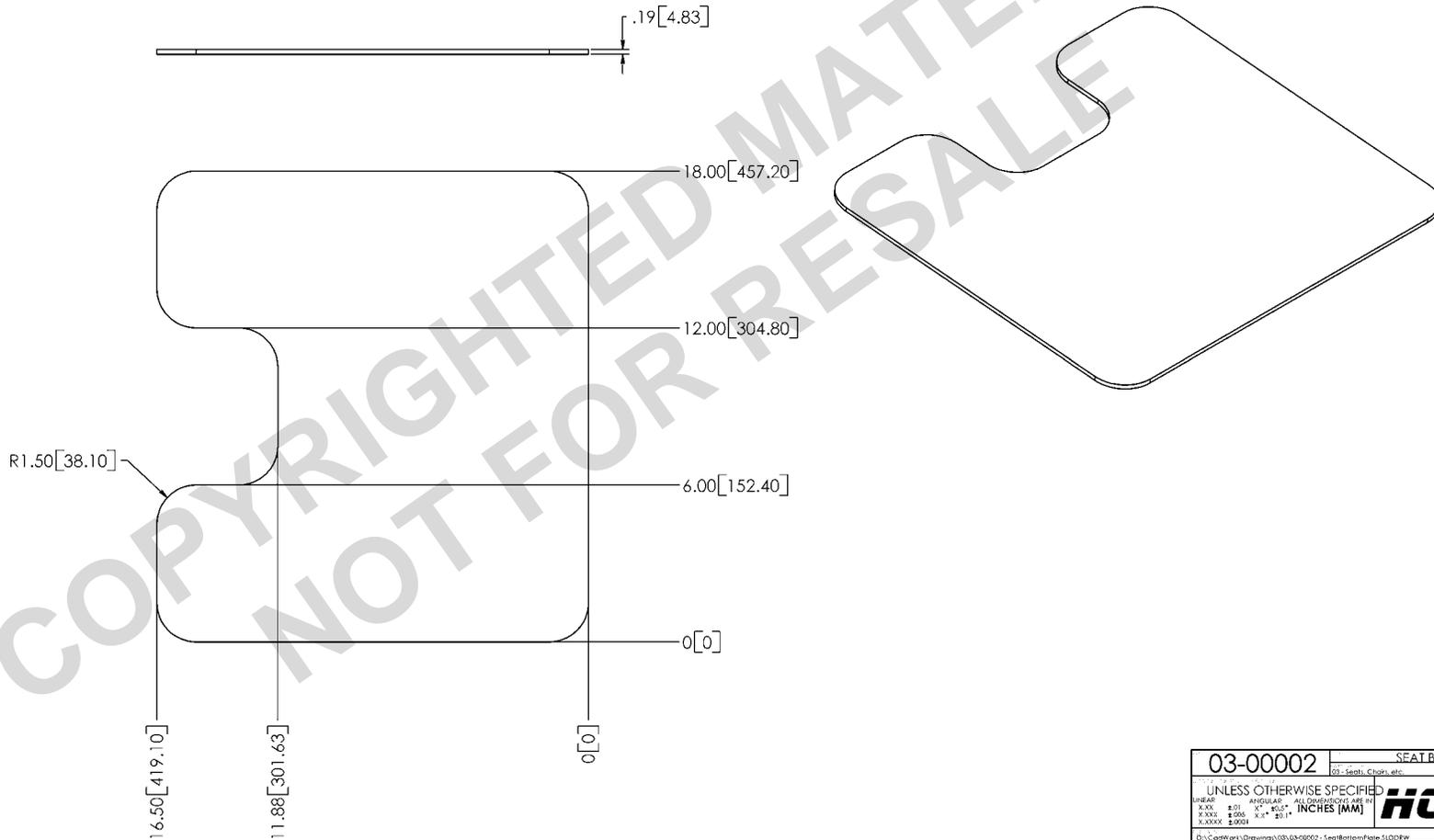
I'm not the smallest guy in the world. I don't fit very well into the seat tanks that are so popular now a days. In my opinion, the seat tanks don't have the best ergonomics. The simple, flat and square design of this seat design has many advantages that the seat tanks do not address. With the Hornet's seat, the cushions are easy to make and can be in any color, with any decoration, logo, print, etc. Also, any type or thickness of padding can be used. A future option might be a ground adjustable seat height mechanism.

If you're anything like myself, I like lots of switches and knobs. But the biggest challenge for most gyro builders is finding a place to mount them. One of the biggest benefits of the Hornets seat design is the ability to mount additional controls, radios, or other pilot gizmos and gadgets. And mounting this stuff is just a matter of drilling a couple holes and running some screws through. With the previous seat design being made from foam, a hard point would be required which adds weight and complexity to an otherwise simple seat. Again, it wasn't worth the effort.

The Hornet utilizes a composite seat made from several different pieces of Birch plywood, cut from a larger plywood sheet that has been pre-covered with Kevlar, fiberglass and epoxy. I had intended to use epoxy and Kevlar over the foam, but thought better of it. Since the seat is not the only part of the Hornet that is made using plywood and composites, it is suggested that a large piece of plywood be pre-laminated with the composite materials, and then cut the individual plywood parts out of this larger sheet using a jigsaw, band saw or other appropriate metal cutting tool. Remember, you're cutting Kevlar, and this stuff is stronger than steel, and chances are that the blade will be trashed after its use. My suggestion would be to use a jigsaw with a carbide hack saw blade.

There are no drawings for the seat pads. Because there are so many different opinions regarding how a seat should be shaped, I thought it better to leave the final seat pad shape and thickness up to the end user. However, as a starting point, the seat pads that I designed on the Hornet are 1" thick and are flat. This will be most likely be the minimum thickness for any padding. Thicker pads are no problem and will help out taller people.

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APPR BY	APPR DATE
1	23404-01	TRIMMED SURFACE TO ELIMINATE INTERFERENCE WITH DIAGONAL BRACES	DTS	2-Jun-04	DTS	2-Jun-04
2	41104-01	ADDED RADII	DTS	3-Oct-04	DTS	3-Oct-04
3	41304-01	REDUCED SEAT DEPTH	DTS	8-Oct-04	DTS	8-Oct-04
4	43105-01	COMPLETE REVISION OF SEAT DESIGN	DTS	16-Oct-05	DTS	16-Oct-05

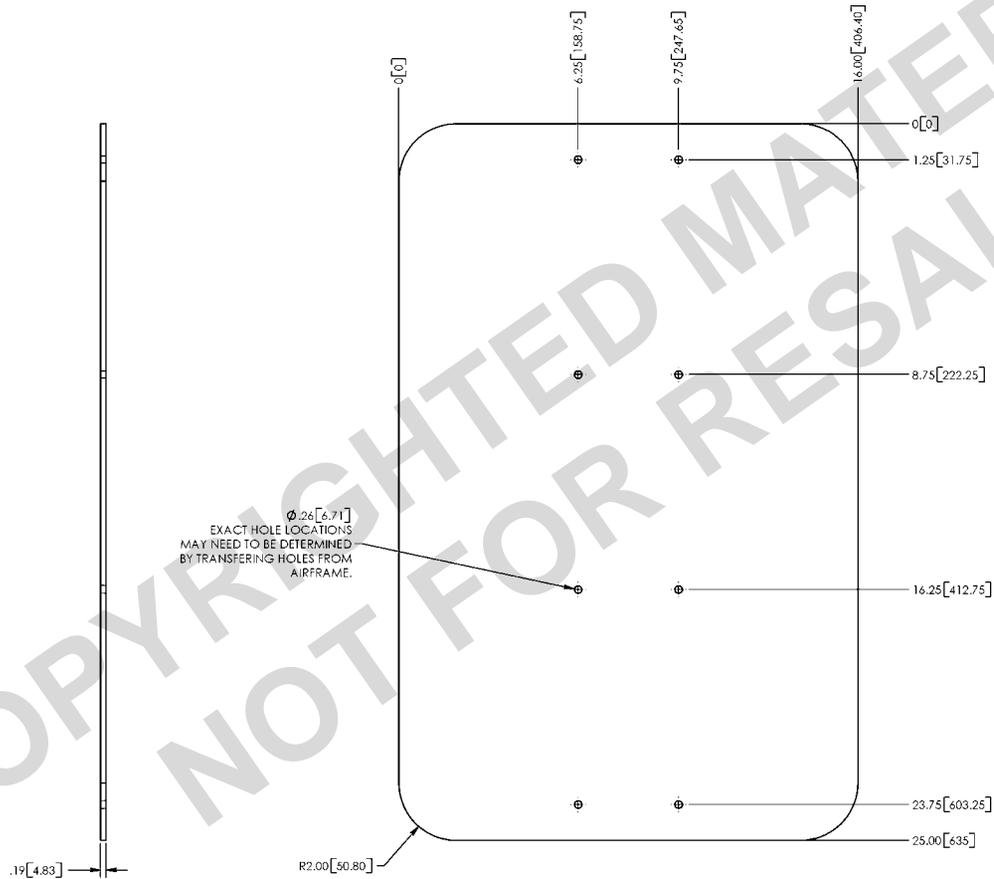


03-00002		SEAT BOTTOM PLATE	
UNLESS OTHERWISE SPECIFIED			
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	
XXX.X	XX.XX	INCHES [MM]	
XXX.X	XX.XX	INCHES [MM]	
XXX.X	XX.XX	INCHES [MM]	
DO NOT SCALE DRAWING			
SolidWorks		4	
D. SHOEBRIDGE		1:2	D
1 OF 1			

Printed on Sunday, October 16, 2006

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	41104-01	FLATTENED FOAM CORE, ADDED RADIUS	DTS	3-01-04	DTS	3-01-04
2	41304-01	REMOVED HOLES FOR SEAT SPINE, RADIUS ALL EDGES, RELOCATED MOUNTING HOLES, CHANGED HEIGHT	DTS	8-01-04	DTS	8-01-04
3	43105-01	COMPLETE REVISION OF SEAT DESIGN	DTS	16-01-05	DTS	16-01-05

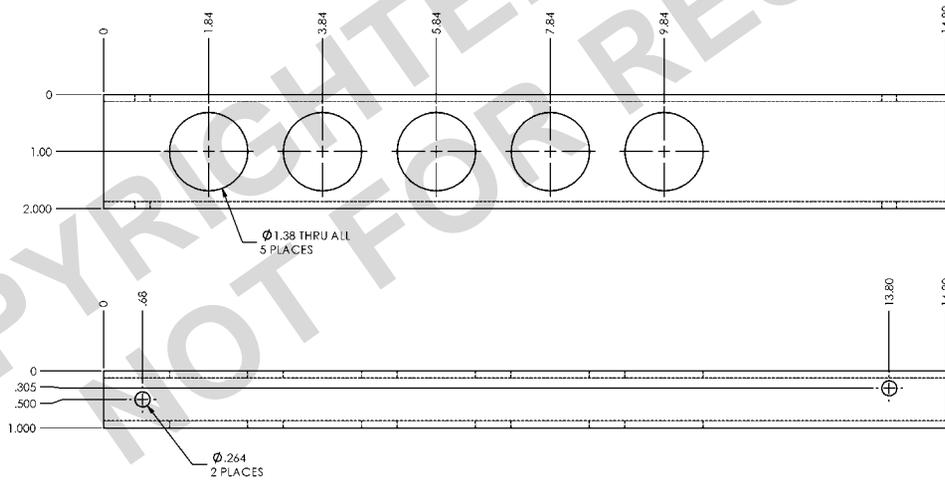
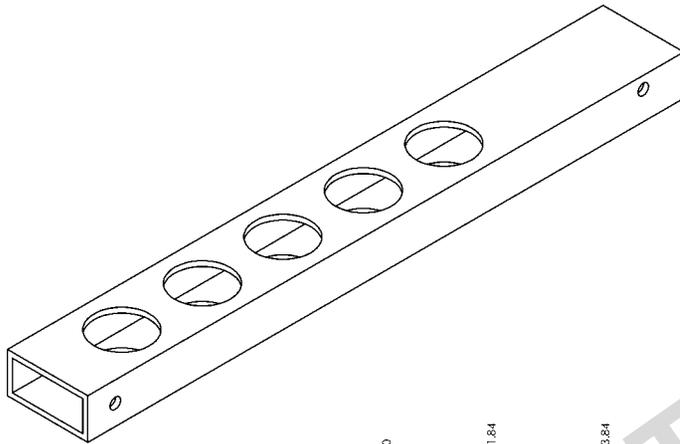
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03-00003		SEAT BACK PLATE	
UNLESS OTHERWISE SPECIFIED		03-Seat, Chair, etc.	
LINEAR	ANGULAR	ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED	
XXXX #01	XX° #0.5°	INCHES (MM)	
XXXX #025	XX° #0.1°		
XXXX #001			
D:\Cognex\Drawings\03-00003-SeatBack.Plate.SLDRAW			
DO NOT SCALE DRAWING	SolidWorks	3	
BIRCH PLYWOOD	D. SHOEBRIDGE	1/2	D
		1 OF 1	

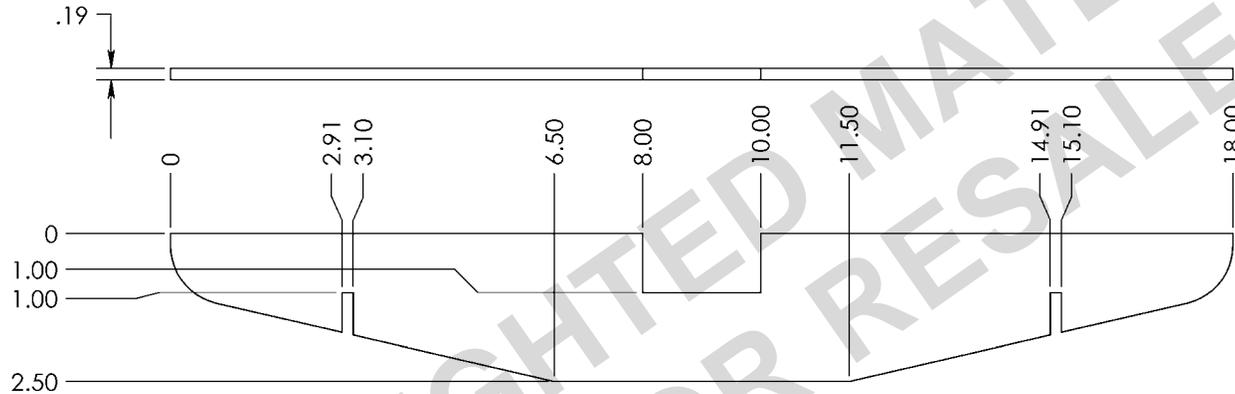
Printed on Sunday, October 16, 2005

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	41304-01	COMPLETELY REDESIGNED PART	DTS	5-Oct-04	DTS	5-Oct-04
2	43105-01	COMPLETE REVISION OF SEAT DESIGN	DTS	16-Oct-05	DTS	16-Oct-05



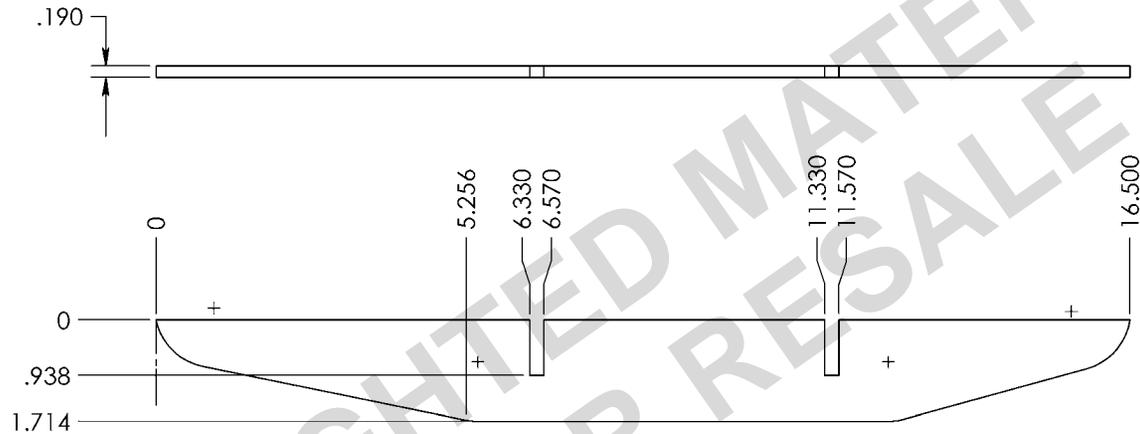
03-00004		SEAT SPINE	
UNLESS OTHERWISE SPECIFIED		D. SHOEBRIDGE	
LINEAR	ANGULAR	ALL DIMENSIONS ARE BY	HORNET
XXX .#01	X.X° #0.1°	INCHES [MM]	
XXXX .#005	X.X° #0.1°		
XXXX .#001			
DO NOT SCALE DRAWING		SolidWorks	2
ALUMINUM, 6061-T6		D. SHOEBRIDGE	1:1
Printed on Sunday, October 16, 2005		1 OF 1	

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	41304-01	REDESIGNED PART TO FIT ADDITIONAL CHANGES TO SEAT ASSEMBLY	DTS	8-Oct-04	DTS	8-Oct-04



P/N	03-00005	TITLE	SEAT CROSS BRACE					
		PART GROUP	03 - Seats, Chairs, etc.					
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		HORNET						
LINEAR	ANGULAR					ALL DIMENSIONS ARE IN		
X.XX ±.01	X° ±0.5°					INCHES [MM]		
X.XXX ±.005	X.X° ±0.1°							
X.XXXX ±.0001								
FILENAME	D:\CadWork\Drawings\03\03-00005 - SeatCrossBrace.SLDDRW							
	DO NOT SCALE DRAWING	CREATED WITH	SolidWorks	REV	1			
MTRL	STYROFOAM, 2 LB/ CU. FT	ENG	D. SHOEBRIDGE	SCALE	1:2			
HEAT TREAT		APRV		DATE				
FINISH		DETAIL		SHEET	1 OF 1			

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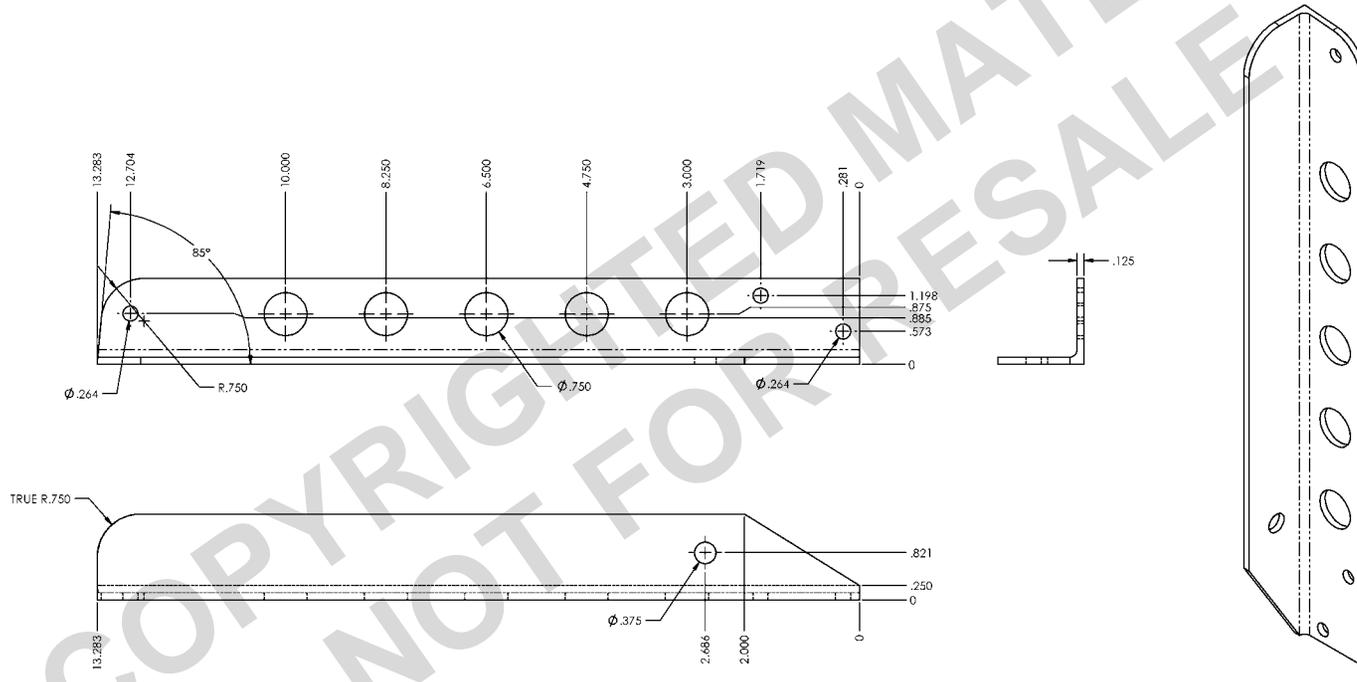


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P/N 03-00006		TITLE SEAT LONGITUDINAL BRACE	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 03 - Seats, Chairs, etc.	
LINEAR X.XX ±.01 X.XXX ±.005 X.XXXX ±.0001	ANGULAR X° ±0.5° X.X° ±0.1°	HORNET	
ALL DIMENSIONS ARE IN INCHES [MM]			
FILENAME D:\CadWork\Drawings\70\70-00054 - SeatLongitudinalBrace.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -
MTRL BIRCH PLYWOOD	ENG D. SHOEBRIDGE	SCALE 1:2	THIRD ANGLE
HEAT TREAT	APRV	DATE	SIZE B
FINISH	DETAIL	SHEET	1 OF 1

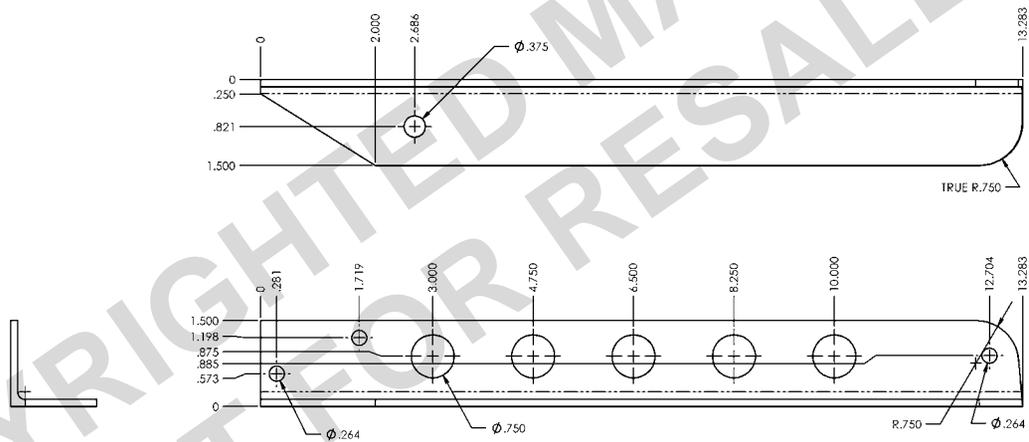
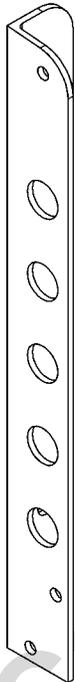
Printed on Sunday, October 16, 2005

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43105-01	COMPLETE REVISION OF SEAT DESIGN	DTS	16-Oct-05	DTS	16-Oct-05



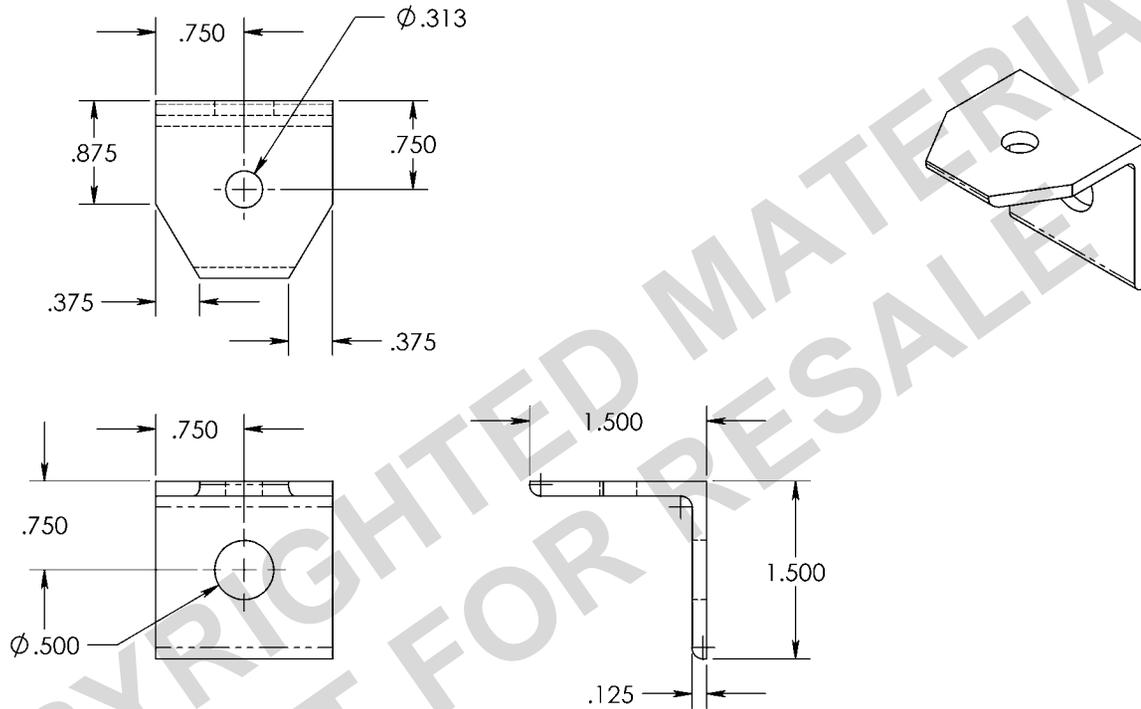
70-00047		FORWARD SEAT BRACE - LEFT	
UNLESS OTHERWISE SPECIFIED		70 - Seating, Supports, Frames, and Brackets	
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN INCHES (MM)	
XXXX #01	XX° .005°	XXXX #001	
XXXX #005	XX° .01°	XXXX #001	
DO NOT SCALE DRAWING		SolidWorks	1
ALUMINUM, 6081-T6		D. SHOEBRIDGE	1:1 D
Printed on Sunday, October 23, 2005		1 OF 1	

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43105-01	COMPLETE REVISION OF SEAT DESIGN	DTS	16-Oct-05	DTS	16-Oct-05



70-00048		FORWARD SEAT BRACE - RIGHT	
UNLESS OTHERWISE SPECIFIED		70 - Seating, Supports, Frames, and Brackets	
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	
X.XX	#01	INCHES (MM)	
X.XXX	#05	X.XXX	
X.XXXX	#001	X.XXXX	
D:\Cogn\Work\Production\70-00048 - Forward Seat Braces Right.sldprt			
DO NOT SCALE DRAWING		SolidWorks	
ALUMINUM, 6061-T6	D. SHOEBRIDGE	1	D
		1:1	
		1 OF 1	

Printed on Sunday, October 23, 2005

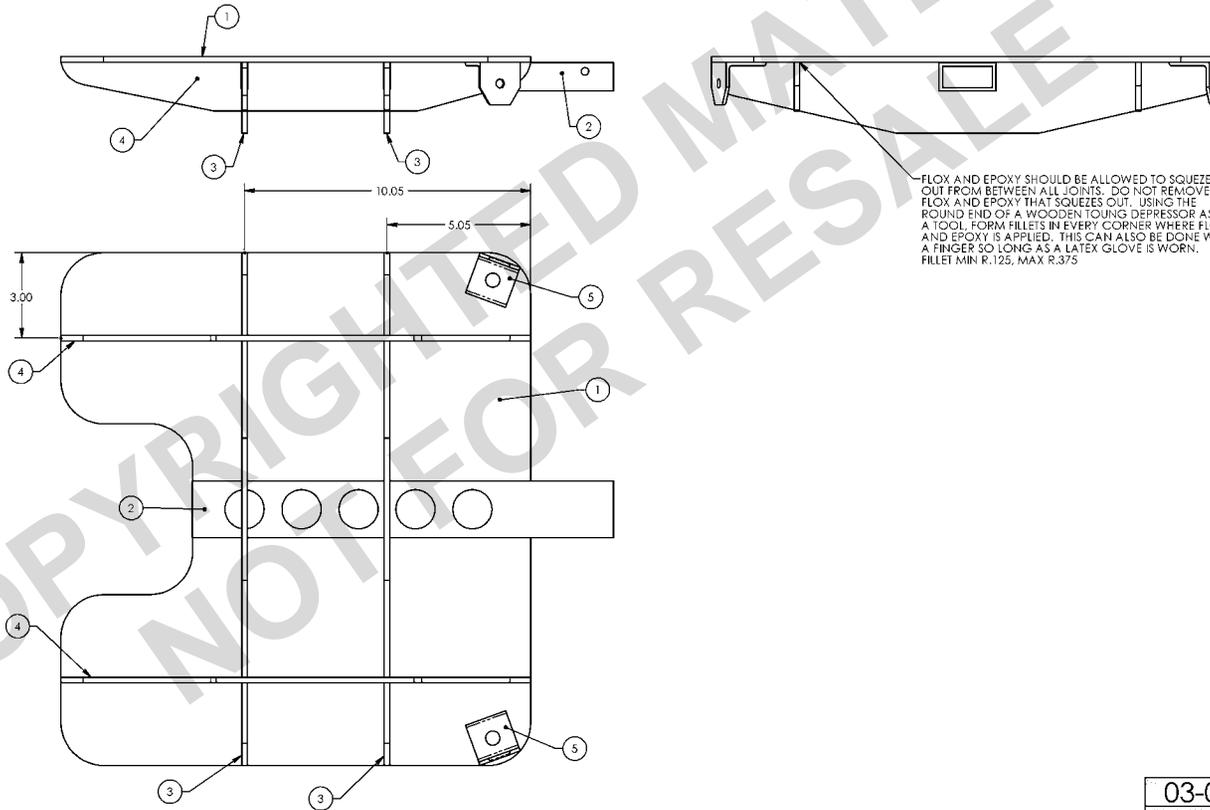


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P/N 70-00061		TITLE LAP BELT ANCHOR BRACKET	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 70 - Bracing, Supports, Frames, And Brackets	
LINEAR X.XX ±.01 X.XXX ±.005 X.XXXX ±.0001	ANGULAR X° ±0.5° X.X° ±0.1°	HORNET	
ALL DIMENSIONS ARE IN INCHES [MM]			
FILENAME LapBeltAnchorBracket.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV - THIRD ANGLE
MTRL ALUMINUM, 6061-T6		ENG D. SHOEBRIDGE	SCALE 1:1 SIZE B
HEAT TREAT		APRV	DATE
FINISH		DETAIL	SHEET 1 OF 1

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ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	03-00002	SEAT BOTTOM PLATE
2	1	03-00004	SEAT SPINE
3	2	03-00005	SEAT CROSS BRACE
4	2	03-00006	SEAT LONGITUDINAL BRACE
5	2	70-00061	LAP BELT ANCHOR BRACKET

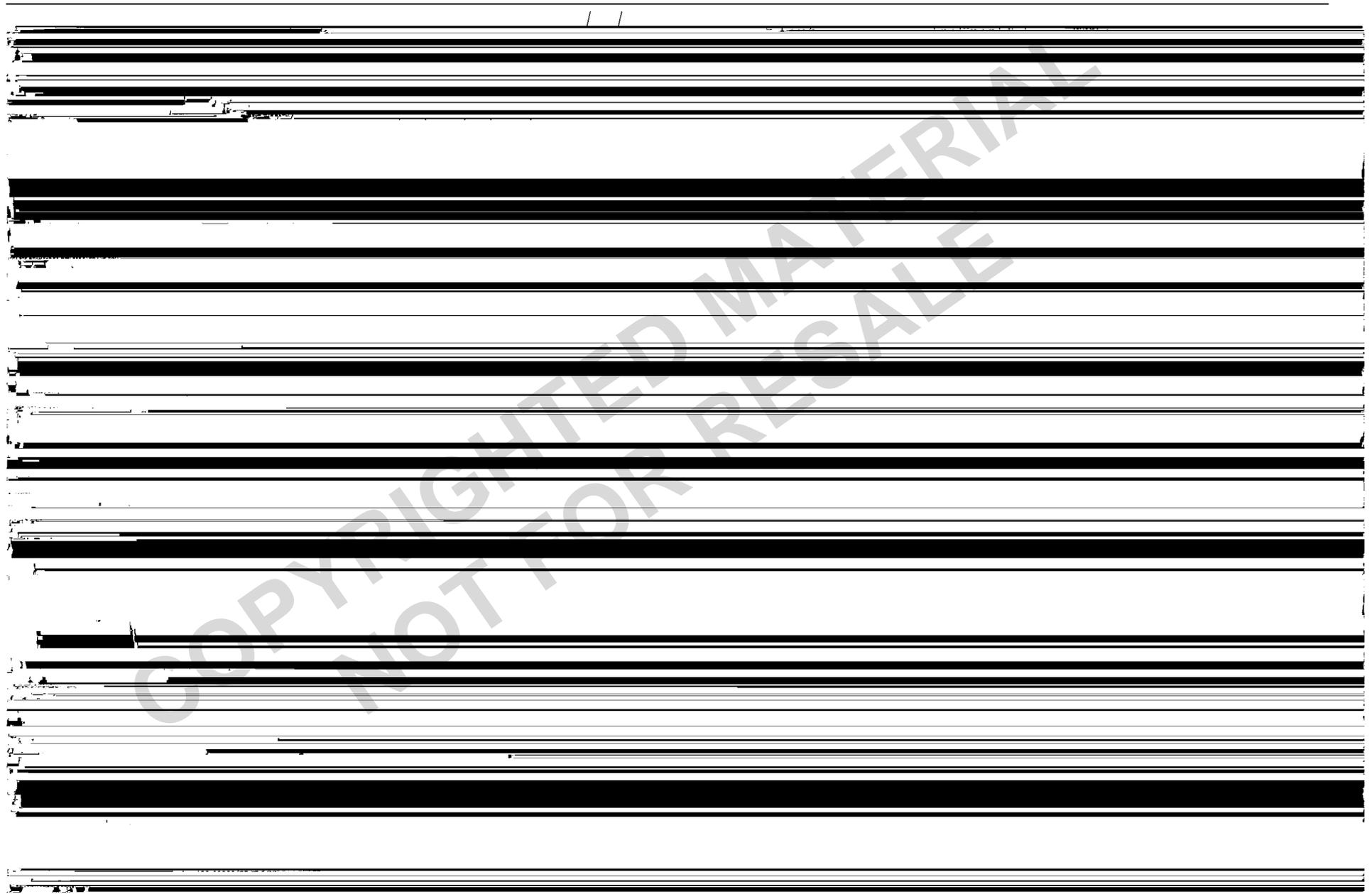


FLOX AND EPOXY SHOULD BE ALLOWED TO SQUEEZE OUT FROM BETWEEN ALL JOINTS. DO NOT REMOVE FLOX AND EPOXY THAT SQUEEZES OUT. USING THE ROUND END OF A WOODEN TONGUING DEPRESSOR AS A TOOL, FORM FILLETS IN EVERY CORNER WHERE FLOX AND EPOXY IS APPLIED. THIS CAN ALSO BE DONE WITH A FINGER SO LONG AS A LATEX GLOVE IS WORN. FILLET MIN R.125, MAX R.375

NOTES: UNLESS OTHERWISE SPECIFIED
 1. BOND ALL COMPONENTS TOGETHER USING A LIBERAL AMOUNT OF "ELEPHANT SNOT" AS INSTRUCTED IN THE HORNET DOCUMENTATION PACKAGE.

03-00007		SEAT BOTTOM ASSEMBLY	
UNLESS OTHERWISE SPECIFIED		HORNET	
LINEAR	ANGULAR	AS DIMENSIONS ARE BY	
XXX #01 X" #0.1"	XXX #01 X" #0.1"	INCHES (MM)	
XXX #005 X" #0.1"	XXX #005 X" #0.1"		
D:\C:\Programs\SolidWorks\2003\030007 - SeatBottomAssembly.SLDPRW			
DO NOT SCALE DRAWING		SolidWorks	
D. SHOEBRIDGE		1:2	D
			1 OF 1

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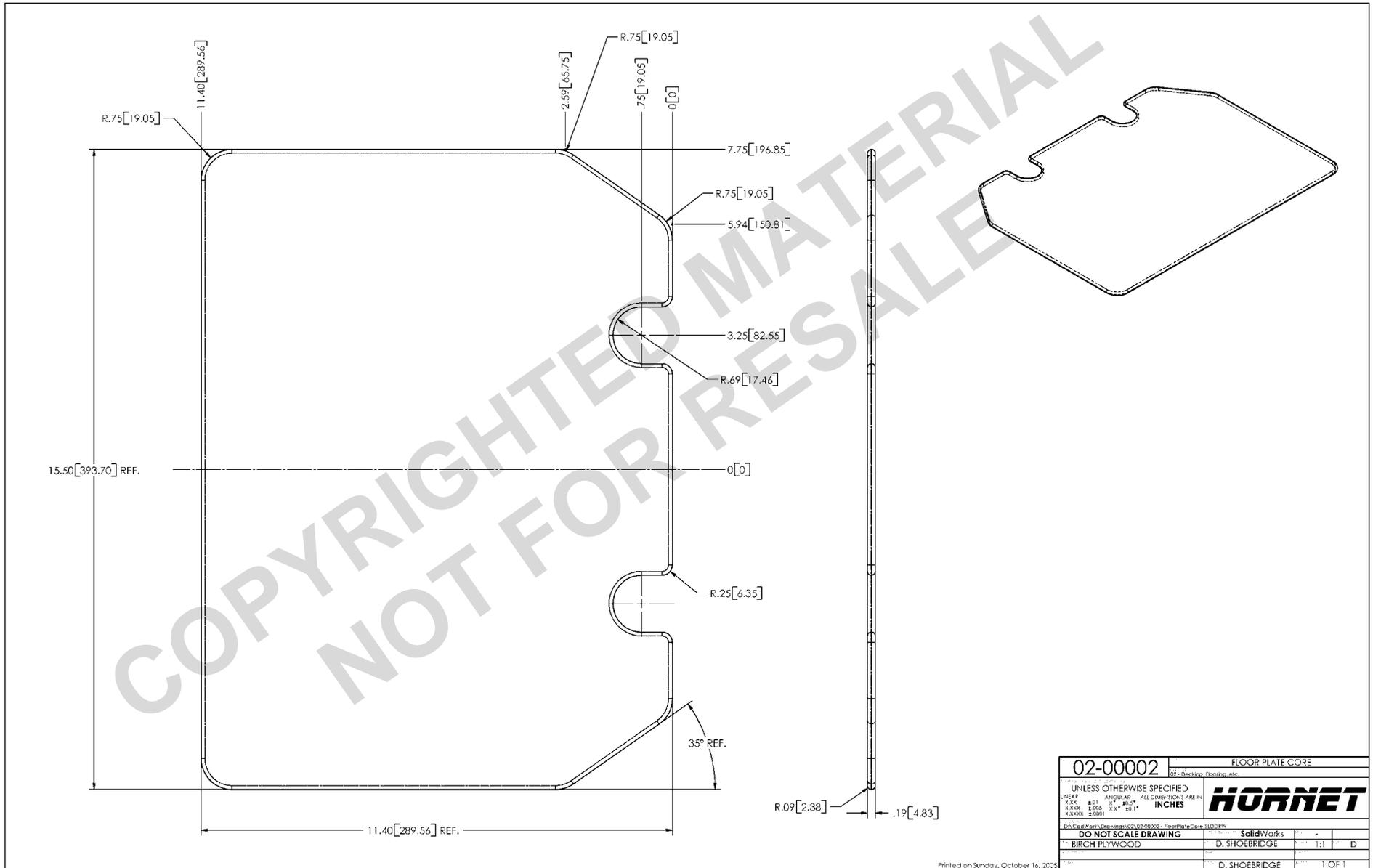


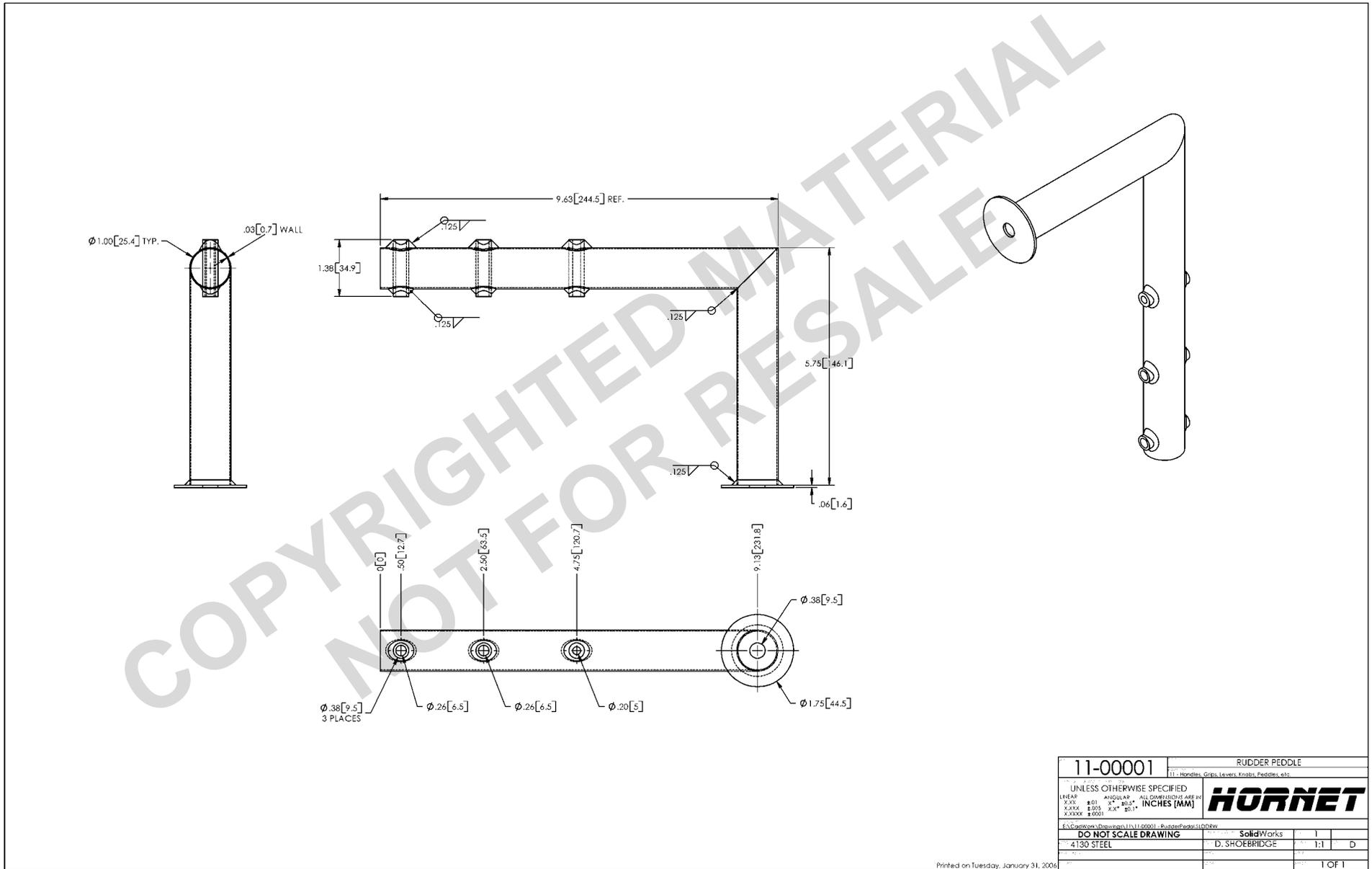
8.6 Floor Plate Assembly

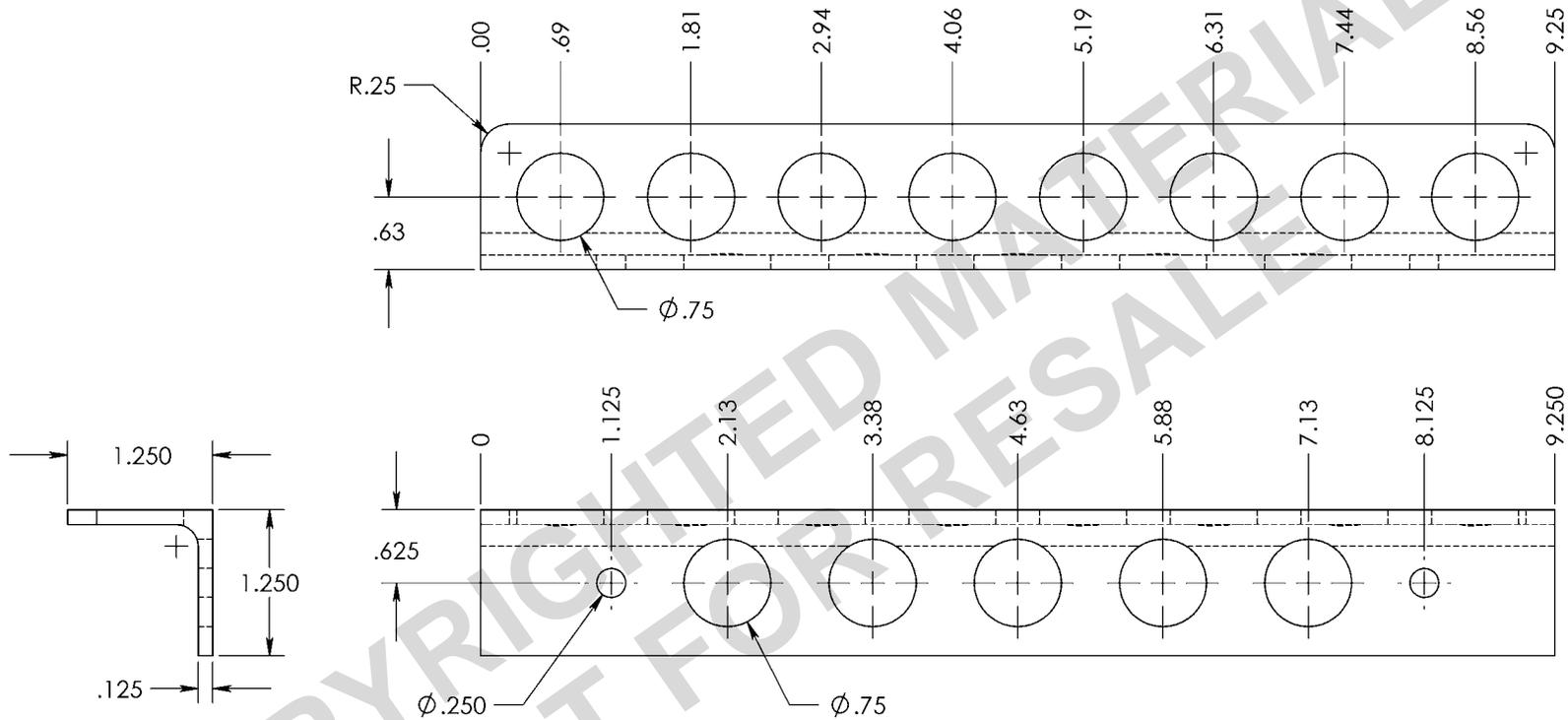
The floor plate assembly, like that of the seat assembly, is a plywood core, Kevlar/fiberglass, and epoxy wet lay-up sandwich. This structure is quite strong and provides you an easier means of ingressing and egressing the gyro, by providing a wide and secure place to stand. It also supports your feet when your feet are resting on the rudder pedals. The Hornet airframe is designed to accept the mounting pattern of the floor plate assembly. When the composite construction is complete, my suggestion would be to apply a large piece of grip tape to the top surface. This should be plenty of friction to keep your feet in-place while flying.

8.6.1 Rudder Pedals

The final design of the rudder pedals for the Hornet was based on the yaw pedals of the Bell UH-1, better known as the Huey. The actual dimensions are not exactly the same as the Huey's, but the design intent is the same. Most gyro pedals are flat, which forces the pilot to lay his feet flat on them, with the pivot point set fairly high up on the foot. The problem is when a rudder input is made, depending on the amount of input, the pilot could have one foot severely pointed, and the other foot pointed back at an extreme angle. This is obviously not a very comfortable position for the pilot's feet to be in. Also with a typical gyro pedal, they are designed as "one size fits all". People with legs that are either longer or shorter than the gyro design originally called for, puts the pilots feet in an awkward position right from the beginning, making long flights cumbersome. With the Hornet pedals, in conjunction with the floor plate, the pilot can place his or her feet at any angle that is most convenient and comfortable. The rudder pedals are part of the floor plate which allows the builder to move the entire assembly fore or aft to best fit their height..

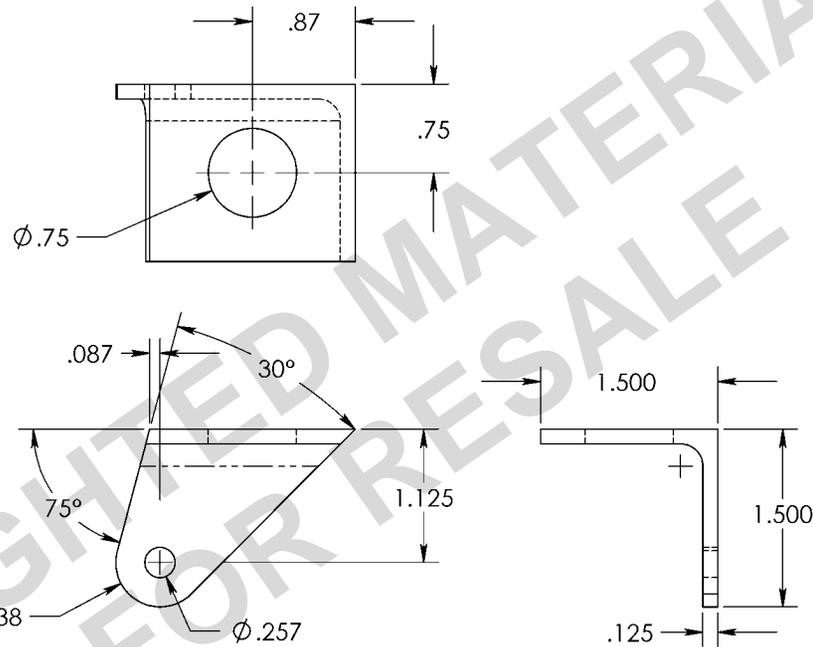
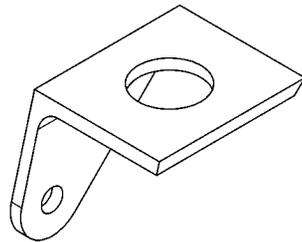






P/N	70-00056			TITLE	FLOOR PLATE MOUNT		
				PART GROUP	70 - Bracing, Supports, Frames, And Brackets		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED							
LINEAR	X.XX ±.01	ANGULAR	X° ±0.5°	ALL DIMENSIONS ARE IN INCHES [MM]			
	X.XXX ±.005		X.X° ±0.1°				
	X.XXXX ±.0001						
FILENAME	D:\CadWork\Drawings\70\70-00056 - FloorPlateMount.SLDDRW						
DO NOT SCALE DRAWING				CREATED WITH	SolidWorks		REV -
MTRL	ALUMINUM, 6061-T6			ENG	D. SHOEBRIDGE		THIRD ANGLE
HEAT TREAT				SCALE	1:1		SIZE B
FINISH				APRV	DATE		SHEET 1 OF 1

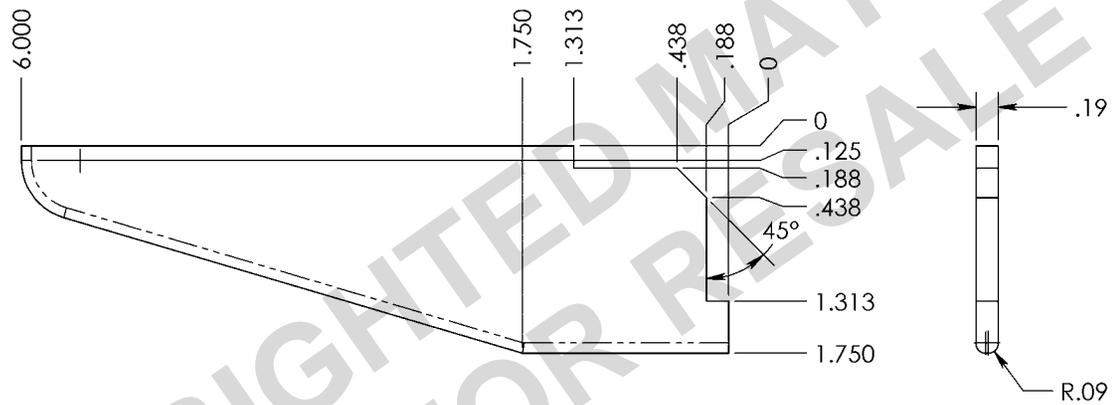
Printed on Sunday, October 16, 2005



NOTES: UNLESS OTHERWISE SPECIFIED
 1. LEFT HAND SHOWN, RIGHT HAND OPPOSITE.

P/N 70-00057		TITLE RUDDER PEDAL PIVOT BRACKET - LEFT		
PART GROUP 70 - Bracing, Supports, Frames, And Brackets		HORNET		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED				
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN		
X.XX ±.01	X° ±0.5°	INCHES [MM]		
X.XXX ±.005	X.X° ±0.1°			
X.XXXX ±.0001				
FILE NAME D:\CadWork\Drawings\70\70-00057 - RudderPedalPivotBracket-Left.SLDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -	THIRD ANGLE
MTRL ALUMINUM, 6061-T6	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 1	

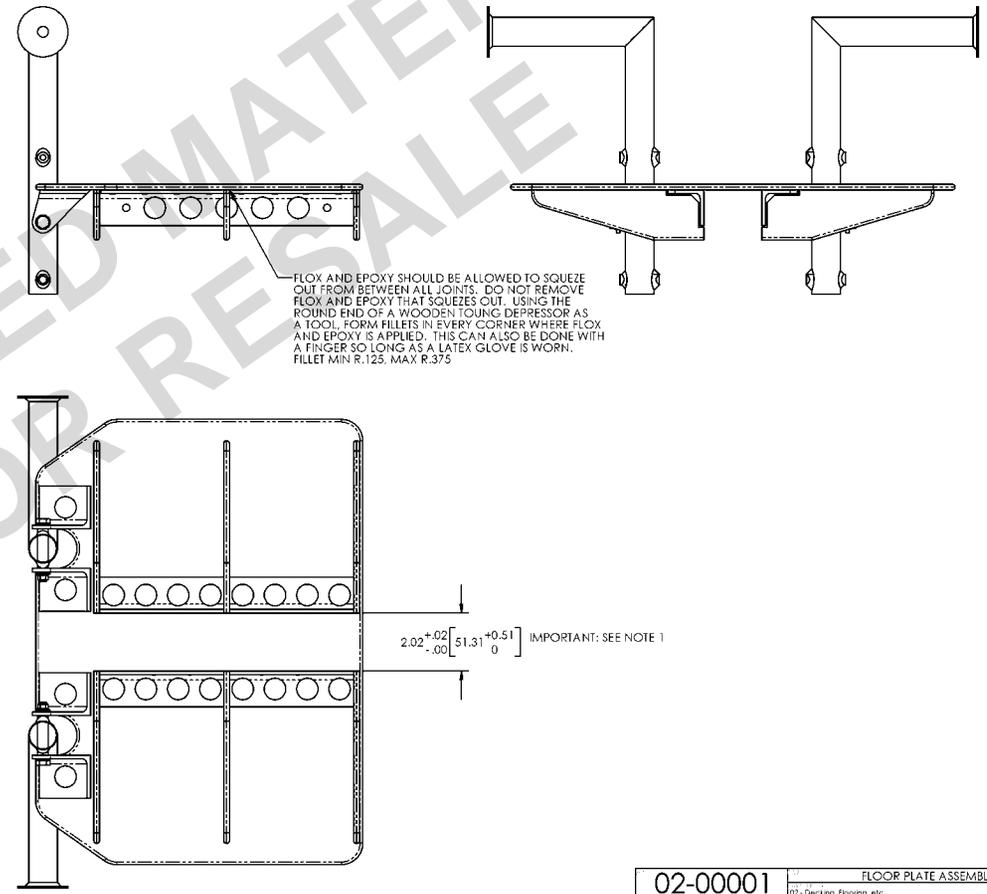
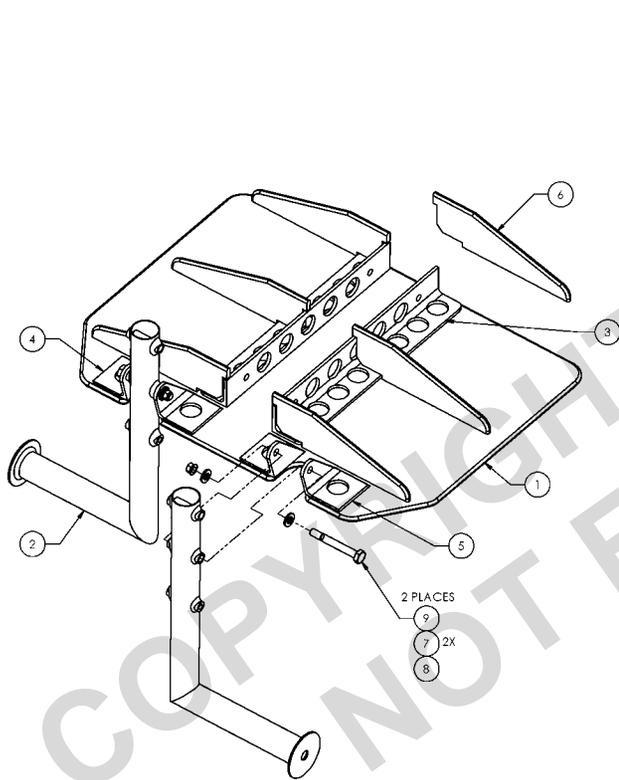
Printed on Sunday, October 16, 2005



P/N 70-00058		TITLE FLOOR PLATE SUPPORT GUSSET	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 70 - Bracing, Supports, Frames, And Brackets	
LINEAR	ANGULAR		
X.XX ±.01	X° ±0.5°		
X.XXX ±.005	X.X° ±0.1°		
X.XXXX ±.0001			
FILENAME D:\CadWork\Drawings\70\70-00058 - FloorPlateSupportGusset.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV - THIRD ANGLE
MTRL BIRCH PLYWOOD	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET	1 OF 1

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ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	02-00002	FLOOR PLATE CORSE
2	2	11-00001	RUDDER PEDDLE
3	2	70-00056	FLOOR PLATE MOUNT
4	2	70-00057	RUDDER PEDAL PIVOT BRACKET - LEFT
5	2	70-00059	RUDDER PEDAL PIVOT BRACKET - RIGHT
6	4	70-00058	FLOOR PLATE SUPPORT GUSSET
7	8	27-00002	ANS60-416 WASHER
8	4	26-00014	NUT MS21042-4 (1/4-28)
9	2	26-00091	AN4-20A BOLT
10	2	26-00086	AN4-25A BOLT



$2.02^{+0.02}_{-0.02} [51.31^{+0.51}_0]$ IMPORTANT: SEE NOTE 1

UNLESS OTHERWISE SPECIFIED:
 1) THE SPACING BETWEEN RAILS MUST BE GREATER THAN 2.00" TO AVOID DAMAGING PAINTED SURFACE OF AIRFRAME DURING FINAL ASSEMBLY. TO OBTAIN ADEQUATE SPACING, APPLY 2 LAYERS OF MASKING TAPE TO BARE SURFACES OF THE AIRFRAME BETWEEN RAILS AND AIRFRAME AT THE TIME THAT THE RAILS ARE BONDED TO THE FLOOR PLATE.

02-00001		FLOOR PLATE ASSEMBLY	
UNLESS OTHERWISE SPECIFIED			
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	HORNET
XXX ±01	° ±0.5	INCHES	
XXXX ±005	° ±0.1		
XXXXX ±0001			
D:\C:\Program Files\SolidWorks\SolidWorks\bin\swdocmgr.exe			
DO NOT SCALE DRAWING		SolidWorks	
		D. SHOEBRIDGE	1:2 D
			1 OF 1

Printed on Monday, October 24, 2005

8.7 Joystick Assembly

One of the biggest complaints that I've been hearing from people is the inability to rest your arm on your lap while still maintaining a grip on the joystick. Hopefully I've taken care of this problem with my joystick design.

I designed the Hornet joystick with several ideas in mind. One idea focused on a simple means of adjusting the joystick to the pilot. I accomplished this through the use of a couple of rod ends attached to opposite ends of the length of 4130 tube (P/N 56-00005 – Pitch Tube Assembly). If the position of the stick grip is not in a position of the pilot's liking, simply pull one of the AN bolts, break a piece of safety wire, loosen a jam nut and screw in (or out) one of the rod ends. Once reassembled, the stick grip will be in a different position. Turning the rod ends in will move the stick grip closer to the occupant.

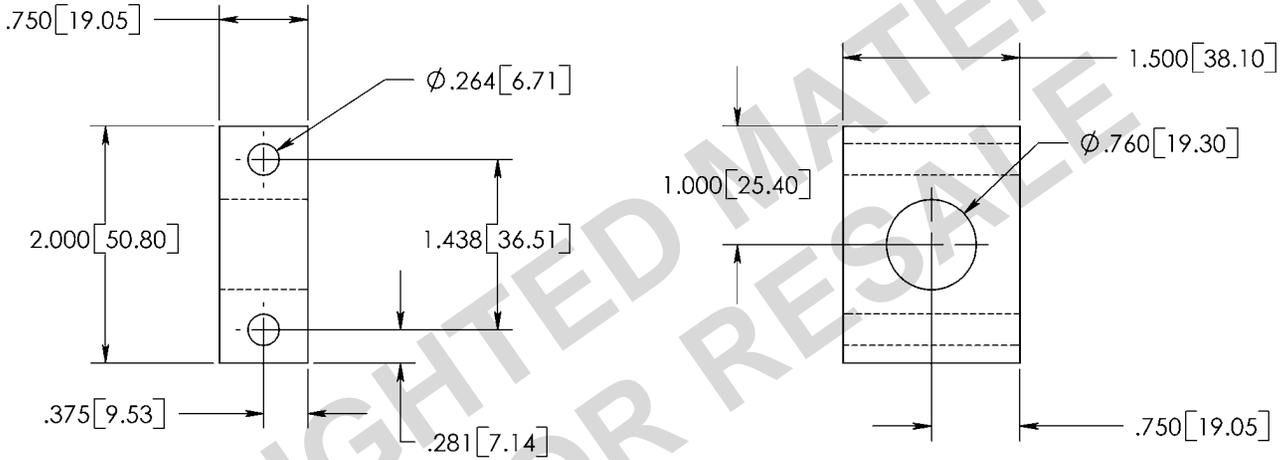
The basic configuration and construction technique of the joystick came from two different sources; 1) the UH-1 Huey and 2) a Piper Cub. I wanted a military looking joystick (like the Huey), but it also had to be simple (like the Cub). Although, the Cub design was a little too wimpy for my tastes, so I beefed it up a bit.

Pitch and roll inputs will be a bit docile in this current configuration. The Control Fork Weldment is purposely narrower and shorter than some of the more common gyro control systems. I consider this to be an initial design. Reason being, I'm not quite sure exactly how the Hornet will fly and I didn't want to have the controls overly sensitive. A story about old and bold pilots comes to mind. I'm sure there will be changes to this assembly based on findings in testing.

In keeping with the simple and rugged design approach, the majority of the joystick assembly is fabricated from welded 4130 steel tube. Yes, it is a bit heavier but it is much stronger and will not fatigue like that of aluminum. I wanted to have a higher degree of confidence with regard to the flight controls.

There are other joystick assemblies available from several different companies, but the bolt mounting hole pattern for the Hornet joystick will be different. If you already have a joystick assembly, don't drill the holes in the keel tube until you know exactly where your third-party joystick assembly should be positioned.

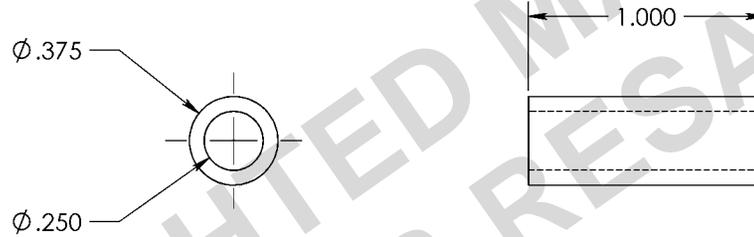
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43105-01	INCREASED HEIGHT TO CLEAR NEW LANDING GEAR MOUNT PLATE	DTS	16-Oct-05	DTS	16-Oct-05



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P/N 08-00008		TITLE JOYSTICK,ROLL,PIVOT,BLOCK				
PART GROUP 08 - Bearings, Bushings						
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		HORNET				
LINEAR	ANGULAR				ALL DIMENSIONS ARE IN	
X.XX ±.01	X° ±0.5°				INCHES [MM]	
X.XXX ±.005	X.X° ±0.1°					
X.XXXX ±.0001						
FILENAME D:\CadWork\Drawings\08\08-00008 - JoyStickRollPivotBlock.SLDDRW						
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1	THIRD ANGLE		
MTRL DELRIN	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B			
HEAT TREAT	APRV	DATE				
FINISH	DETAIL	SHEET	1 OF 1			

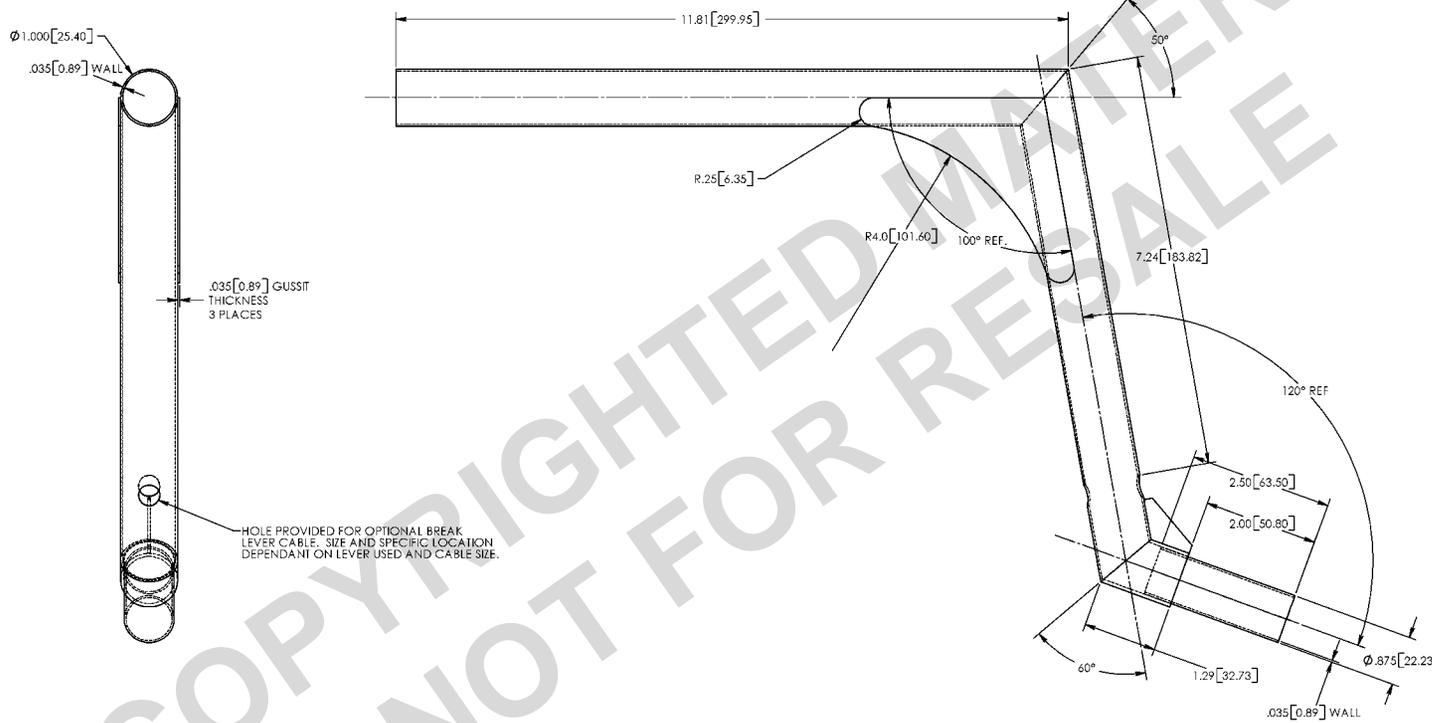
Printed on Sunday, October 16, 2005



P/N 08-00016		TITLE BRONZE BUSHING - .25 ID X .375 OD X 1.00 LONG		
		PART GROUP 08 - Bearings, Bushings		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR X.XX ±.01 X.XXX ±.005 X.XXXX ±.0001 ANGULAR X° ±0.5° X.X° ±0.1° ALL DIMENSIONS ARE IN INCHES [MM]				
FILENAME BronzeBushings.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -	THIRD ANGLE
MTRL BRONZE	ENG D. SHOEBRIDGE	SCALE 2:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET 1 OF 1		

Printed on Monday, October 17, 2005

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	45104-01	CHANGED TUBE DIAMETER FROM .750 TO .875	DTS	31-Oct-04	DTS	31-Oct-04
2	43205-01	ELIMINATED BENDS. CHANGED OVERALL HEIGHT.	DTS	17-Oct-05	DTS	17-Oct-05



NOTES: UNLESS OTHERWISE SPECIFIED
 1. GAS WELD ALL ACCESSABLE JOINS. DO NOT MIG WELD.

11-00004		JOY STICK TUBE	
UNLESS OTHERWISE SPECIFIED		SolidWorks	
LINEAR	ANGULAR	AS DIMENSIONS ARE BY	2
XXXX ±.01	X° ±.05/1°	INCHES (MM)	1:1
XXXX ±.005	XXXX ±.01/1°		D
DO NOT SCALE DRAWING		D. SHOEBRIDGE	
4130 STEEL		1 OF 1	

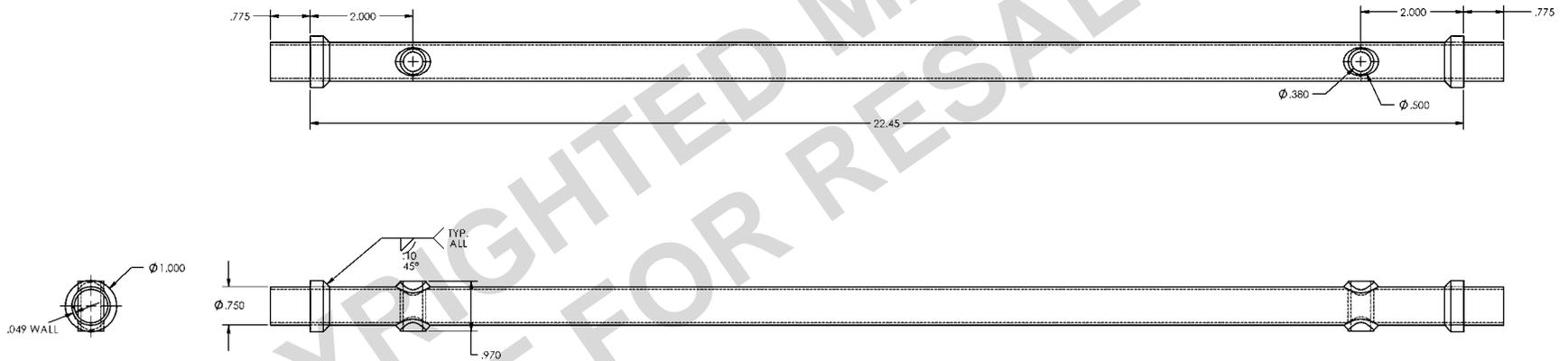
Printed on Thursday, October 20, 2006



P/N 27-00020		TITLE JOYSTICK SPACER TUBE		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		PART GROUP 27 - Washers, Spacers, Stand-Offs, Shims, etc.		
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN		
X.XX ±.01	X° ±0.5°	INCHES [MM]		
X.XXX ±.005	X.X° ±0.1°	HORNET		
X.XXXX ±.0001		FILENAME JoystickSpacerTube.SLDDRW		
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV -	THIRD ANGLE
MTRL ALUMINUM, 6061-T6	ENG D. SHOEBRIDGE	SCALE 4:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 1	

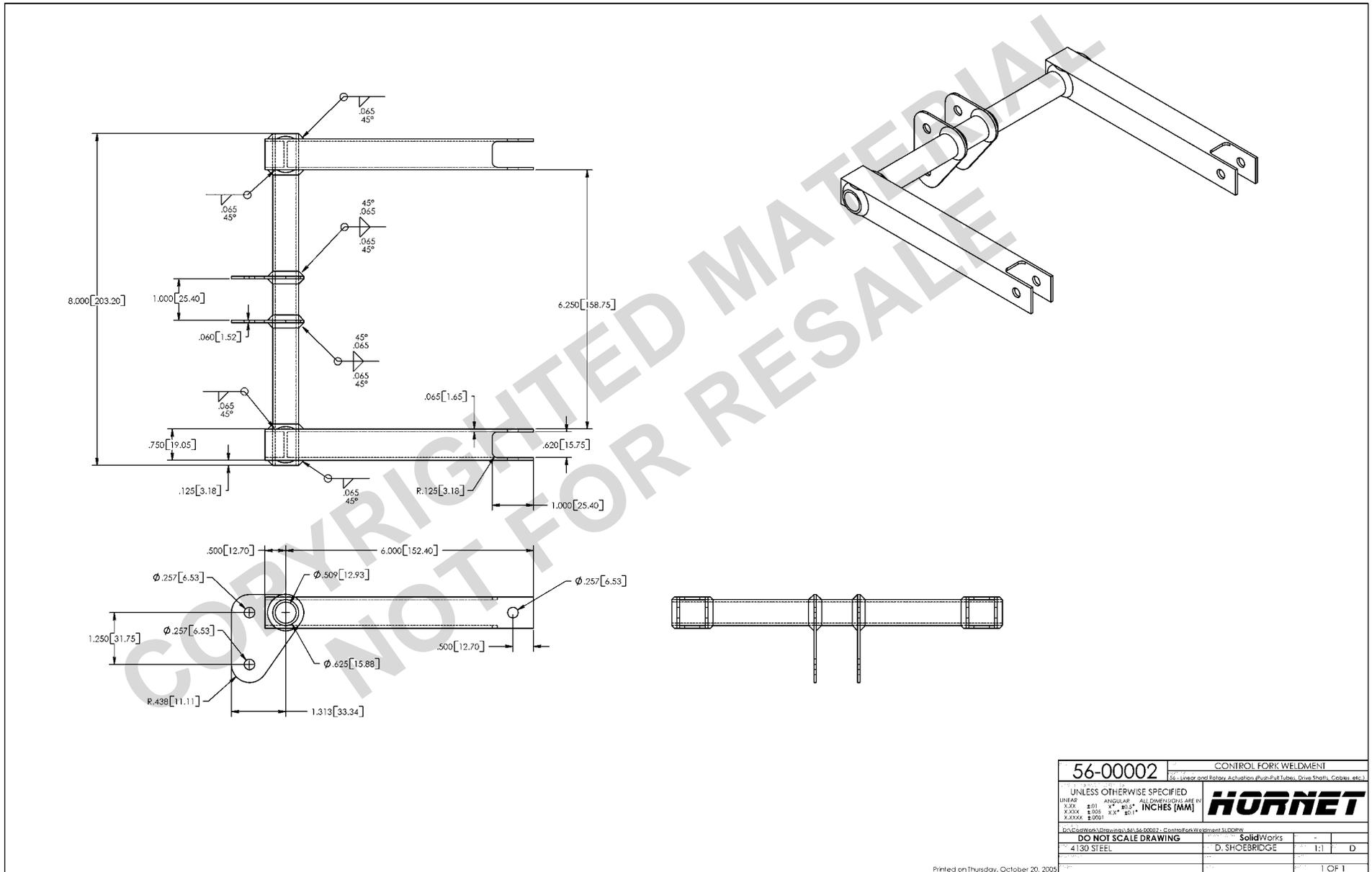
Printed on Thursday, October 20, 2005

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43205-01	RELOCATED CROSS TUBES TO PROVIDE BETTER CLEARANCE	DTS	17-Oct-05	DTS	17-Oct-05

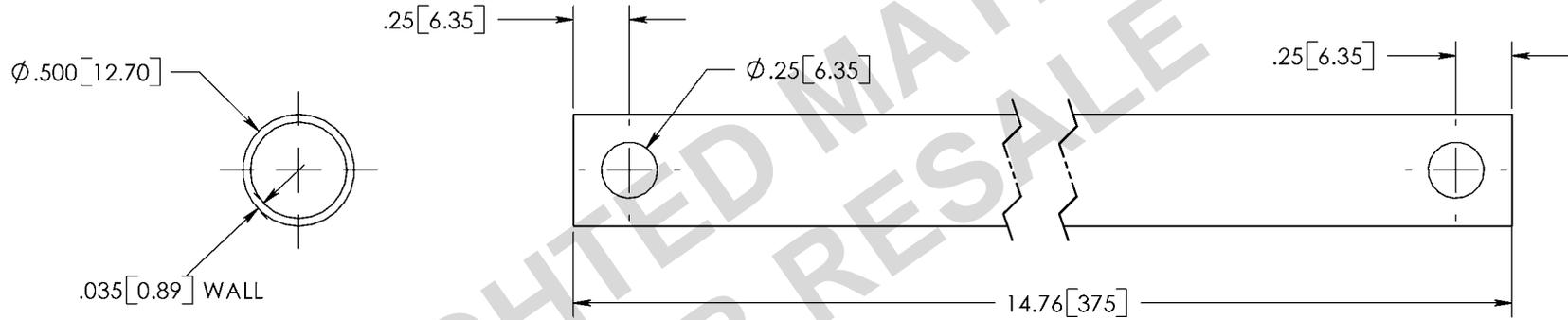


56-00001		JOY STICK TORQUE TUBE	
<small>56 - Linear and Rotary Actuators (Push-Pull Tubes, Drive Shafts, Clutches, etc.)</small>			
UNLESS OTHERWISE SPECIFIED			
LINEAR	±.01	ANGULAR	±.01°
XXX	±.005	XXX	±.01°
XXXX	±.002	XXXX	±.005°
D:\Compass\Drawings\56-00001 - Joy Stick Torque Tube.dwg			
DO NOT SCALE DRAWING		SolidWorks	1
		D. SHOEBRIDGE	1:1 D
			1 OF 1

Printed on Monday, October 17, 2005



REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43705-01	ADDED HOLES FOR PLUG WELDING	DTS	22-Oct-05	DTS	22-Oct-05

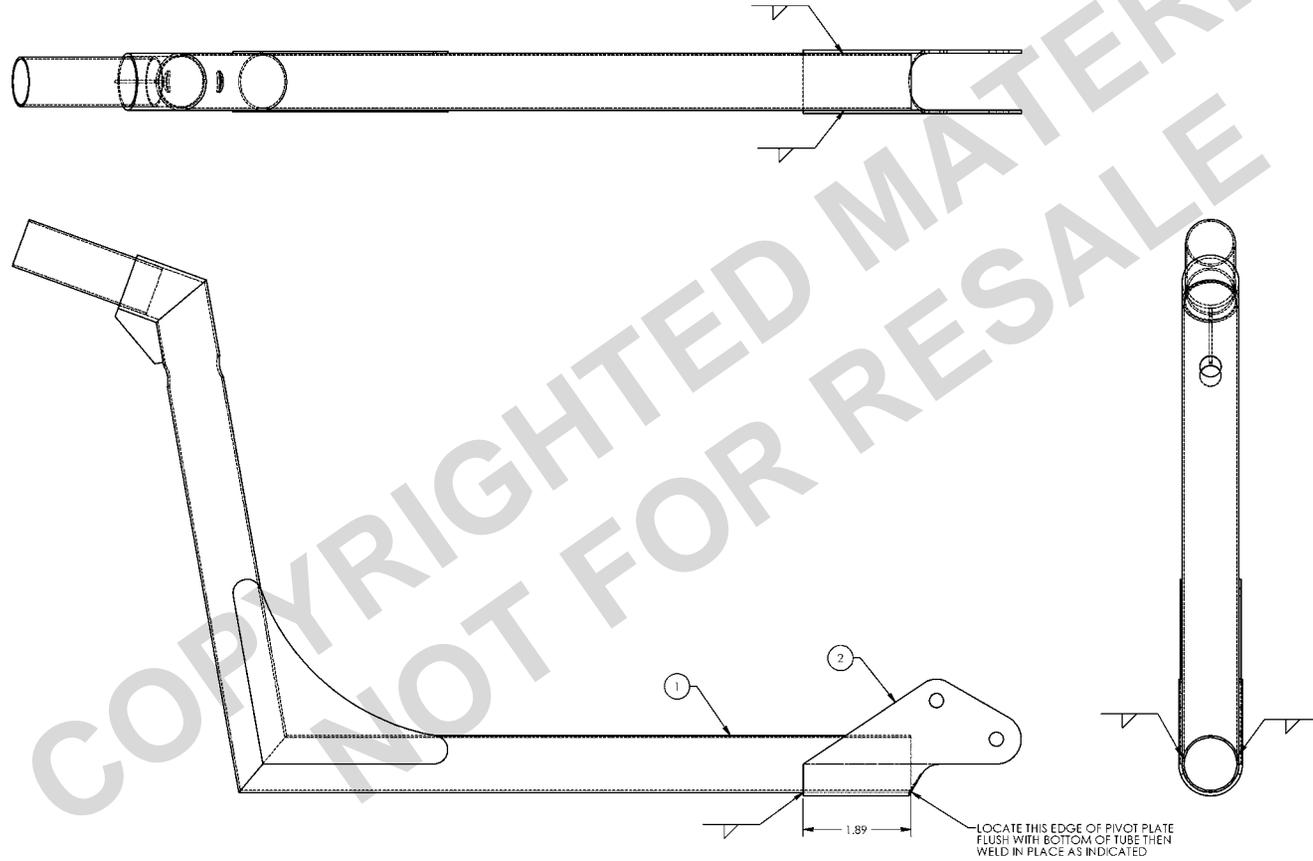


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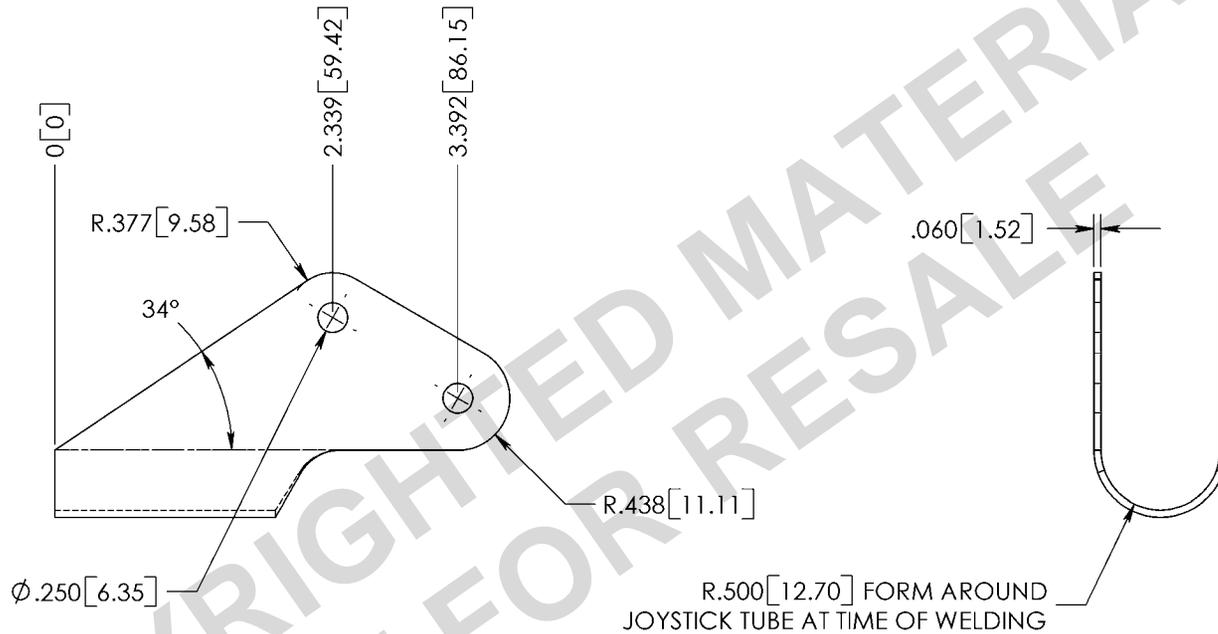
P/N 56-00004		TITLE PITCH TUBE	
PART GROUP 56 - linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)		HORNET	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° INCHES [MM] X.XXX ±.005 X.X° ±0.1° X.XXXX ±.0001			
FILENAME D:\CadWork\Drawings\56\56-00004 - PitchTube.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1 THIRD ANGLE
MTRL 4130 STEEL	ENG D. SHOEBRIDGE	SCALE 2:1	SIZE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET	1 OF 1

Printed on Saturday, October 22, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	11-00004	JOY STICK TUBE
2	1	69-00003	JOY STICK PIVOT PLATE



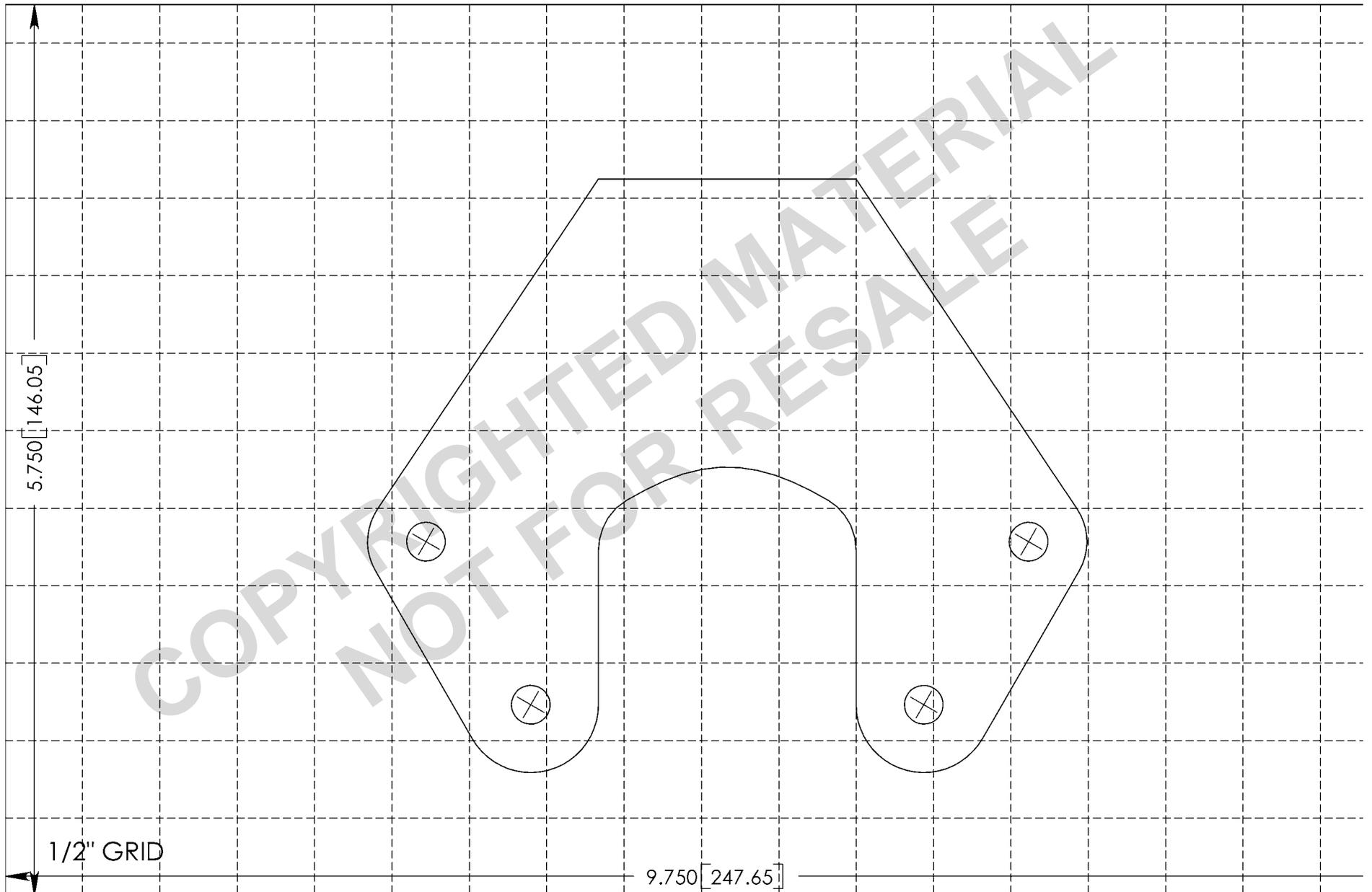
56-00006		JOY STICK ASSEMBLY	
UNLESS OTHERWISE SPECIFIED		S&S - Linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)	
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	HORNET
XXXX #.01	XX' XX" XX"	INCHES [MM]	
XXXX #.005	XX' XX" XX"	INCHES [MM]	
XXXX #.0001	XX' XX" XX"	INCHES [MM]	
DO NOT SCALE DRAWING			
SolidWorks		-	
D. SHOEBRIDGE		1:1 D	
Printed on Thursday, October 20, 2005		2 OF 2	



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P/N 69-00003		TITLE JOY STICK PIVOT PLATE		
PART GROUP 69 - Plates (Anchor, Tie, Connection)		HORNET		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED				
LINEAR X.XX ±.01 X.XXX ±.005 X.XXXX ±.0001 ANGULAR X° ±0.5° X.X° ±0.1° ALL DIMENSIONS ARE IN INCHES [MM]				
FILENAME D:\CadWork\Drawings\69\69-00003 - JoyStickPivotPlate.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1	THIRD ANGLE
MTRL STEEL, 4130	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 2	

Printed on Thursday, October 20, 2005



P/N 69-00003

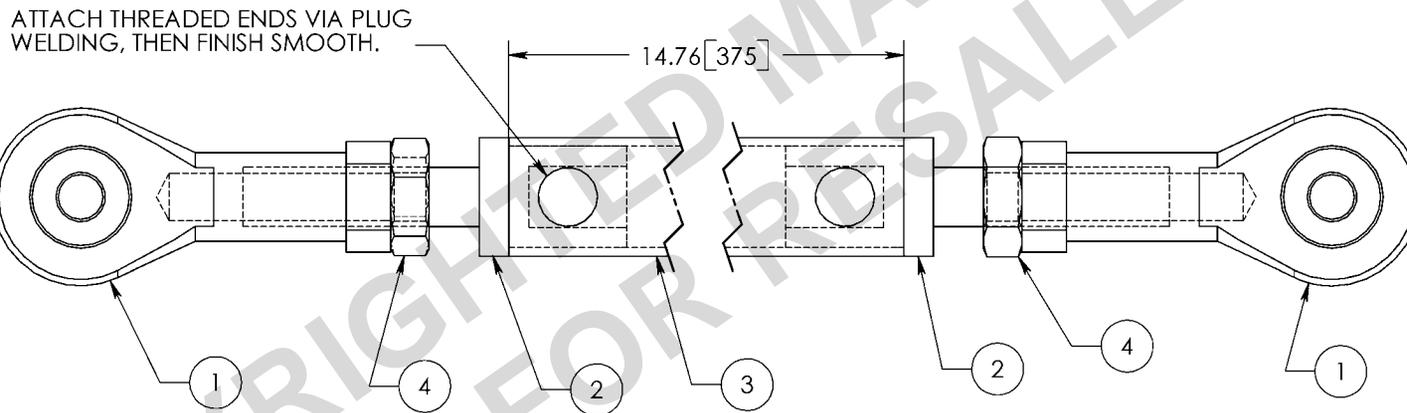
THIS DRAWING INTENDED FOR TRACE CUTTING FLAT PA

TITLE JOY STICK PIVOT PLATE

MTRL STEEL, 4130



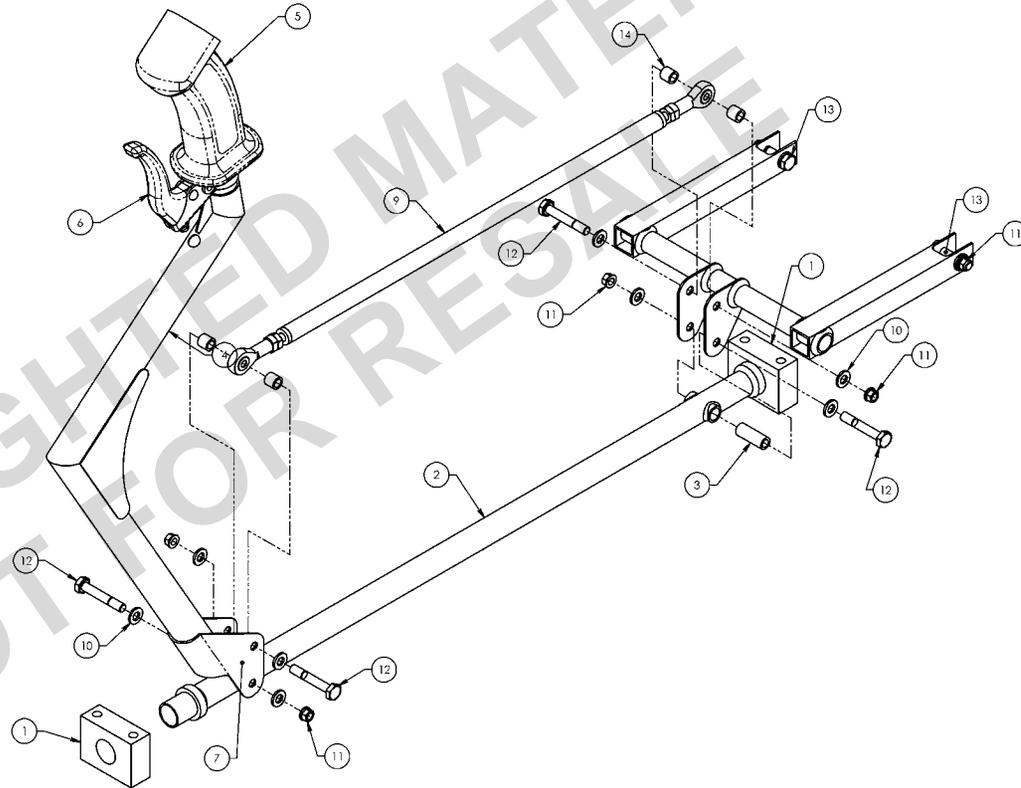
ITEM NO.	QTY.	PART NO.	DESCRIPTION	REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	2	08-00005	ROD END, 1/4-28 FEMALE, .25 BORE	1	43705-01	UPDATED VIEWS	DTS	22-Oct-05	DTS	22-Oct-05
2	2	56-00003	THREADED ROD END, AN490HT8P							
3	1	56-00004	PITCH TUBE							
4	2	26-00088	HEX JAM NUT, 1/4-28 DRILLED, NAS509-4							



P/N	56-00005	TITLE	PITCH TUBE ASSEMBLY					
		PART GROUP	56 - linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)					
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		HORNET						
LINEAR	ANGULAR					ALL DIMENSIONS ARE IN		
X.XX ±.01	X° ±0.5°					INCHES [MM]		
X.XXX ±.005	X.X° ±0.1°							
X.XXXX ±.0001								
FILENAME	D:\CadWork\Drawings\56\56-00005 - PitchTube.SLDRW							
	DO NOT SCALE DRAWING		CREATED WITH	SolidWorks	REV 1			
MTRL		ENG	D. SHOEBRIDGE	SCALE	2:1			
HEAT TREAT		APRV		DATE				
FINISH		DETAIL		SHEET	1 OF 1			

Printed on Saturday, October 22, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	2	08-00008	JOYSTICK ROLL PIVOT BLOCK
2	1	56-00001	JOY STICK TORQUE TUBE
3	2	08-00016	BRONZE BUSHING - 25 ID X .375 OD X 1.00 LONG
4	1	11-00004	JOY STICK TUBE
5	1	11-00005	STICK GRIP
6	1		BRACE LEVER BICYCLE
7	1	69-00003	JOY STICK PIVOT PLATE
8	1	54-00002	CONTROL FORK WELDMENT
9	1	56-00005	PITCH TUBE ASSEMBLY
10	12	27-00002	AN960-416 WASHER
11	6	26-00014	NUT MS21042-4 (1/4-28)
12	4	26-00080	AN4-14A BOLT
13	2	26-00084	AN4-11A BOLT
14	4	27-00020	JOYSTICK SPACER TUBE



56-00006		JOY STICK ASSEMBLY	
56 - Linear and Rotary Actuators (Push-Pull Tubes, Drive Shafts, Cables, etc.)			
UNLESS OTHERWISE SPECIFIED			
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	
X.XXX #.01	X.XX #0.001"	INCHES [MM]	
X.XXX #.005	X.X #0.1"		
X.XXX #.0001	X.XX #0.01"		
D:\Component\Borealis\56-00006 - Joy Stick Assembly.SLDPRG			
DO NOT SCALE DRAWING		SolidWorks	
-	D. SHOEBRIDGE	1:1.6	D
		1 OF 2	

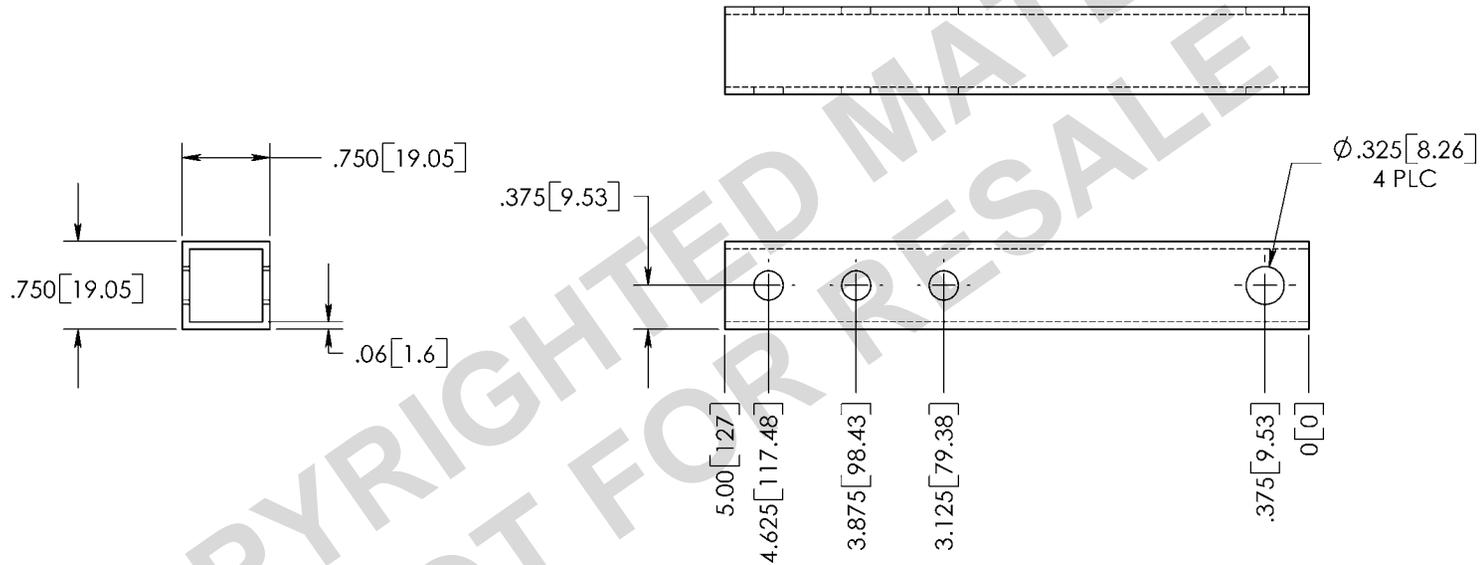
Printed on Thursday, October 20, 2005

8.8 Rotor Control

Rotor control is accomplished through four short push rods. Why four? If two long push rods were used between the control fork and the rotor head, because of the distance that they would have to span, during flight they would shake a great deal. So to eliminate this from happening, I added two push rod swing arms – one to either side of the mast, about half way between the rotor head and the control fork. Then I added two push rods between the control fork and the push rod swing arms (lower push rods), and two more push rods between the push rod swing arms and the rotor head (upper push rods). The four push rods are exactly the same as the Pitch Tube Assembly except that the overall length is different. The length of the lower push rods is a known value. However, the distance from the push rod swing arms to the rotor head is a different matter. Depending on which rotor head is selected for installation, the correct length of the upper push rods will change.

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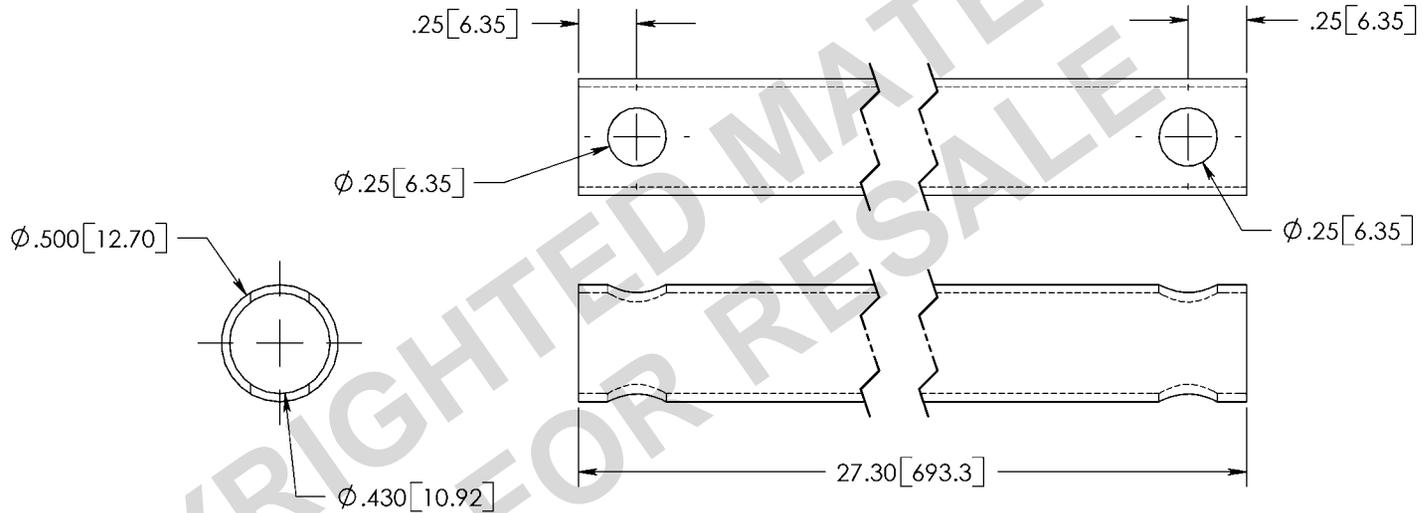
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43505-01	CHANGED MATERIAL AND WALL THICKNESS	DTS	20-Oct-05	DTS	20-Oct-05



P/N 56-00007		TITLE PUSH ROD SWING ARM		
PART GROUP 56 - Linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)		HORNET		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR X.XX ±.01 X° ±0.5° ALL DIMENSIONS ARE IN INCHES [MM] X.XXX ±.005 X.X° ±0.1° X.XXXX ±.0001				
FILENAME D:\CadWork\Drawings\56\56-00007 - PushRodSwingArm.SLDDRW		CREATED WITH SolidWorks	REV -	THIRD ANGLE
DO NOT SCALE DRAWING		ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
MTRL STEEL, 4130	HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET 1 OF 1		

Printed on Thursday, October 20, 2005

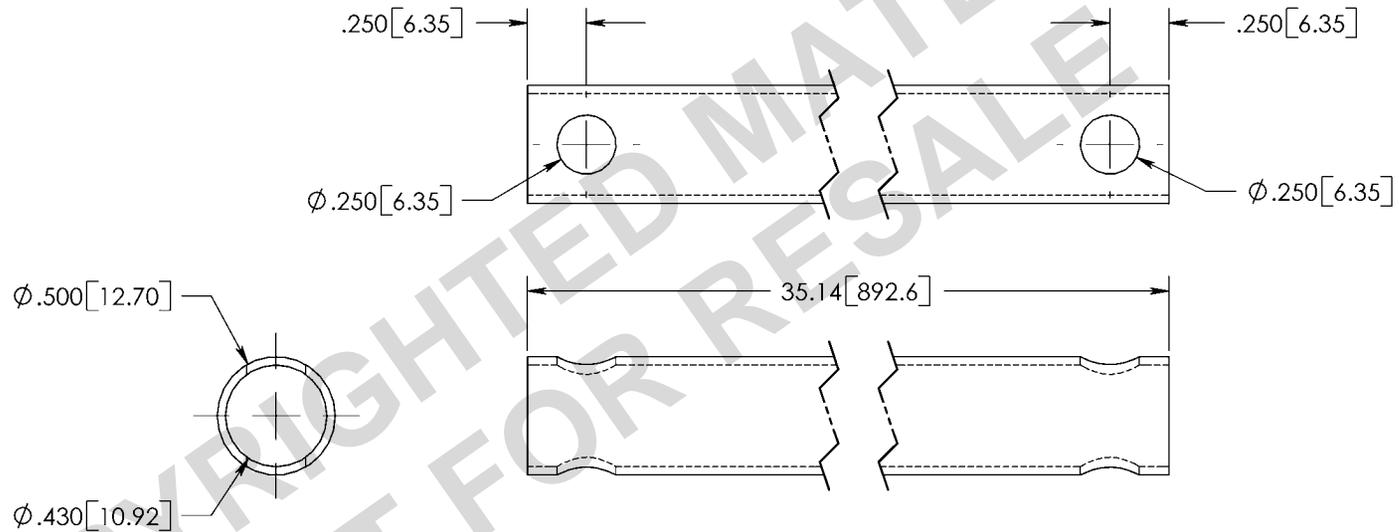
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43505-01	ADDED HOLES FOR PLUG WELDING	DTS	20-Oct-05	DTS	20-Oct-05



P/N	56-00010		TITLE	LOWER PUSH PULL TUBE	
			PART GROUP	56 - Linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)	
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED			HORNET		
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN			
X.XX ±.01	X° ±0.5°	INCHES [MM]			
X.XXX ±.005	X.X° ±0.1°				
X.XXXX ±.0001					
FILENAME	D:\CadWork\Drawings\56\56-00010 - LowerPushPullTube.SLDDRW				
	DO NOT SCALE DRAWING		CREATED WITH	SolidWorks	REV 1 THIRD ANGLE
MTRL	4130 STEEL		ENG	D. SHOEBRIDGE	SCALE 2:1 SIZE B
HEAT TREAT			APRV		DATE
FINISH			DETAIL		SHEET 1 OF 1

Printed on Thursday, October 20, 2005

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43505-01	ADDED HOLES FOR PLUG WELDING	DTS	20-Oct-05	DTS	20-Oct-05

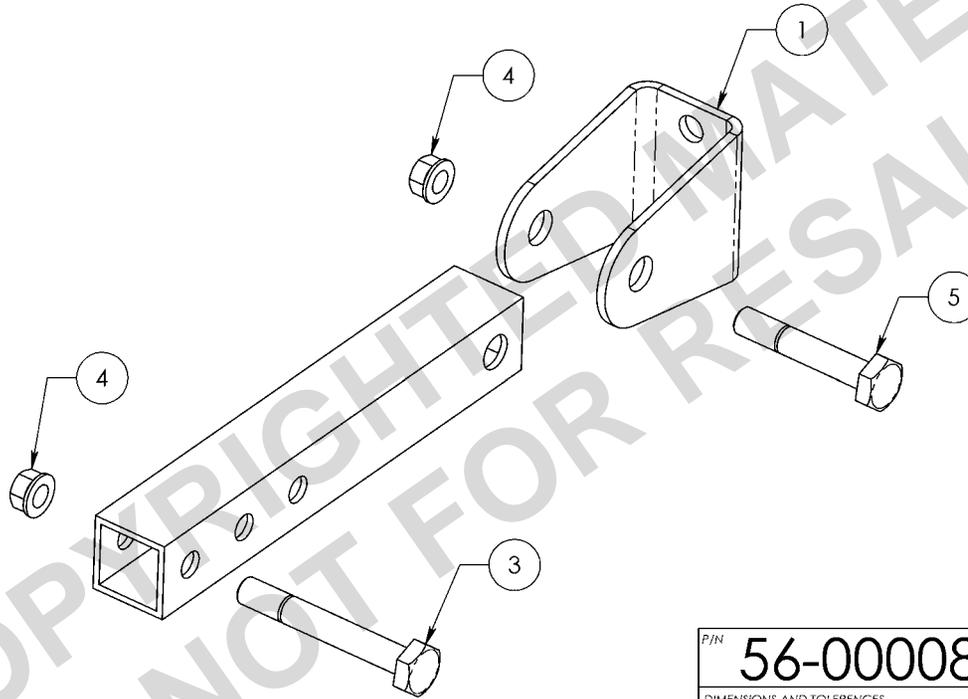


P/N 56-00012		TITLE UPPER PUSH PULL TUBE		
PART GROUP 56 - Linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)		HORNET		
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED				
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN		
X.XX ±.01	X° ±0.5°	INCHES [MM]		
X.XXX ±.005	X.X° ±0.1°			
X.XXXX ±.0001				
FILENAME D:\CadWork\Drawings\56\56-00012 - UpperPushPullTube.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1	THIRD ANGLE
MTRL 4130 STEEL	ENG D. SHOEBRIDGE	SCALE 2:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET 1 OF 1		

Printed on Thursday, October 20, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	70-00051	1.5 X 1W X 1.5D X 0.3125 DIA X 0.25 MNT TWIN ST
2	1	56-00007	PUSH ROD SWING ARM
3	1	26-00094	AN4-16A BOLT
4	2	26-00014	NUT MS21042-4 (1/4-28)
5	1	26-00081	AN4-13A BOLT

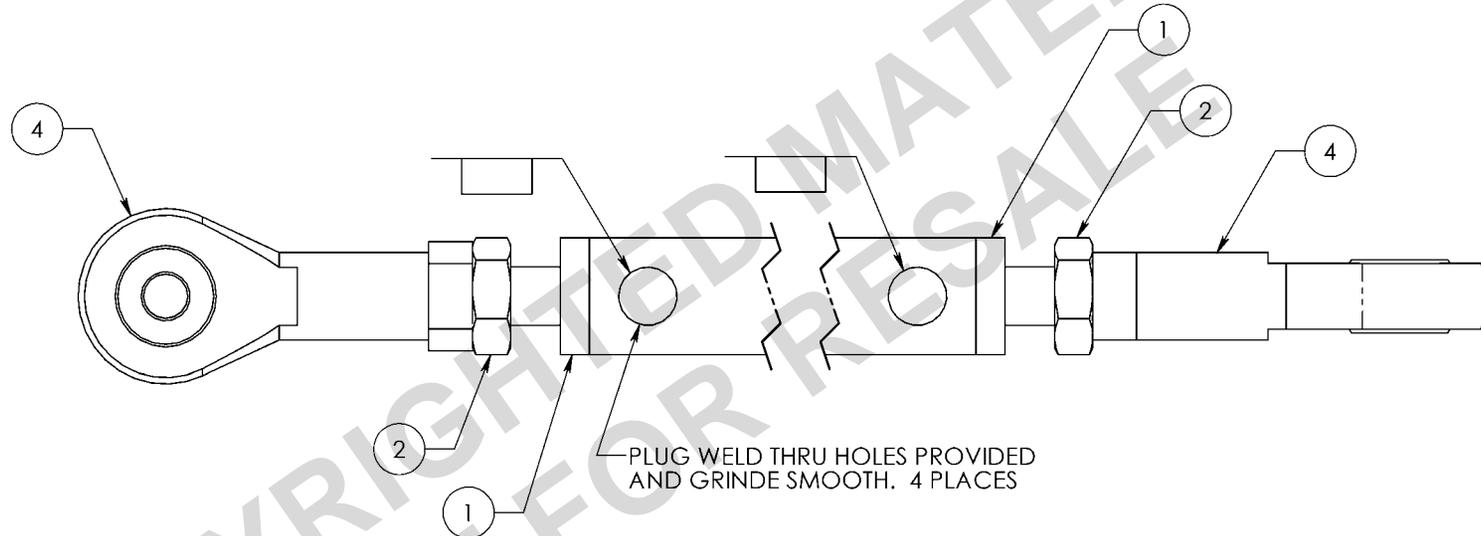
REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	43505-01	COMMONIZED SHACKLE WITH MAIN LANDING GEAR	DTS	20-Oct-05	DTS	20-Oct-05



P/N	56-00008		TITLE	PUSH ROD SWING ARM				
			PART GROUP	56 - Linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)				
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED				HORNET				
LINEAR	±.01	ANGULAR	±0.5°				ALL DIMENSIONS ARE IN INCHES [MM]	
X.XX		X°						
X.XXX	±.005	X.X°	±0.1°					
X.XXXX	±.0001							
FILENAME	D:\CadWork\Drawings\56\56-00008 - PushRodSwingArm.SLDDRW							
	DO NOT SCALE DRAWING		CREATED WITH	SolidWorks	REV	1		
MTRL			ENG	D. SHOEBRIDGE	SCALE	1:1		
HEAT TREAT			APRV		DATE			
FINISH			DETAIL		SHEET	1 OF 1		

Printed on Thursday, October 20, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	2	56-00003	THREADED ROD END, AN490HT8P
2	2	26-00088	HEX JAM NUT, 1/4-28 DRILLED, NAS509-4
3	1	56-00010	LOWER PUSH PULL TUBE
4	2	08-00005	ROD END, 1/4-28 FEMALE, .25 BORE

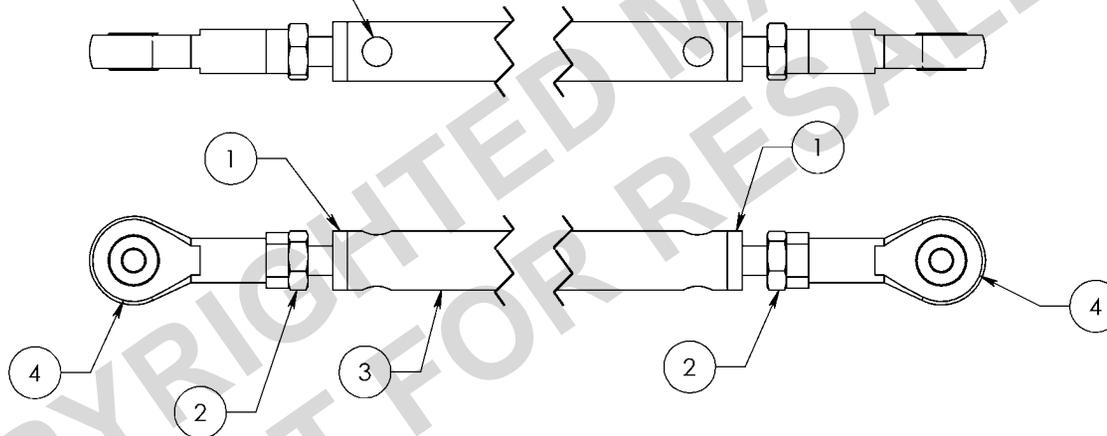


P/N 56-00009		TITLE LOWER PUSH ROD	
PART GROUP 56 - Linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)			
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR X.XX ±.01 X° ±0.5° ALL DIMENSIONS ARE IN INCHES [MM] X.XXX ±.005 X.X° ±0.1° X.XXXX ±.0001			
FILENAME D:\CadWork\Drawings\56\56-00009 - LowerPushRod.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV - THIRD ANGLE
MTRL _	ENG D. SHOEBRIDGE	SCALE 2:1	SIZE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET	1 OF 1

Printed on Thursday, October 20, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	2	56-00003	THREADED ROD END, AN490HT8P
2	2	26-00088	HEX JAM NUT, 1/4-28 DRILLED, NAS509-4
3	1	56-00012	UPPER PUSH PULL TUBE
4	2	08-00005	ROD END, 1/4-28 FEMALE, .25 BORE

PLUG WELD THRU HOLE AND GRIND SMOOTH. 4 PLACES



P/N 56-00011		TITLE UPPER PUSH ROD	
PART GROUP 56 - Linear and Rotary Actuation (Push-Pull Tubes, Drive Shafts, Cables, etc.)			
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED		HORNET	
LINEAR X.XX ±.01 X.XXX ±.005 X.XXXX ±.0001	ANGULAR X° ±0.5° X.X° ±0.1°		
ALL DIMENSIONS ARE IN INCHES [MM]			
FILENAME D:\CadWork\Drawings\56\56-00011 - UpperPushRod.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1 THIRD ANGLE
MTRL _	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET	1 OF 1

Printed on Thursday, October 20, 2005

8.9 Tail Feathers

The construction of the Hornet tail feathers uses a foam core with a Kevlar/fiberglass/epoxy outer skin. Because of the tail feathers configuration, they do not need any extra bracing. The horizontal stabilizer is a single foam piece, unlike the Watson tail which has 2 separate horizontal stabilizers cantilever mounted over two pieces of 4130 steel tubing. It was found that building the Hornet tail similar to the Watson tail would have added a great deal of complexity and some unneeded weight to the entire assembly. The total surface area for the Hornet horizontal stabilizer is about 8.5 sq/ft.

The original intention for the construction of the tail feathers was to have the aerodynamic shapes hot-wire foam cut. But because of the difficulty in creating these shapes using the hot-wire method, I found that it was easier to make these surfaces from 1.5 to 2 inch thick foam board and then simply radius the leading and trailing edges by using a long, homemade sanding block with 60 grit sand paper attached. The sanding block that was used was fabricated from a leftover piece of 1 x 2 x .125 wall x 36 long aluminum tube. Three pieces of 60 grit sand paper were secured to the 2 inch wide surface of the tube using spray glue. This provided roughly 33 inches of sanding length. The excess sand paper was trimmed off at the edge of the tube making a 2 x 33 inch sized sanding block.

The design of the tail feathers is pretty much finalized. However, until Hornet 03-001 has been fully built and flown for some time, there is no way of telling if the tail feathers are adequate or correct. Therefore, the drawings provided for the tail feathers are for reference only. I strongly suggest that you NOT build these or any aircraft. The technique used to fabricate the Hornet tail feathers isn't any different that you might find from other sources. But with that said, as with any aircraft, aerodynamic shapes such as tail feathers require flight-testing to be fully proven and developed. This tail assembly has not flown and is not proven.

8.9.1 Tools

There are several different hand tools required to build the Hornet tail feathers. A few of which have been mentioned earlier in this document. The following tools are required to build the Hornet tail feathers; 1) dust mask or respirator, 2) safety glasses or goggles, 3) latex or vinyl examination gloves, 3) large tongue depressors, 4) disposable plastic drinking cups (size not smaller than 12 ounces), 5) 36" long sanding block (as mentioned earlier), 6) small sanding block with various sand paper grits, 7) hacksaw blade, 8) a retractable thin bladed knife (1.5 inch min. blade length preferred), 9) soft plastic squeegee (body filler style), 10) 2' x 4' work bench, 11) plastic drop sheeting (vapor barrier material), 12) epoxy and hardener (1 gallon kit), 13) 1-1/4 inch diameter hole saw, 14) electric hand drill, 15) various clamps (bar, squeeze, and "C" types), 16) fine tip permanent marker, 17) long straight edge (3 foot minimum, 6 foot maximum), 18) measuring device (decimal tape measure works best, but a fractional will also work), 19) an electronic calculator, 20) cotton flox (1 pound will do), 21) micro balloons (1 pound will do), 22) large wood rasp file, 23) Kevlar sheers, 24) style 120 Kevlar (6 yards Aircraft Spruce P/N 01-38100), 25) 1.45 oz/sq-yd E-Glass (6 yards Aircraft Spruce P/N 1080-50).

A drill press is very useful for this construction and it's assumed that you already have one because of the other parts in this documentation package, such as the airframe, which at a minimum, requires the use of a drill press. This list may be missing a couple of items so if there's anything else that you can think of, by all means, include them.

8.9.2 Construction Sequence

There are several steps required to build the Hornet tail feathers. None of these steps are all that difficult, but after awhile, they tend to become tedious and are somewhat labor intensive. Construction of the tail feathers requires the most craftsmanship of the entire Hornet. If you take your time, read all of the steps completely, and understand what the steps require, no one should have a problem with building a set of tail feathers.

The first step in constructing this tail is the easiest. Start by making all of the parts necessary for the construction of the tail feathers. You'll notice that some of the parts have features that are added after they have been bonded to the foam cores, and after they have been glassed over. This is done for structural reasons and must be followed to the letter.

8.9.3 Foam Cores

Of the entire construction, handling and shaping the foam core is the most difficult. You must have a light touch and be very careful not to ding the foam or else you're going to be spending a lot of time filling holes with micro balloons and epoxy.

8.9.3.1 Drawing and Cutting

Using a permanent marker, draw the outside profile of the piece you are going to be making directly onto the foam. Make sure you double check your measurements and make as few drawing mistakes (double lines) as possible. Make sure you draw the cut outs for the hard points. Once that's done, using a thin bladed knife, carefully cut outside (1/8 inch or so) of the lines you just drew. Do not cut out the foam for the hard points at this time. Don't try to cut through the entire piece of foam in one pass, because it'll only cause problems. The extra space you provided outside the lines will allow you to sand down to the finished size and shape.

8.9.3.2 Sanding

Once the foam core has been cut as specified above, any edges that are aerodynamic such as the leading edge of the vertical stab, and the leading and trailing edges of the horizontal stab, draw a reference line where this shape starts on the foam surface. All of the foam core drawings have dimensions showing the offset distance for these aerodynamic shapes. Typically, these dimensions are 3–6 inches inward from the outside profile. This reference line is to help you when sanding. You sand the aerodynamic shapes up to this line and no farther. Also, you can draw the aerodynamic profile on the end of the foam to provide even more sanding references for you to follow. Using the long sanding block, make long strokes along the edges of the foam until you have shaped the foam as per the drawings. There is going to be some areas that you will not be able to use the large sanding block. In these cases,

use a smaller sanding block and do the best you can. Use a small sanding block to radius any sharp corners as per the drawings. There should not be any square corners left on any of the foam cores. The Kevlar and fiberglass are not able to make sharp corners, so everything must have a generous radius.

8.9.3.3 Hard Points

Once you have the foam completely sanded, cut out the areas for the hard points. For the round hard points, use a 1-1/4 inch diameter hole saw. This would be a good use for the drill press. Fit all of the hard points into these cut outs. Don't go to fast and make the cutouts too big. Take your time and make the cutout fit the parts, but make the part shape match the foam. You don't want any step between the foam and the hard point if you can help it. If you have any step at all, make the hard point smaller than the foam. This will allow you to fill in the step and make everything smooth. Once you have the hard points fitted the way you want, bond them in using Elephant Snot. Wipe away any extra Elephant Snot that squeezes out and allow the piece to fully cure. Once cured, do any necessary filing or sanding to make the mating surfaces smooth.

8.9.3.4 Cutting the fabric

Unroll the Kevlar over one side of the foam. Position the fabric on the foam providing an over hang of about an inch or so. Cut the fabric around the parameter of the foam, maintaining the 1 inch over hang. You will need 2 pieces of Kevlar and 2 pieces of 1.45 oz fiberglass for each piece. Before you remove the fabric from the foam, using a straight edge and a permanent marker, draw reference lines on the fabric where the reference lines from the foam show through. When done, roll the fabric up without picking it up. Then carefully pick up the fabric and store it in a clean area for later use.

8.9.3.5 What to Watch Out For

There really is only one thing to watch out for when doing composites, and that is anything that can cause delamination. Grease, oils, dust or not enough epoxy can all promote delamination. Before you mix the first drop of epoxy and micro balloons, you must make sure the surface of the foam is clean. Careful handling and blowing off sanding dust is a must. You must not allow your fabrics to become contaminated with dust, oils, dirt, etc. Also, paper cups that have a wax coating must never be used for mixing any epoxy. The wax will contaminate the epoxy, prevent proper adhesion and will greatly weaken the structure. Just for reference, wax is sometimes used as a mold release agent in composites when a mold is used. When adding epoxy to your fabrics, you should see the fabric become semi-translucent when enough epoxy is applied. If you see areas that look silvery in color, then you need to add epoxy to these areas and squeegee them out.

8.9.3.6 First layer

There's one tool that you will need that I didn't mention. You will need a small platform to set your foam core on so that you can roll the layer of Kevlar/fiberglass under the edge. You can make this using a piece of foam that is smaller than the foam part you are going to glass. Tape on a layer of plastic over this smaller piece of foam so that epoxy will not stick to it. Tape this platform down to your work surface so that it doesn't move around.

Set the piece to be covered on top of the platform. Using a mixture of (roughly) 40% micro balloons and 60% epoxy, pour a small amount onto the top surface of the foam and spread with a squeegee. This layer of balloons and epoxy is for filling in any dents or holes that there may be. Also, polystyrene foam is somewhat porous and will soak up epoxy if not sealed. The micro balloons and epoxy will also seal the foam so that the epoxy will not be absorbed into the foam causing the piece to become heavier than it needs to be.

While the balloons and epoxy are still wet, carefully place one piece of the Kevlar fabric that was previously cut onto the wet foam surface. Make sure you line up the reference lines best you can by gently pulling on the edges of the fabric. Once this is done, using straight epoxy, pour a silver dollar sized spot in the middle of the foam panel. Using a squeegee, very lightly spread the epoxy out from the center of the panel. Add more epoxy where necessary. At this point, all you are trying to do is get all of the fabric saturated with epoxy. This process is called "wetting out". It will take a little while for the fabric to become saturated so take your time and don't get into a hurry. You will have to pull the 1 inch over hang under the foam panel and make sure that it sticks to the under side of the foam. You should have at least 20 minutes of working time before the epoxy starts to thicken up. You need to have everything wetted out, have the fabric in its final location and laid flat all the way to the edge within about 10 to 15 minutes.

Once everything is loaded with epoxy, starting from the middle of the panel, squeegee the fabric with a little more pressure. At this stage, you're trying to remove any excess epoxy so you don't have to sand as much. This will also help to keep the weight down. Allow this panel to fully cure. Some people use a product called "Peel Ply" at this stage to smooth out the area where the Kevlar or fiberglass ends. Peel Ply comes in the form of a tape and is applied over the edge of the fabric. It is squeegeed down and will remain there till the epoxy has cured. The Peel Ply will not stick to the epoxy and can be easily removed after curing.

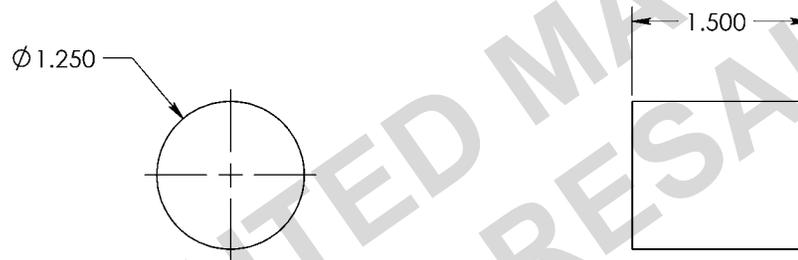
Once cured, remove the Peel Ply. Very little if any sanding will be required along the edge where Peel Ply was used. Sand if necessary, flip the panel over and repeat the process using the second piece of Kevlar.

8.9.3.7 Second Layer

Once you have both layers of Kevlar applied and they are fully cured, you can sand down any epoxy drips or rough spots. Where the last layer of Kevlar ends, you will have a rough spot if you didn't use Peel Ply. Try to sand the rough areas down best you can. You will not be able to get a perfectly smooth finish with the Kevlar. If you make contact with the Kevlar during sanding, you will begin to see fuzz on the panel surface. Don't sand these spots any more than you have to. You will be fighting a losing battle if you try to sand the Kevlar to remove the fuzz.

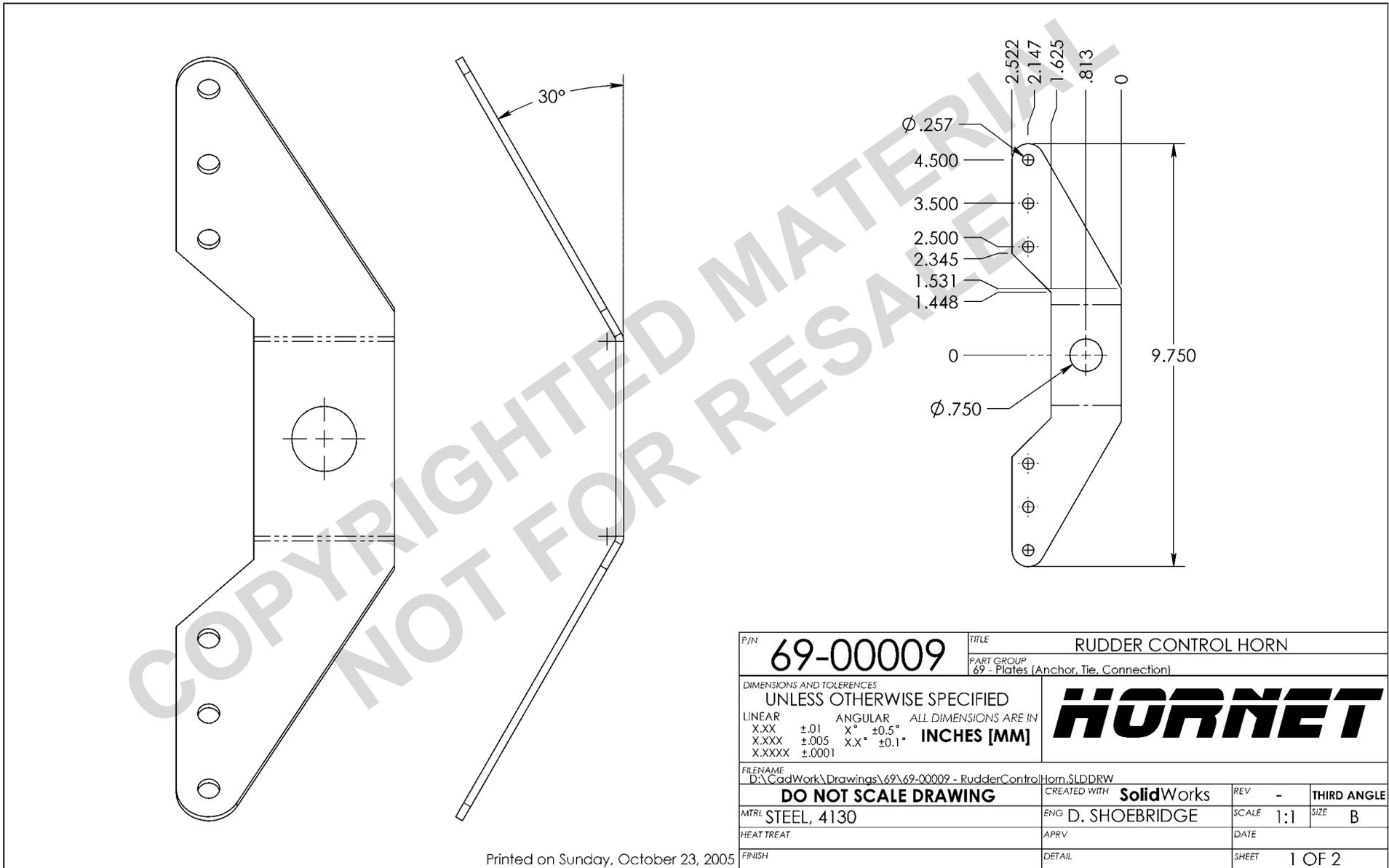
Once the sanding is complete, you can add your fiberglass layer. It is not necessary to add a micro balloon and epoxy layer between the Kevlar and fiberglass. The only time micro balloons are needed is if there are holes and dents in the Kevlar layer. Using the same technique as above, wet out the fiberglass using straight epoxy. Allow this layer of fiberglass to fully cure before covering the other side in the same manner.

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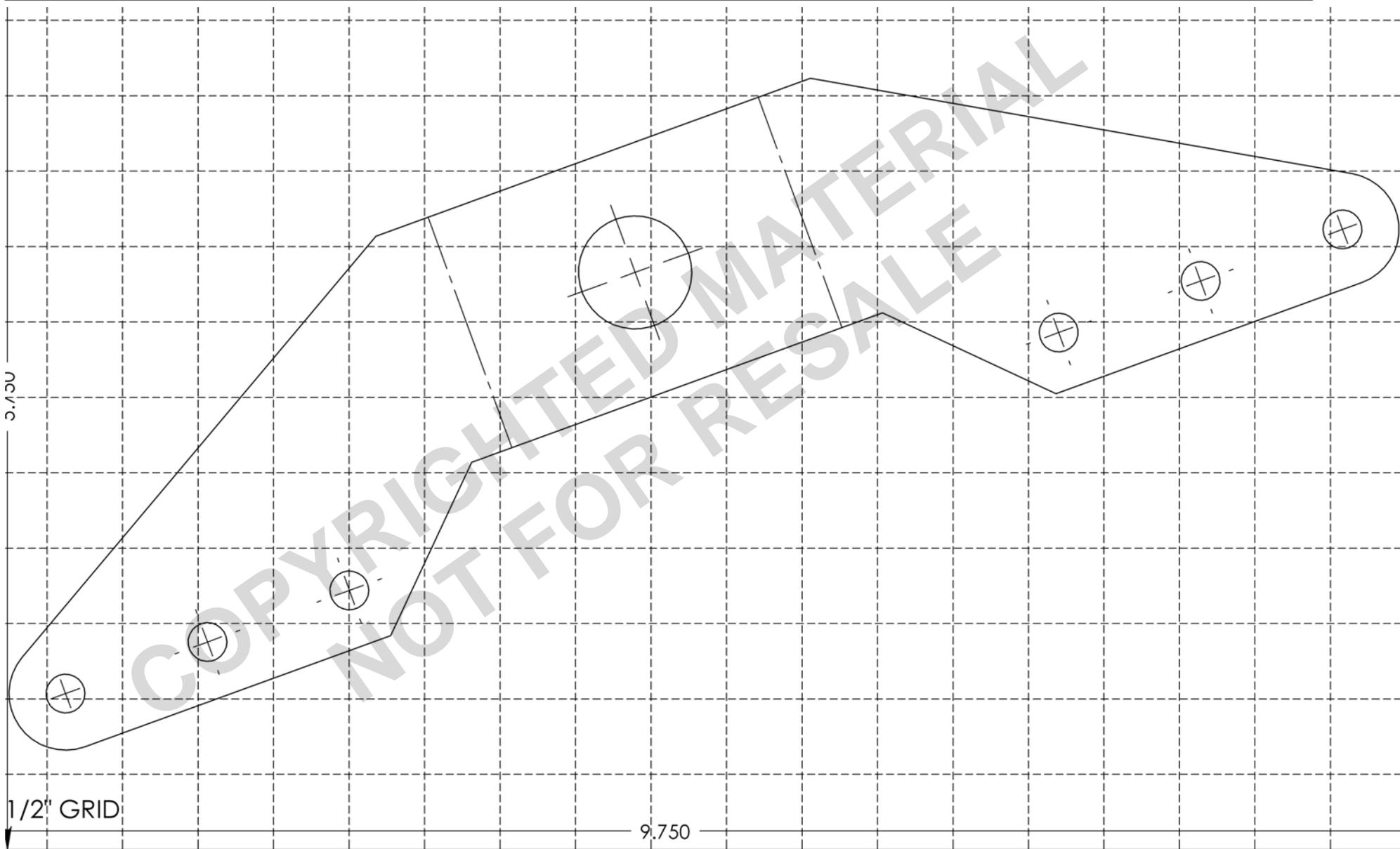
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		PART GROUP 46 - Wood and Paper Products	
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HEAT TREAT	APRV	DATE	
FINISH	DETAIL	SHEET	1 OF 1

Printed on Sunday, October 23, 2005



P/IN	69-00009	TITLE	RUDDER CONTROL HORN		
		PART GROUP	69 - Plates (Anchor, Tie, Connection)		
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	X.XXXX ±.0001				
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HEAT TREAT		APRV		DATE	
FINISH		DETAIL		SHEET	1 OF 2
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Printed on Sunday, October 23, 2005



69-00009

THIS DRAWING INTENDED FOR TRACE CUTTING FLAT PARTS

RUDDER CONTROL HORN

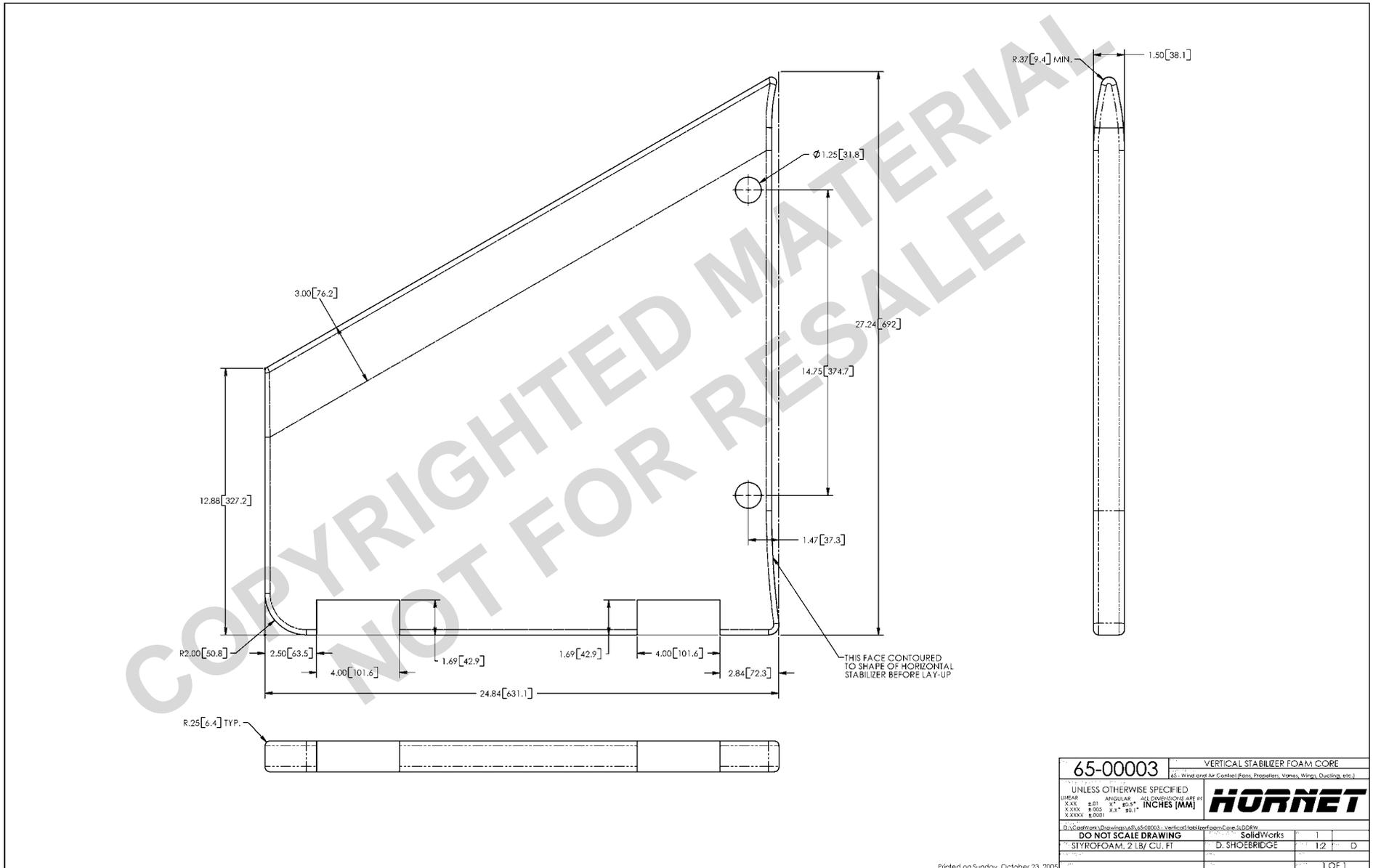
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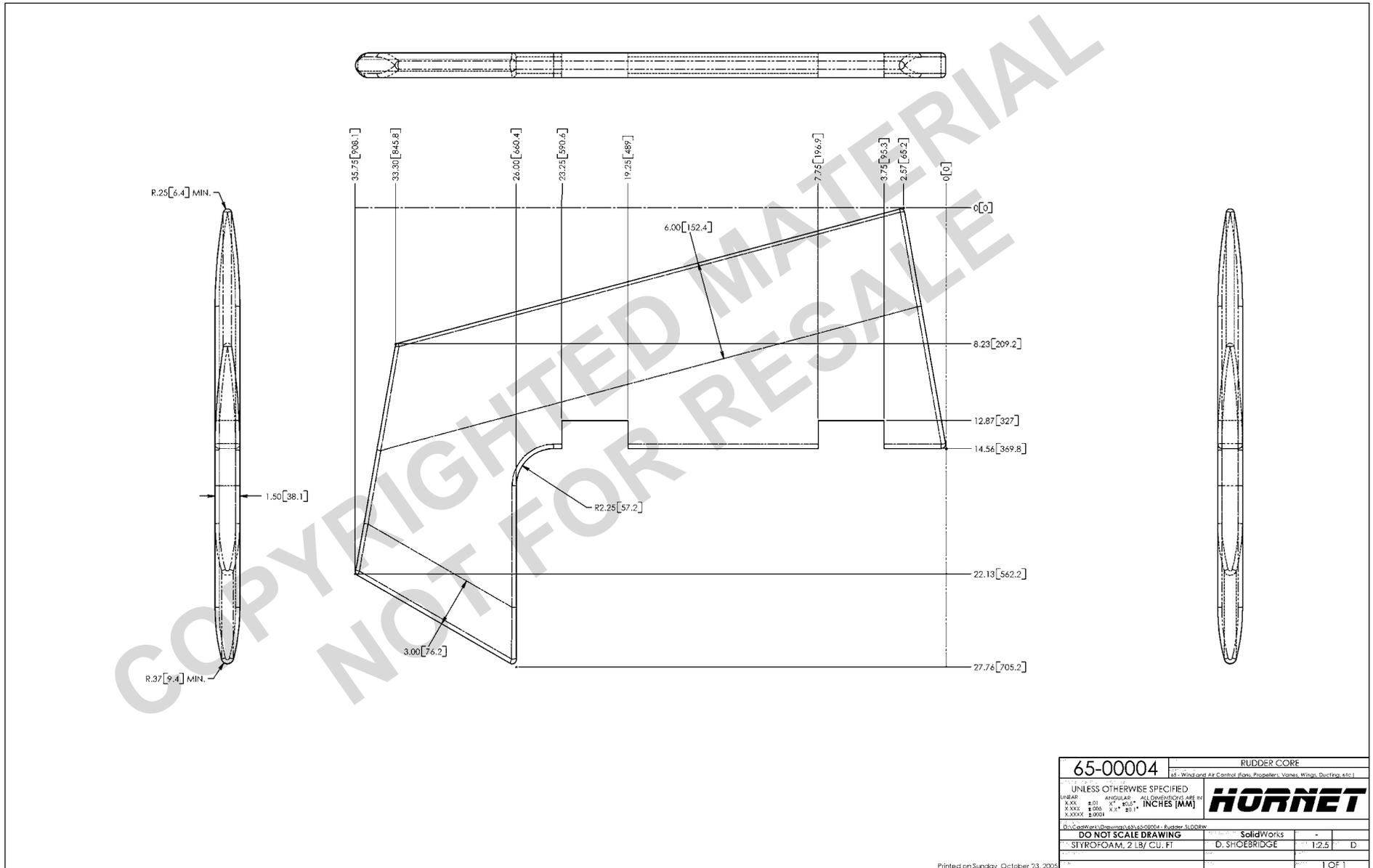
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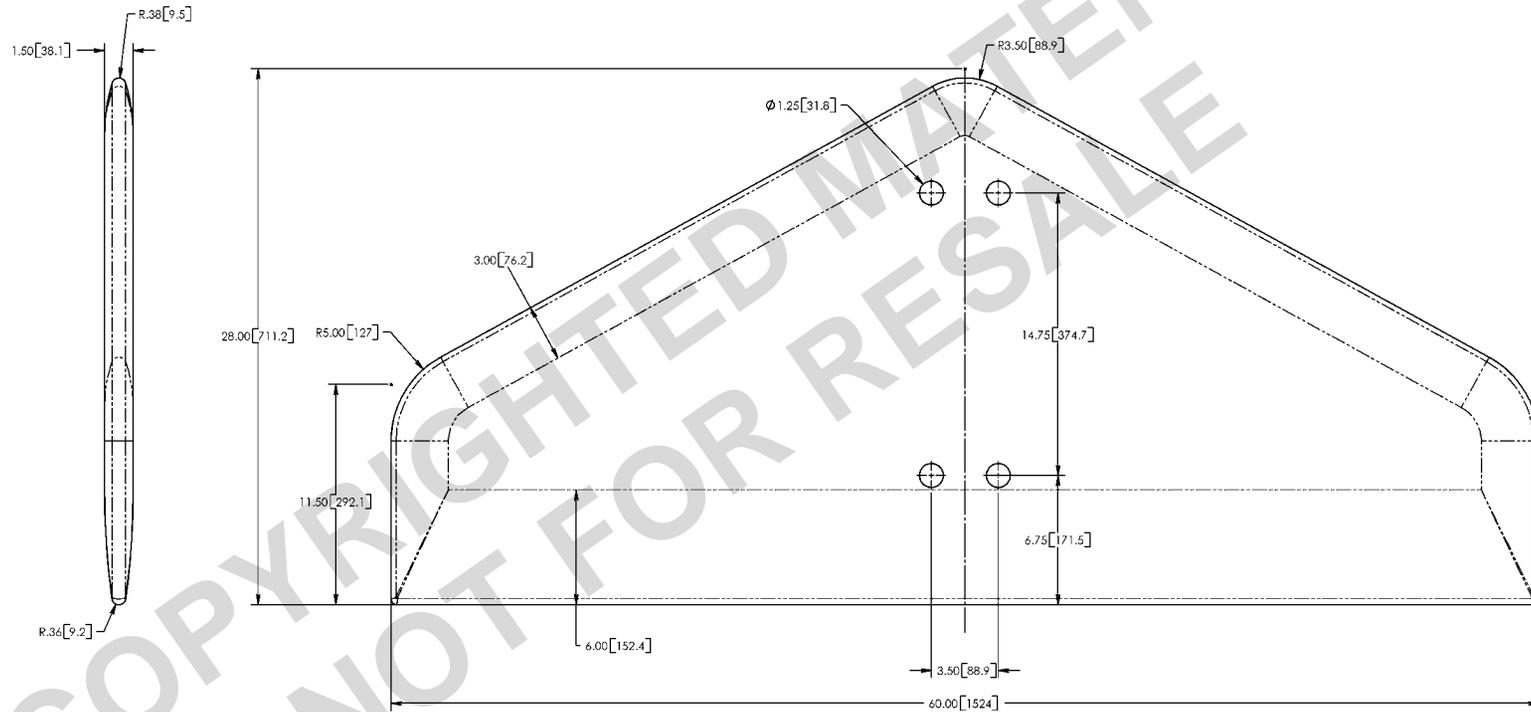


P/N 46-00002		TITLE HINGE HARDPOINT	
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FINISH	DETAIL	DATE	SHEET 1 OF 1

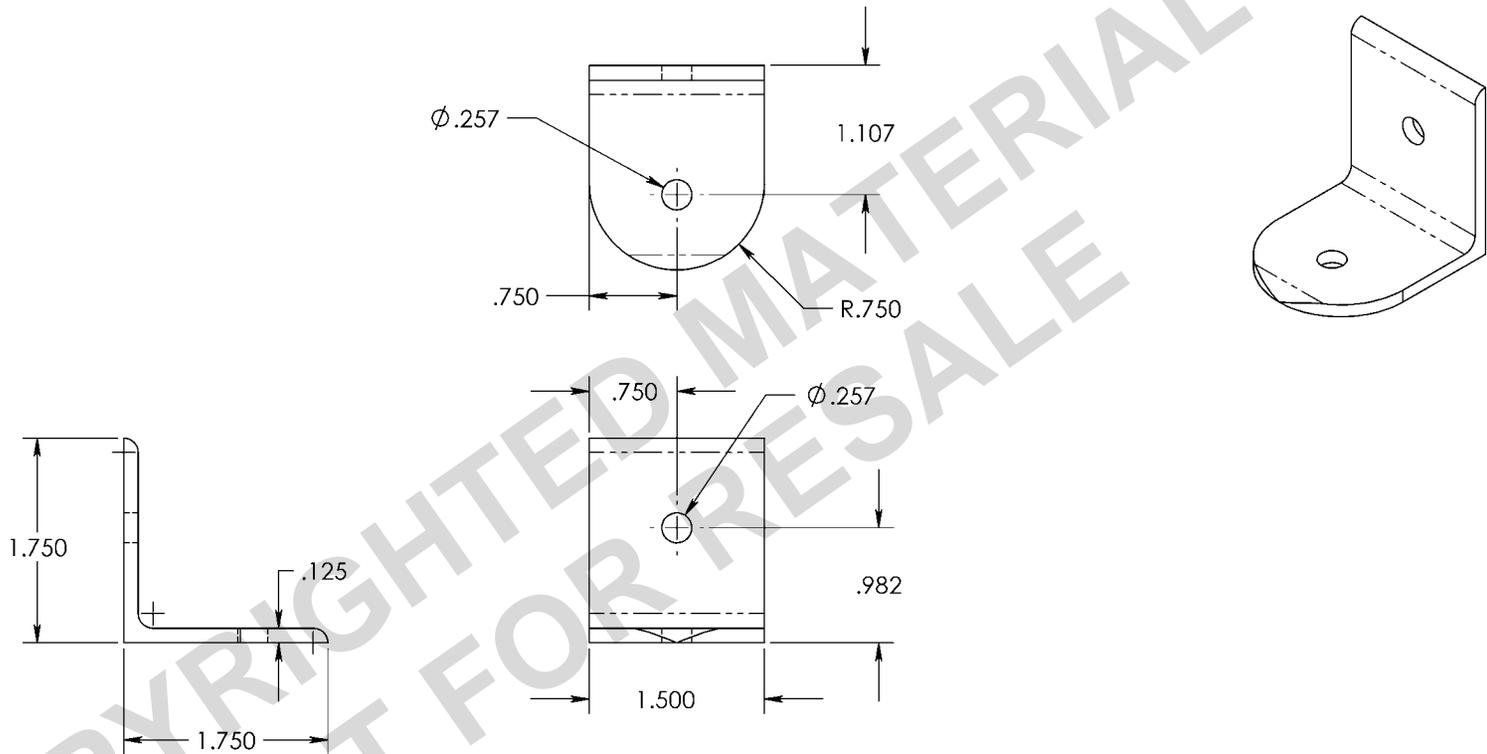
Printed on Sunday, October 23, 2005





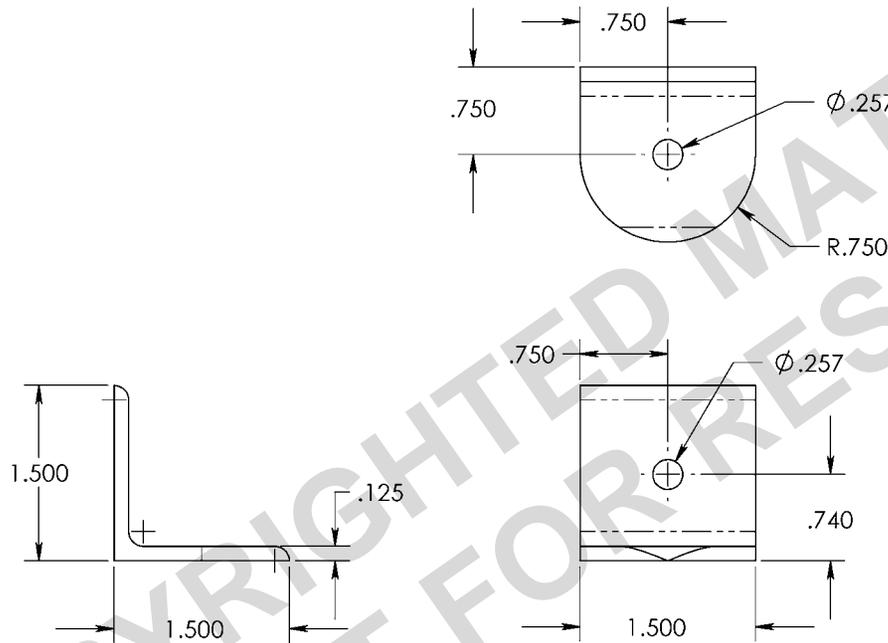


65-00007		HORIZONTAL STABILIZER	
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X.XXX	XX°	INCHES	
X.XXXX	XX°	INCHES	
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STYROFOAM, 2 LB/ CU. FT		D. SHOEBRIDGE	1:3 D
Printed on Saturday, October 22, 2005		1 OF 1	



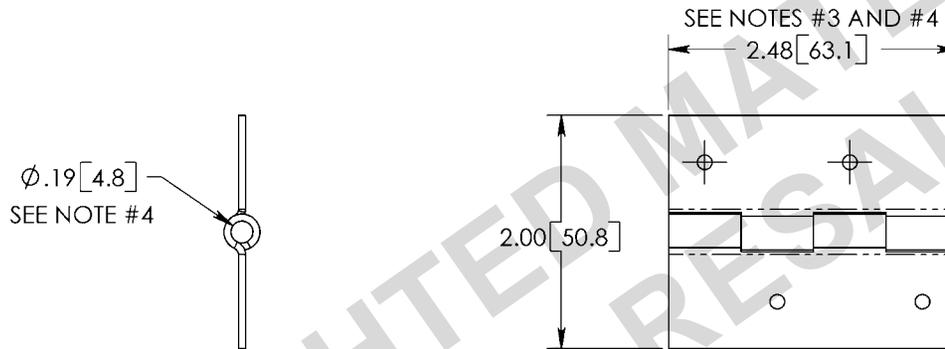
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PART GROUP 70 - Bracing, Supports, Frames, And Brackets				
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ALL DIMENSIONS ARE IN INCHES [MM]				
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HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 1	

Printed on Sunday, October 23, 2005



P/N 70-00063		TITLE TAIL FEATHER MOUNT BRACKET		
PART GROUP 70 - Bracing, Supports, Frames, And Brackets				
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HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 1	

Printed on Sunday, October 23, 2005



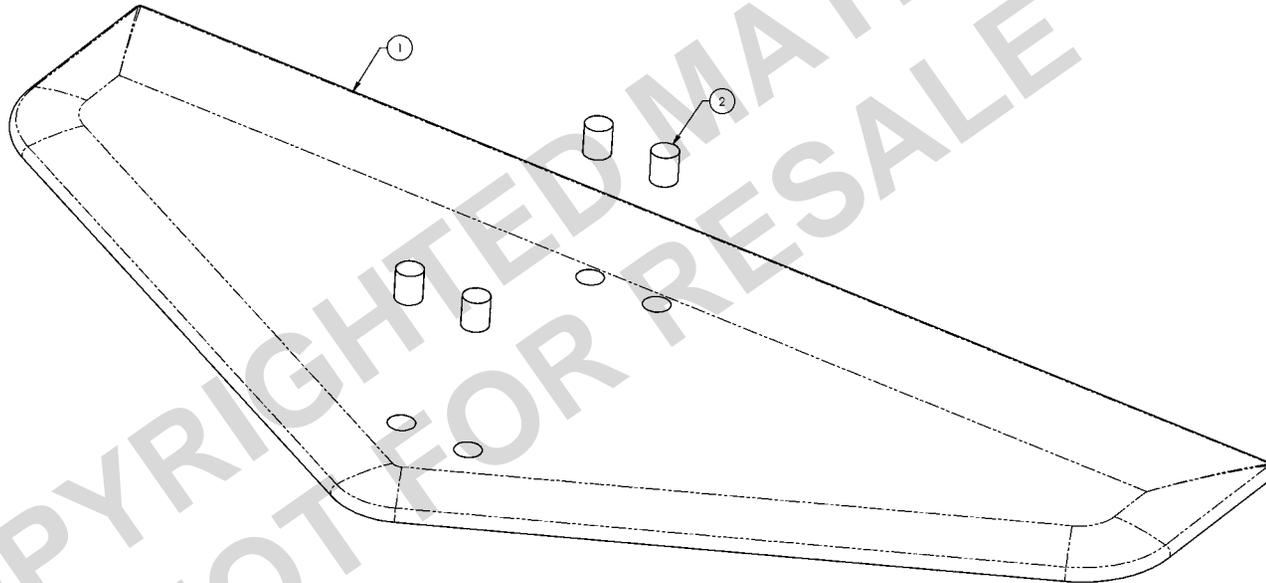
NOTES:

1. HINGE SUPPLIED BY McMASTER-CARR IN 72" LENGTHS. (P/N 11555A22)
2. EQUIVALENT HINGE SUBSTITUTES ARE ALLOWED.
3. DIMENSION NOT CRITICAL. HOWEVER, INSURE THAT THERE IS AT LEAST TWO LOOPS OF HINGE ON EACH SIDE.
4. CENTER ROD OF HINGE MUST BE SHORTER THEN OVERALL LENGTH OF HINGE. AT TIME OF FINAL ASSEMBLY, END LOOPS OF HINGE MUST BE CRIMPED CLOSED TO RETAIN HINGE PIN.

Printed on Sunday, October 23, 2005

P/N 72-00001		TITLE CONTINUOUS HINGE		
PART GROUP 72 - Hinges and Pivots		HORNET		
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X.XXX ±.005	X.X° ±0.1°			
X.XXXX ±.0001				
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MTRL -	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET	1 OF 1	

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	65-00007	HORIZONTAL STABILIZER
2	4	46-00001	HARDPOINT PLUG



NOTES: UNLESS OTHERWISE SPECIFIED
 1. BOND IN HARDPOINT PLUG USING FLOX AND EPOXY JUST PRIOR TO COVERING FOAM WITH KEVLAR/FIBERGLASS AND EPOXY.
 2. HARDPOINT PLUGS MUST BE FLUSH OR SLIGHTLY BELOW FLUSH WITH FOAM CORE SURFACE. USE FLOX AS A FILLER TO MAKE AREA OVER PLUG FLUSH WITH FOAM SURFACE.

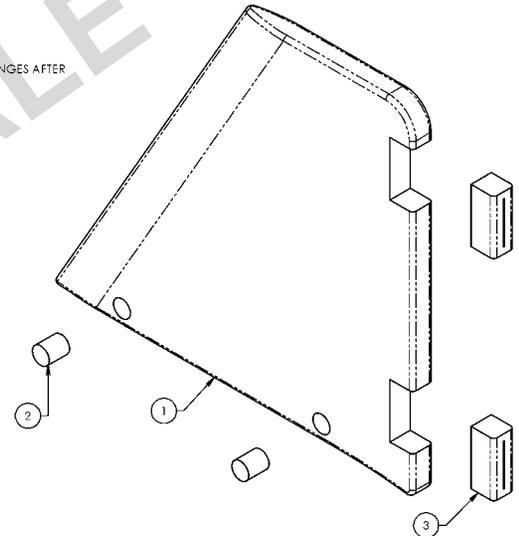
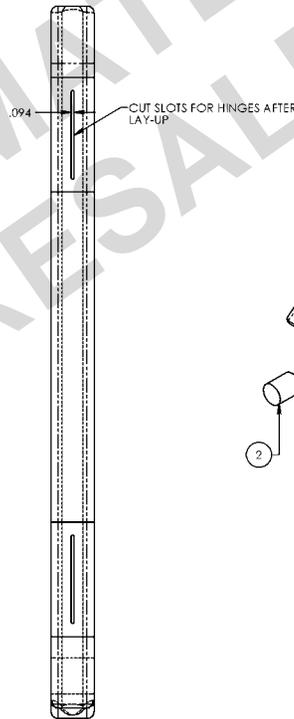
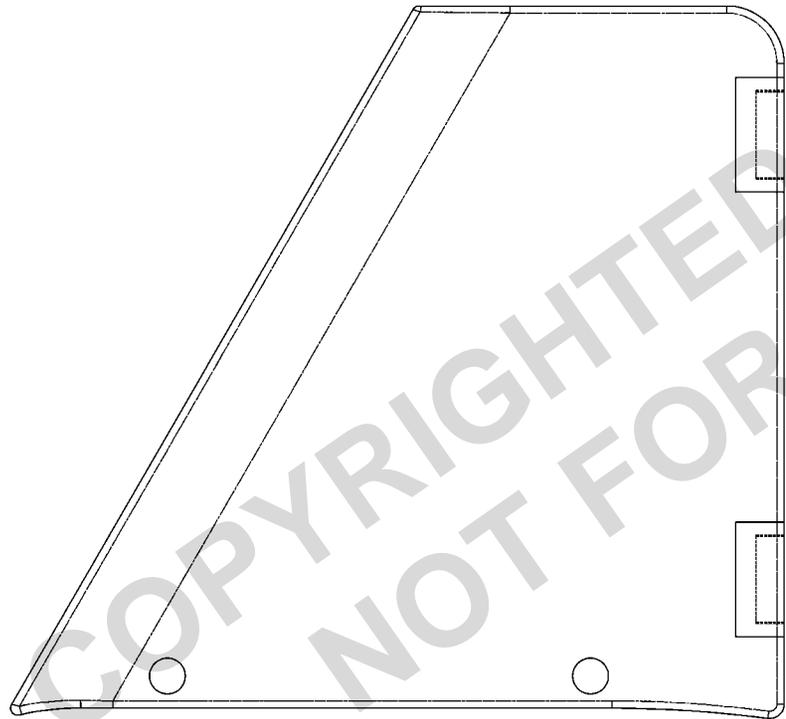
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65-00006		HORIZONTAL STABILIZER	
UNLESS OTHERWISE SPECIFIED		AS - Wind Turb Air Control Plans, Propellers, Voms, Wings, Ducting, etc.	
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN	HORNET
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X.XXX	#05	INCHES (MM)	
X.XXXX	#001	INCHES (MM)	
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DO NOT SCALE DRAWING		SolidWorks	
Author	D. SHOEBRIDGE	Scale	1:2.5 D
Sheet		Page	1 OF 1

Printed on Saturday, October 22, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	65-00003	VERTICAL STABILIZER FOAM CORE
2	2	46-00001	HARDEPOINT PLUG
3	2		

REV.	ECN#	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	25104-03	ADDED FOAM SPACERS		13-Jun-04		13-Jun-04
2	44105-01	REDESIGNED TAIL VERTICAL STAB	DTS	23-Oct-05	DTS	23-Oct-05

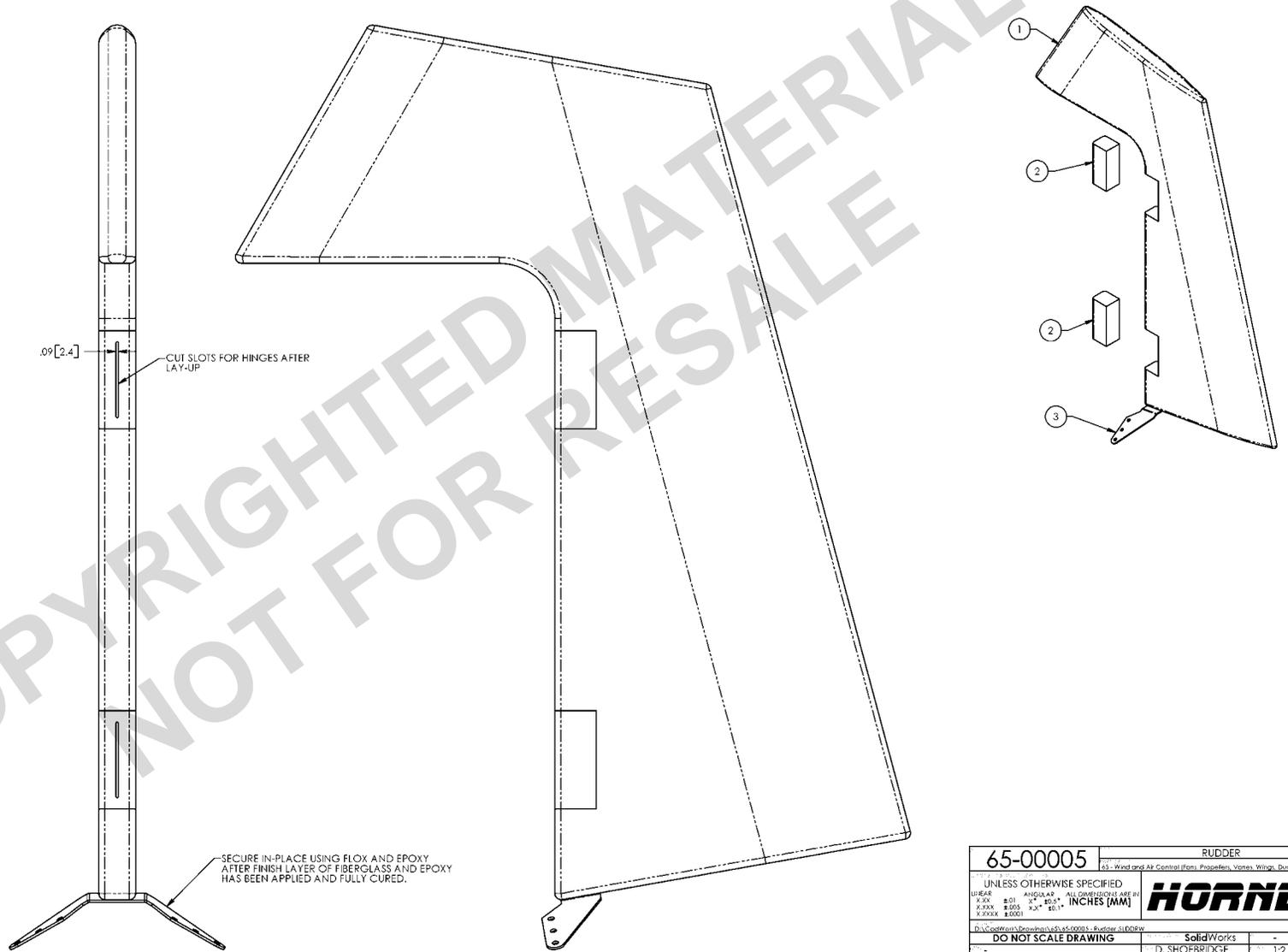


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65-00002		VERTICAL STABILIZER	
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X.XXX	#05	X.XX	
X.XXXX	#001	X.XX	
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DO NOT SCALE DRAWING		2	
		D. SHOEBRIDGE	1:2 D
			1 OF 1

Printed on Sunday, October 23, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
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2	2	66-00002	HINGE HARDPOINT
3	1	69-00009	RUDDER CONTROL HORN

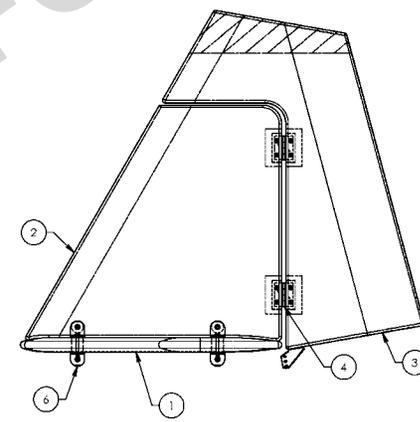
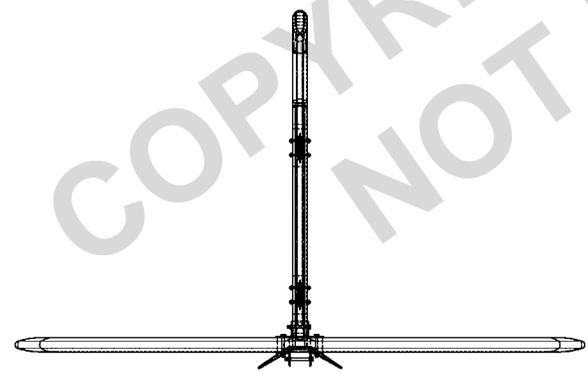
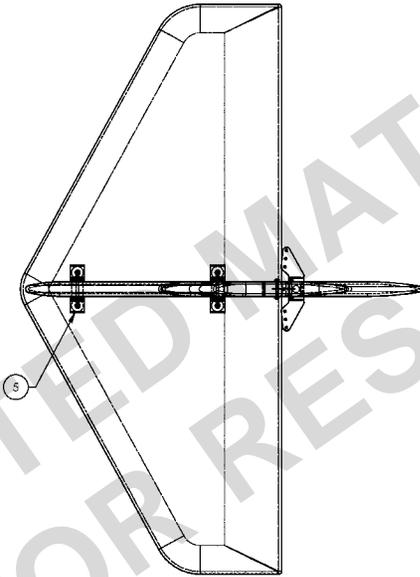
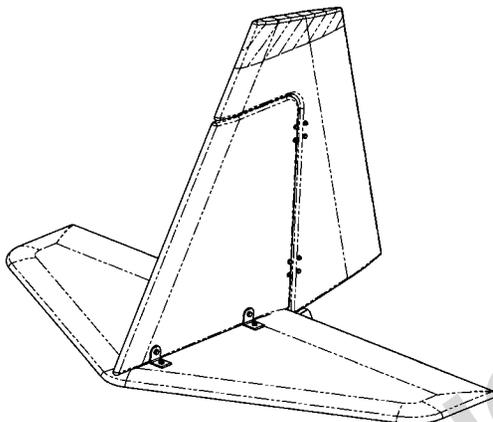


65-00005		RUDDER	
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X.XXX	#.005	X.XX" ±.01"	
X.XXXX	#.0001	X.XXX" ±.001"	
D:\C:\Program Files\SolidWorks\65-00005 - Rudder.rld (DWG)			
DO NOT SCALE DRAWING		SolidWorks	
		D. SHOEBRIDGE	1:2 D
		1 OF 1	

Printed on Sunday, October 23, 2005

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	65-00006	HORIZONTAL STABILIZER
2	1	65-00002	VERTICAL STABILIZER
3	1	65-00005	RUDDER
4	2	72-00001	CONTINUOUS HINGE
5	4	70-00062	VERTICAL STAB MOUNT BRACKET
6	4	70-00063	TAIL FEATHER MOUNT BRACKET
7	16	27-00002	AN960-416 WASHER
8	6	26-00092	AN4-22A BOLT
9	2	26-00096	AN4-26A BOLT
10	8	26-00014	NUT MS21042-4 (1/4-28)
11	16	27-00012	AN960-10 WASHER
12	8	26-00006	AN3-17A BOLT
13	8	26-00013	NUT MS21042-3 (10-32)

REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	14104-02	CHANGED NUT FROM MS17825-4 TO MS21042-4	DTS	28-Mar-04	DTS	28-Mar-04
2	44105-01	REDESIGNED TAIL FEATHERS	DTS	23-Oct-05	DTS	23-Oct-05



FINAL ASSEMBLY SEQUENCE NOTES

- 1) BOLT TAIL FEATHER MOUNT BRACKET 70-00063 TO TAIL BOOM OF AIRFRAME.
- 2) LOCATE HORIZONTAL STABILIZER 65-00006 TO TAIL FEATHER MOUNT BRACKETS 70-00063 SO THE BOLT HOLES PASS AS CLOSE AS POSSIBLE TO CENTER OF HARD POINT PLUGS. ALLOW HORIZONTAL STABILIZER 65-00006 TO LAY FLUSH ON TOP OF TAIL BOOM. MAKE SURE HORIZONTAL STABILIZER IS SQUARE AND CENTERED TO TAIL BOOM.
- 3) TRANSFER HOLES OF TAIL FEATHER MOUNT BRACKETS 70-00063 TO BOTTOM SURFACE OF HORIZONTAL STABILIZER 65-00006.
- 4) USING A DRILL PRESS, DRILL FOUR .264" DIAMETER HOLES THRU HARDPOINT PLUGS IN HORIZONTAL STABILIZER 65-00006.
- 5) BOLT HORIZONTAL STABILIZER 65-00006 AND VERTICAL STAB MOUNT BRACKET 70-00062 TO TAIL FEATHER MOUNT BRACKETS 70-00063 AS SHOWN.
- 6) LOCATE VERTICAL STABILIZER 65-00002 BETWEEN VERTICAL STAB MOUNT BRACKET 70-00062 - BEST POSSIBLE ALIGNMENT WITH HORIZONTAL STABILIZER 65-00006 AND HARDPOINT PLUGS IN VERTICAL STABILIZER 65-00002. USE SQUEEZE CLAMPS TO HOLD VERTICAL STABILIZER 65-00002 IN PLACE.
- 7) TRANSFER HOLES OF VERTICAL STAB MOUNT BRACKET 70-00062 TO VERTICAL STABILIZER 65-00002 FROM ONE SIDE ONLY.
- 8) USING A DRILL PRESS, DRILL TWO .264" DIAMETER HOLES THRU VERTICAL STABILIZER 65-00002.
- 9) BOLT VERTICAL STABILIZER IN PLACE
- 10) INSTALL CONTINUOUS HINGE 72-00001 INTO RUDDER 65-00005. USE A SINGLE .190 DIAMETER ROD THRU BOTH CONTINUOUS HINGES TO INSURE ALIGNMENT.
- 11) USING A DRILL PRESS, DRILL FOUR .195" DIAMETER HOLES THRU HINGE HARDPOINTS IN RUDDER 65-00002 AND THRU CONTINUOUS HINGE 72-00001.
- 12) BOLT CONTINUOUS HINGES 72-00001 INTO RUDDER 65-00005 AS SHOWN.
- 13) USING A 1/4" THICK SPACER LOCATED ON TOP SURFACE OF VERTICAL STABILIZER 65-00002, INSTALL RUDDER 65-00005 AND CONTINUOUS HINGE 72-00001 ASSEMBLY INTO VERTICAL STABILIZER 65-00002. USE SCRAP WOOD AND SQUEEZE CLAMPS TO HOLD IN PLACE.
- 14) MARK VERTICAL STABILIZER 65-00002 FOR DRILLING. DRILLED HOLES MUST PASS THRU CONTINUOUS HINGES 72-00001.
- 15) REMOVE RUDDER 65-00005 AND CONTINUOUS HINGE 72-00001 ASSEMBLY FROM VERTICAL STABILIZER 65-00002.
- 16) REMOVE VERTICAL STABILIZER 65-00002 FROM VERTICAL STAB MOUNT BRACKETS 70-00062.
- 17) USING A DRILL PRESS, DRILL FOUR .195" DIAMETER HOLES THRU VERTICAL STABILIZER 65-00002.
- 18) REINSTALL VERTICAL STABILIZER 65-00002 BETWEEN VERTICAL STAB MOUNT BRACKET 70-00062.
- 19) USING A 1/4" THICK SPACER LOCATED ON TOP SURFACE OF VERTICAL STABILIZER 65-00002, REINSTALL RUDDER 65-00005 AND CONTINUOUS HINGE 72-00001 ASSEMBLY.
- 20) TRANSFER HOLES DRILLED IN VERTICAL STABILIZER HINGE HARDPOINTS TO THE CONTINUOUS HINGES 72-00001.
- 21) REMOVE CONTINUOUS HINGES 72-00001 AND DRILL .195" DIAMETER HOLES WHERE MARKED.
- 22) INSTALL NORMAL HINGE PINS INTO CONTINUOUS HINGES 72-00001 AND CRIMP HINGE TO RETAIN PIN.
- 23) INSTALL CONTINUOUS HINGES 72-00001 BETWEEN RUDDER 65-00005 AND VERTICAL STABILIZER 65-00002.

65-00001		TAIL STABILIZATION GROUP	
65 - Wind and Air Control Fins, Propellers, Vanes, Wings, Ducting, etc.			
UNLESS OTHERWISE SPECIFIED		HORNET	
LINEAR X.XX #01	ANGULAR X.XX #01	AS DIMENSIONS ARE BY X.XX #005 X.XX #01"	INCHES (MM)
D:\C:\Programs\Drawings\65-00001 - Tail\TailStabilizationGroup.SLDPRW			
DO NOT SCALE DRAWING		SolidWorks	2
D. SHOEBRIDGE		1:6	D
			1 OF 1

Printed on Sunday, October 23, 2005

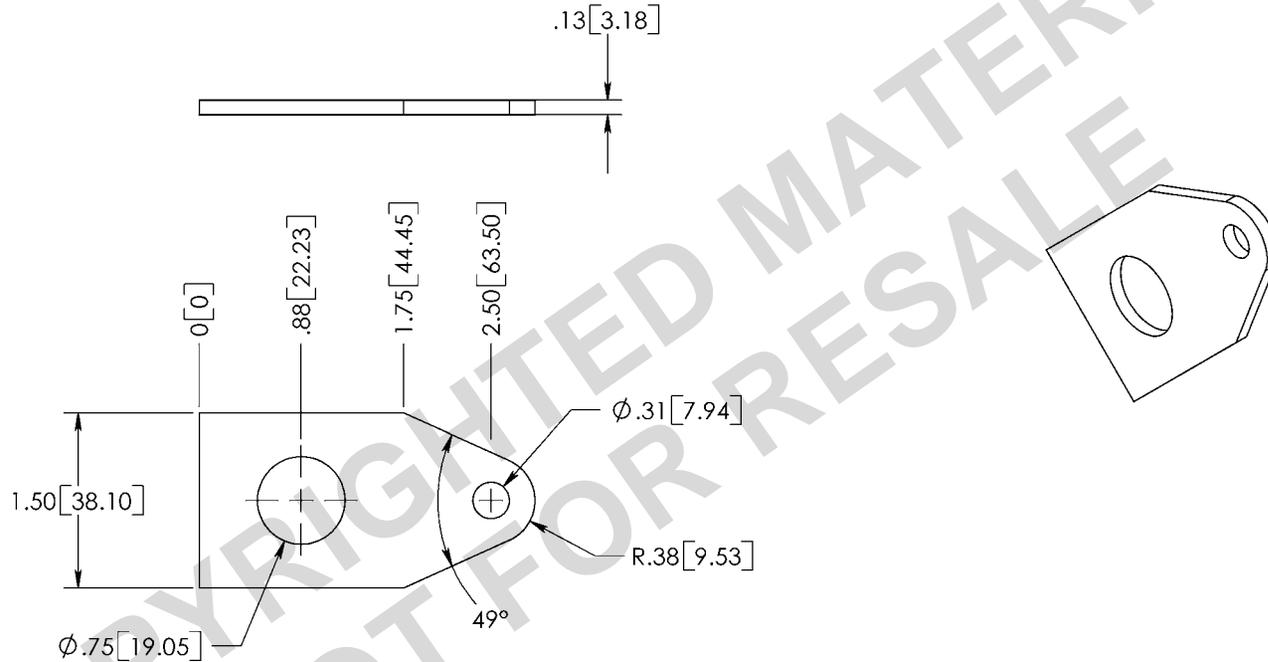
8.10 Fuel Tank

One of the simplest, and yet, one of the most time-consuming designs on the Hornet has been the fuel tank. Early on, I wanted to have an aerodynamic shape to the tank, and I wanted to try and minimize the CG swing of the Hornet as fuel was burned off. Also, in an effort to find a simple and cheap way to manufacture the tank, the design kept changing. I have changed the fuel tank design so many times over the course of this design that, frankly, I was becoming tired of looking at it. I had been focusing on one specific method of fabrication for the fuel tank - Kevlar over foam. I figured that the foam could then be melted out after the wet-lay-up process, leaving a Kevlar shell. Other previous ideas have been to vacuum or blow mold the tank as needed, which is a very expensive option in low quantities. I also played with the idea of making the fuel tank out of welded aluminum. Here again, too complicated and expensive.

To simplify the installation of a fuel tank on the Hornet, a purchased fuel tank will be used. I started out by using a GT400 fuel tank. The GT400 fuel tank is also the same tank that is used on the GyroBee. Like the GyroBee, I wanted to use a similar method of mounting the fuel tank to the Hornet, that being bungee cords. But one major difference between the Hornet and GyroBee is the use of a plywood composite mounting shelf. The frame that is used to hold the fuel tank on the GyroBee is made of individual aluminum pieces and then bolted together. The location of the Hornet is similar to the GyroBee - directly underneath the engine mounts, just aft of the mast.

A second option for fuel is to use two 2-1/2 gallon plastic portable fuel cans. They are very inexpensive and are easy to find. Just about any hardware store will have them. For those that want more endurance, two 5 gallon tanks can be used. Whatever configuration chosen to be used, the fuel tank mount plate can hold all three of the different tank styles.

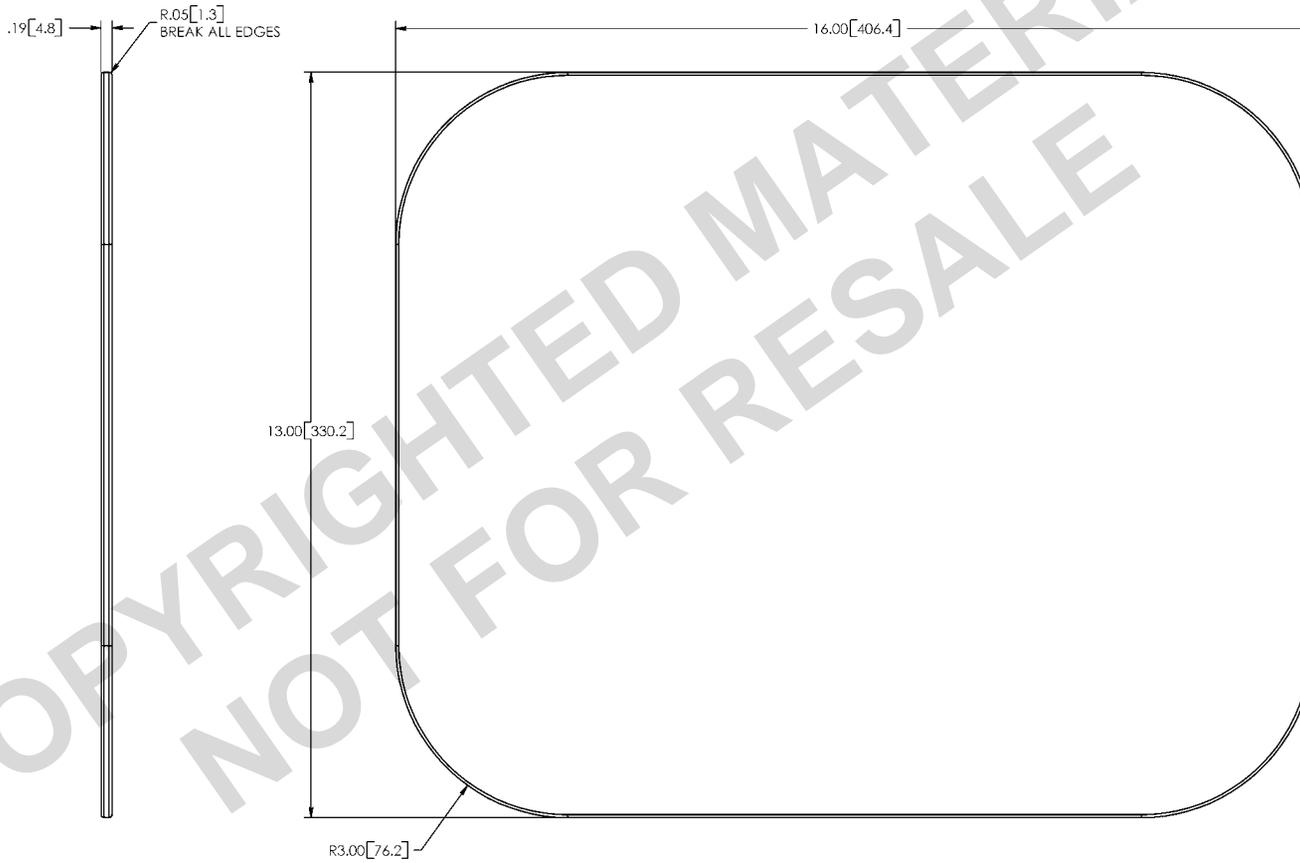
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	38705-01	REDUCED HOLE SIZE	DTS	17-Sep-05	DTS	17-Sep-05



P/N 69-00005		TITLE FUEL TANK BUNGEE ANCHOR		
PART GROUP 69 - Plates (Anchor, Tie, Connection)				
DIMENSIONS AND TOLERANCES UNLESS OTHERWISE SPECIFIED				
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN INCHES [MM]		
X.XX ±.01	X° ±0.5°			
X.XXX ±.005	X.X° ±0.1°			
X.XXXX ±.0001				
FILENAME D:\CadWork\Drawings\69\69-00005 - FuelTankBungeeAnchor.SLDDRW				
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV 1	THIRD ANGLE
MTRL ALUMINUM, 6061-T6	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B	
HEAT TREAT	APRV	DATE		
FINISH	DETAIL	SHEET 1 OF 1		

Printed on Saturday, September 17, 2005

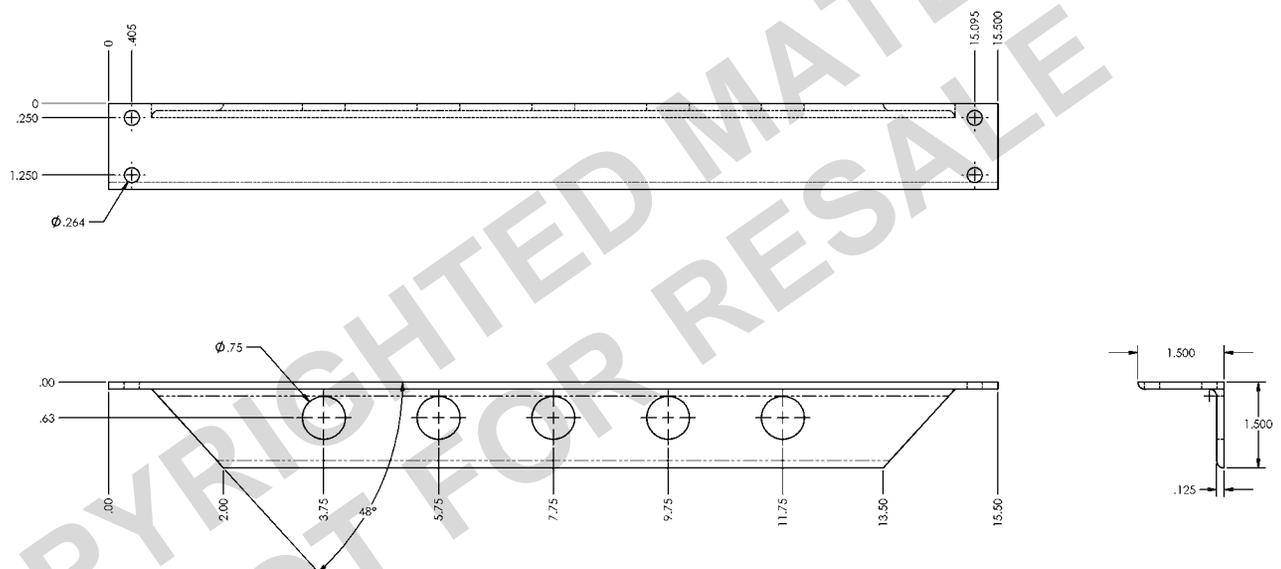
REV.	ECN #	DESCRIPTION	CHG BY	CHG DATE	APRV BY	APRV DATE
1	38705-01	REDESIGNED PART TO USE PLYWOOD	DTS	17-Sep-05	DTS	17-Sep-05



UNLESS OTHERWISE SPECIFIED:
1) SEE HORNET DOCUMENTATION FOR FABRICATION DETAILS.

70-00033		FUEL TANK MOUNT PLATE	
UNLESS OTHERWISE SPECIFIED		70 - Brackets, Supports, Frames, And Brackets	
LINE#	QUANTITY	UNIT	DESCRIPTION
X,XXX	#01	INCHES [MM]	HORNET
X,XXX	#05	INCHES [MM]	
X,XXX	#001	INCHES [MM]	
D:\CadWorks\Projects\70_70-00033 - FuelTankMountPlate.SLDRAW			
DO NOT SCALE DRAWING		SolidWorks	1
BIRCH PLYWOOD	D. SHOEBRIDGE	1:1	D
		1 OF 1	

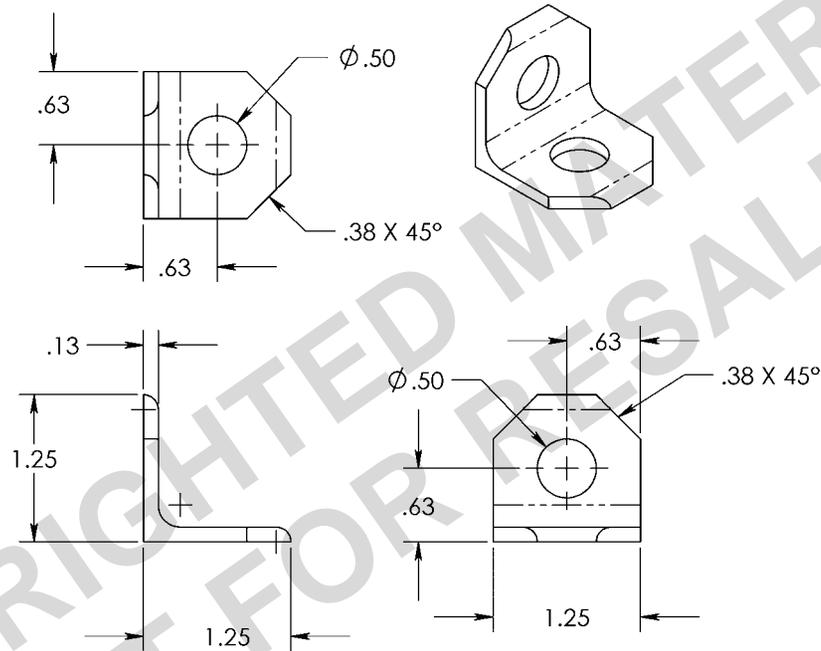
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70-00053		FUEL TANK MOUNT RAIL	
UNLESS OTHERWISE SPECIFIED		70 - Bracing, Supports, Frames, And Brackets	
FINISH	ANGLE	HORNET	
X.XX ±.01	2" ±.01" INCHES (MM)		
X.XXX ±.005	0.1" ±.001"		
X.XXXX ±.0001	0.001"		
Fuel Tank Mount Rail 11/00/06			
DO NOT SCALE DRAWING	SolidWorks		
ALUMINUM, 6061-T6	D. SHOEBRIDGE	1:1	D
			1 OF 1

Printed on Saturday, September 17, 2005



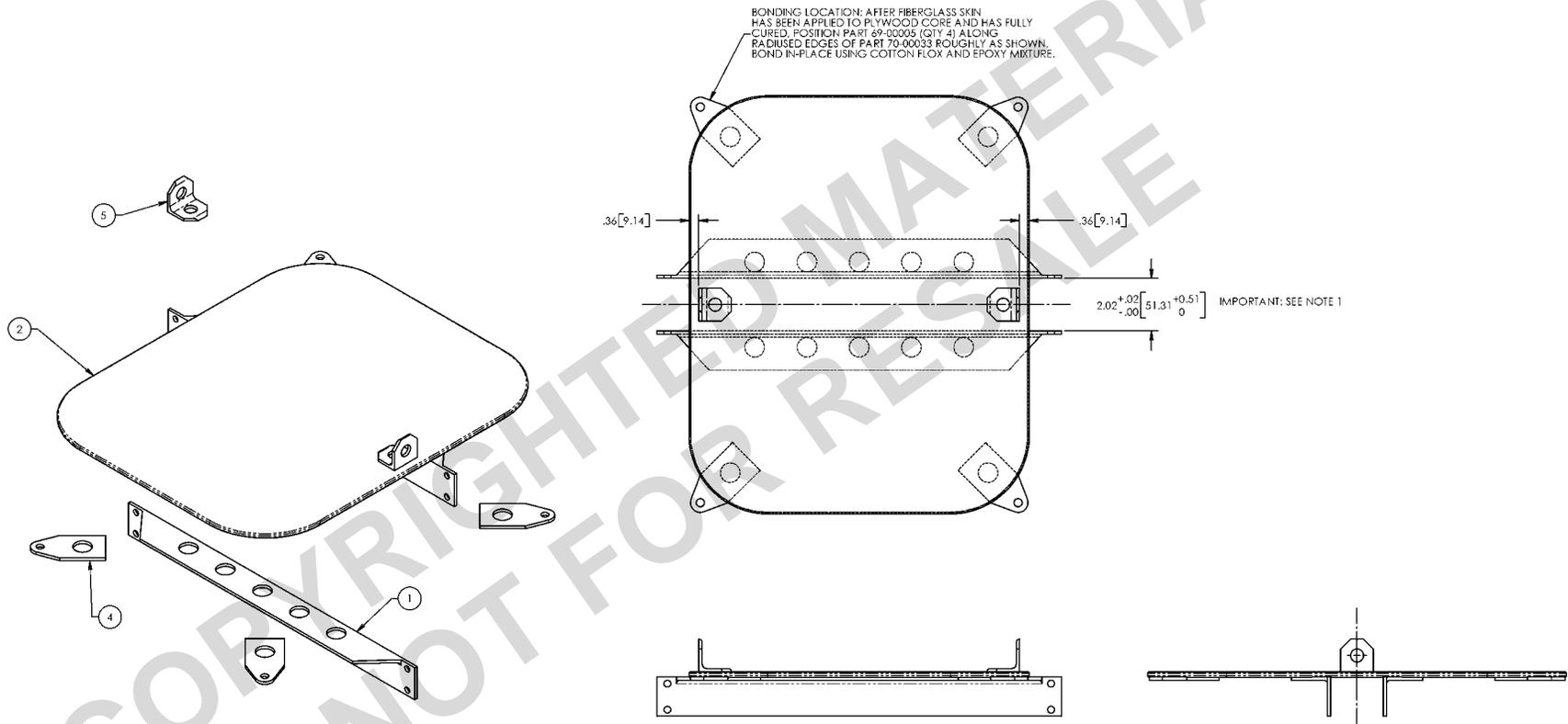
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NOT FOR RESALE

P/N 70-00055		TITLE CENTER BUNGEE ANCHOR	
PART GROUP 70 - Bracing, Supports, Frames, And Brackets		HORNET	
<small>DIMENSIONS AND TOLERANCES</small> UNLESS OTHERWISE SPECIFIED LINEAR ANGULAR ALL DIMENSIONS ARE IN X.XX ±.01 X° ±0.5° X.XXX ±.005 X.X° ±0.1° INCHES [MM] X.XXXX ±.0001			
FILENAME FuelTankCenterBungeeAnchor.SLDDRW			
DO NOT SCALE DRAWING		CREATED WITH SolidWorks	REV - THIRD ANGLE
MTRL ALUMINUM, 6061-T6	ENG D. SHOEBRIDGE	SCALE 1:1	SIZE B
HEAT TREAT	APRV D. SHOEBRIDGE	DATE 17 SEP 05	
FINISH	DETAIL D. SHOEBRIDGE	SHEET 1 OF 1	

Printed on Saturday, September 17, 2005

ITEM NO.	QTY	PART NO.	DESCRIPTION
1	2	70-00053	FUEL TANK MOUNT RAIL
2	1	70-00033	FUEL TANK MOUNT PLATE
3	1		KEVLAR/FIBERGLASS AND EPOXY
4	4	69-00005	FUEL TANK BUNGEE ANCHOR
5	2	70-00055	CENTER BUNGEE ANCHOR

REV	ECN #	DESCRIPTION	CHG BY	CHG DATE	APPR BY	APPR DATE
1	38705X	REDESIGNED ENTIRE SUB-ASSEMBLY USING PLYWOOD AS BASE MATERIAL. ADDED ADDITIONAL BUNGEE ANCHORS	DTS	17-Sep-05	DTS	17-Sep-05



UNLESS OTHERWISE SPECIFIED:
 1) THE SPACING BETWEEN RAILS MUST BE GREATER THAN 2.00" TO AVOID DAMAGING PAINTED SURFACE OF AIRFRAME DURING FINAL ASSEMBLY. TO OBTAIN ADEQUATE SPACING, APPLY 2 LAYERS OF MASKING TAPE TO BARE SURFACES OF THE AIRFRAME BETWEEN RAILS AND AIRFRAME AT THE TIME THAT THE RAILS ARE BONDED TO THE FUEL TANK MOUNT PLATE.

05-00001		FUEL TANK ASSEMBLY	
UNLESS OTHERWISE SPECIFIED		HORNET	
DO NOT SCALE DRAWING		SolidWorks	
D. SHOEBRIDGE		1:2 D	
		1 OF 1	

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8.11 Engine and Propeller

The standard power plant package for the Hornet is a 40 hp Rotax 447 (2.58:1 ratio “B” gear box), swinging a ground adjustable, 2 bladed, Powerfin propeller, up to 64 inches in diameter. Because the Hornet is so close to the weight and size of the GyroBee, performance should be about the same. Use of a Rotax is not mandatory, as other manufacturers make perfectly suitable engines in the 40-45 hp range that would do just as well, assuming the use of a reduction drive that would let you swing an efficient 60-64 inch prop. Unless you are very heavy or generally fly from high elevation fields, the Rotax 447 should do just fine. If you have an altitude or weight problem, a larger engine will be required. A larger engine may not require any additional bracing or supports, but until a complete series of tests have been performed, installation of an engine greater than a Rotax 503 should not be attempted! Keep in mind that because of the increased weight and greater airspeed that a larger engine will provide, you may have to register the Hornet as an “Experimental”. In this case, you would be required to receive training and obtain a pilot certificate of some kind, usually a Private Pilot certificate, but at the very least, a Student Pilot Certificate. Contact a gyro rated Certified Flight Instructor for more details. You can find a list of CFI’s at www.pra.org.

8.12 Rotor Blades

With the GyroBee, keeping the CD above the thrust line is done by using inefficient (draggy) rotor blades. This drag pulls back on the top of the rotor mast, keeping the CD from falling too low. Amplifying this much needed force is done through the use of a taller than average mast. However, relying on the drag of the rotor to always be there is not a sure bet, regardless of the type, brand, or configuration of gyro.

The biggest difference between the Hornet and the other Bee family members is the selection of rotor blades that can be used. Because of the CLT configuration of the Hornet, rotor drag is not an issue, as is the case with the GyroBee and HoneyBee. Therefore, any properly sized rotor system can be used on the Hornet. Like that of the GyroBee and HoneyBee, it is recommended that a disc loading of about 1.0 pound per square foot (PSF) be used. A low disc loading such as this will cause the Hornet to be a “floater”. This not only improves your chance of finding a suitable spot to land in the event of a power failure, it also means that you can fly your approach at a significantly lower airspeed and that you can execute a no-roll landing much more easily, even without a stiff breeze to help.

Besides the necessary stabilizing affect, it is important to remember that the higher drag rotor blades used on the GyroBee and HoneyBee, limit their top speed to the FAA mandated 63 mph (55 KTS). Anything faster than that, and the aircraft will have to be registered as an “Experimental”. Except for the stabilizing affect, the same goes for the Hornet. Efficient rotor blades, having less drag, will cause the Hornet to fly faster than 63 mph. On the Hornet, even though high drag rotor blades are not required to maintain stability, they will keep the maximum airspeed at or below the part 103 limits.

9. Final Assembly Sequence

9.1 Phase 1

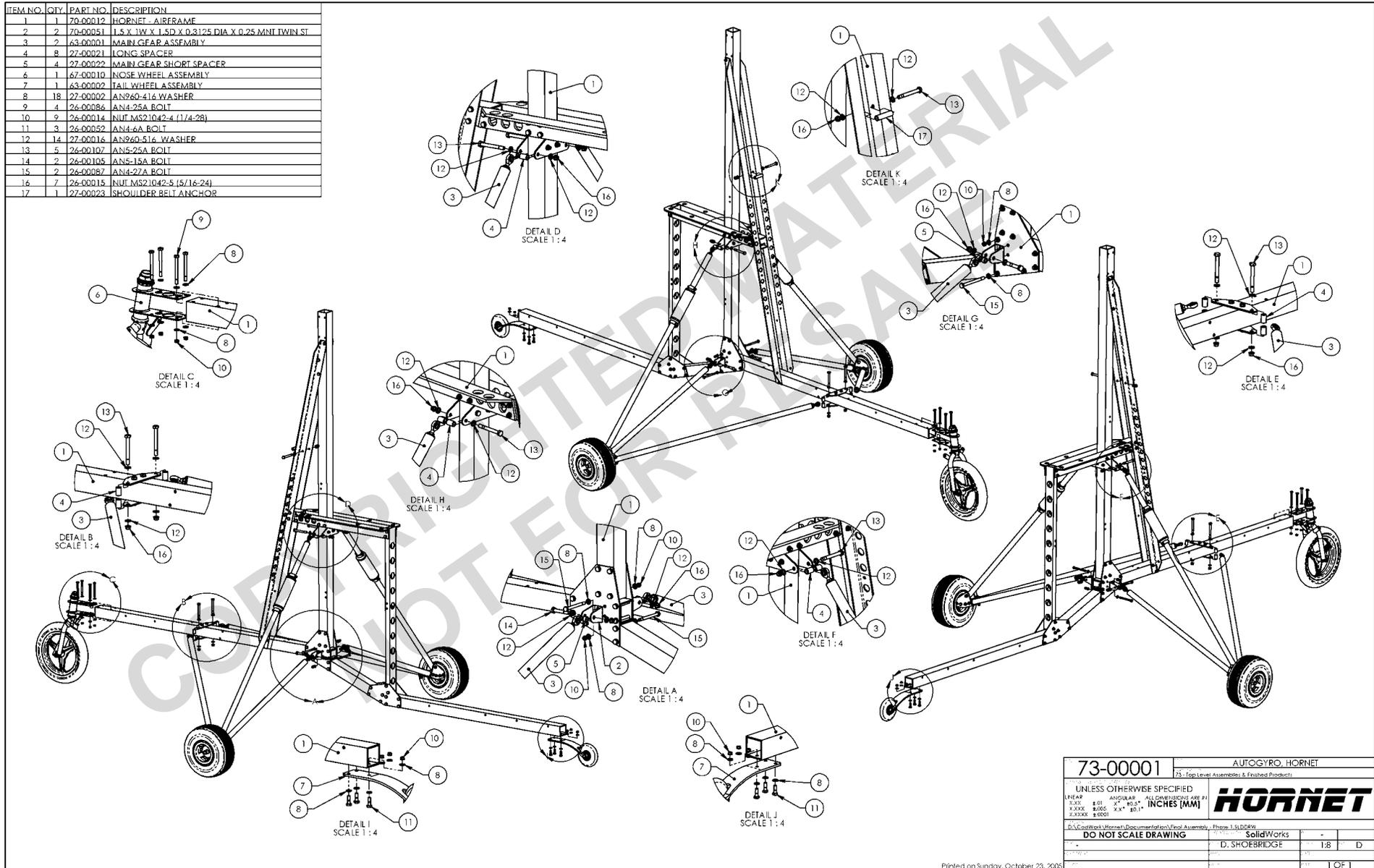
The first objective to building the Hornet is to get the airframe built, and then get it up on its own feet. This makes it much easier to work on. It also helps a great deal with ones pride and instills a sense of accomplishment. All of which are strong motivators to finish the project.

Once the four landing gear assemblies are fabricated and pre-assembled, attaching them to the airframe is a simple and straight forward matter. If the landing gear components have been properly fabricated, there should be no problem with bolt hole alignment. A small amount of “persuasion” may be required, so a soft plastic or rubber headed mallet will come in handy.

Since the main landing gear assembly uses several rod ends, adjustment will be required. Therefore, once the shackles have been mounted to the airframe, attach to landing gear to the shackles using only the bolts specified. Do not install the washers and nuts as you will have to remove them so that the rod ends can be adjusted. Using an “inclinator” (fancy name for protractor), with the landing gear installed, measure the angle of the mast. Adjust the rod ends till the Hornet is sitting roughly 1.5 to 2.0 degrees nose down. Once you have the Hornet completed, the airframe should be roughly 0 to 1 degree nose down when fully loaded. Obviously, the side to side angle of the mast should be zero. Keep in mind that if your shop floor is not level, then your mast reading will be off as well. Therefore, you’ll have to measure the slope of the floor before you begin, then add or subtract this number from your mast angle measurement. This is a good 2 person job since you will have to take all of the weight off the landing gear to adjust the rod ends. Once the rod ends have been adjusted and the mast is where it should be, then the rod ends on the drag struts must be adjusted to insure that the wheels are pointing straight down the runway.

Adjusting the drag struts is a much easier job. This is a simple matter of using a tape measure. Per the drawing 67-00014 (Drag Strut), adjust both rod ends depicted in the drawing to the dimension provided. As long as the holes in the airframe are in the correct location, the main gear should track just fine. A final adjustment may be required later, but this will not be known until taxi tests have been performed.

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	70-00012	HORNET - AIRFRAME
2	2	70-00051	1.5 X 1W X 1.5SD X 0.3125 DIA X 0.25 MINI TWIN ST
3	2	63-00001	MAIN GEAR P. ASSEMBLY
4	8	27-00021	LONG SPACER
5	4	27-00022	MAIN GEAR SHORT SPACER
6	1	67-00010	NOSE WHEEL ASSEMBLY
7	1	63-00002	TAIL WHEEL ASSEMBLY
8	18	27-00002	AN960-516 WASHER
9	4	26-00086	AN4-25A BOLT
10	9	26-00014	NUT MS21042-4 (1/4-28)
11	3	26-00052	AN4-6A BOLT
12	14	27-00016	AN960-516 WASHER
13	5	26-00107	AN5-25A BOLT
14	2	26-00105	AN5-15A BOLT
15	2	26-00087	AN4-27A BOLT
16	7	26-00015	NUT MS21042-5 (5/16-24)
17	1	27-00023	SHOULDER BELT ANCHOR



73-00001		AUTOGYRO HORNET	
UNLESS OTHERWISE SPECIFIED		73 - Top Level Assemblies & Finished Products	
LINEAR	ANGULAR	ALL DIMENSIONS ARE IN INCHES [MM]	
XXX	XXX	XXX	
XXXX	XXXX	XXXX	
XXXXX	XXXXX	XXXXX	
D:\Capitol\Hornet\Documentation\Final Assembly_Phase 1.sldprt			
DO NOT SCALE DRAWING		SolidWorks	
D. SHOEBRIDGE		1-8	D
		1 OF 1	

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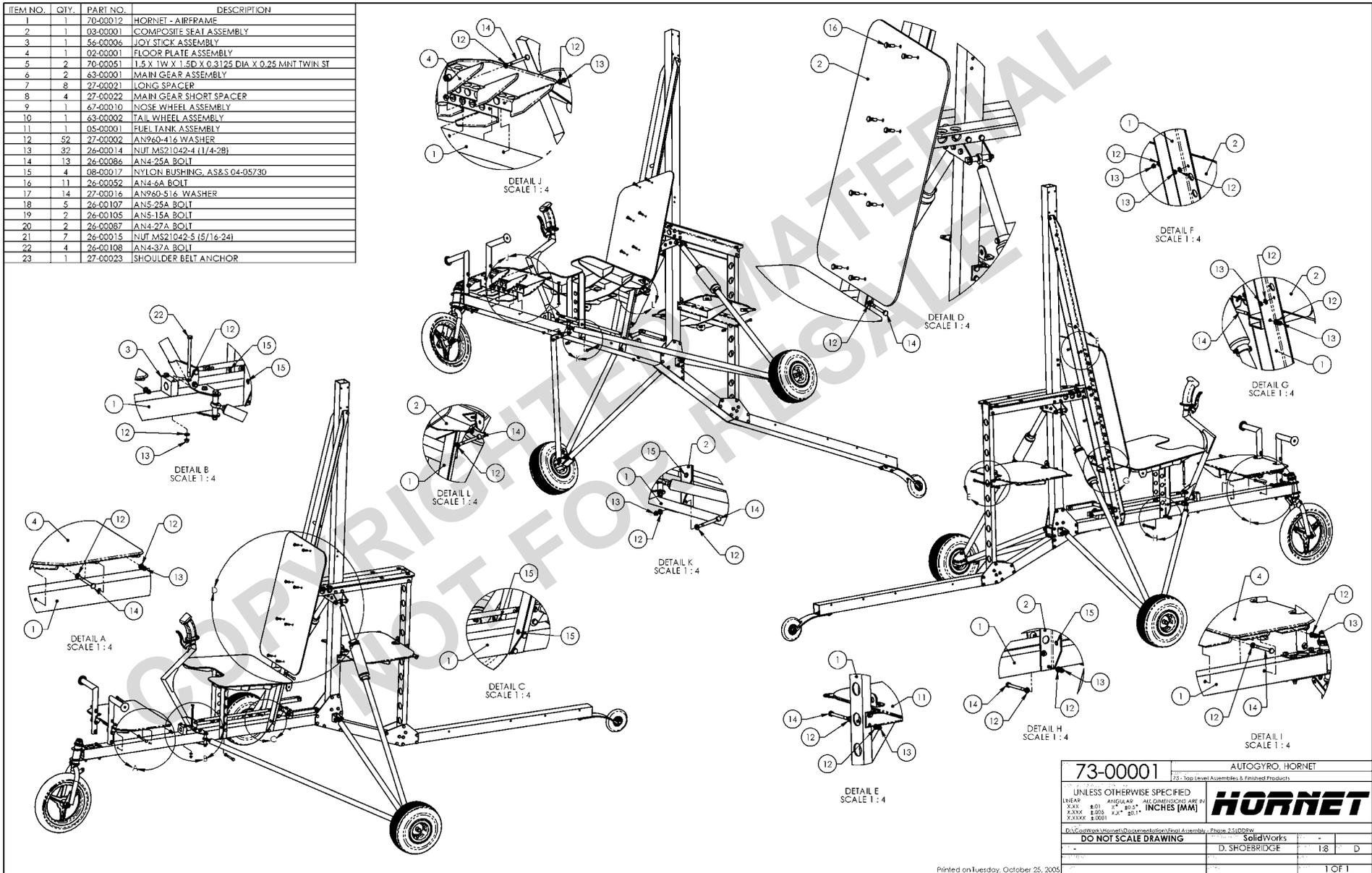
9.2 Phase 2

Now that the airframe and landing gear are fully assembled, it's time to install all of the plywood composite components. Installation of the seat back, seat bottom and fuel tank shelf are straight forward. The only thing that'll need some thought will be the installation of the floor plate. You'll need someone to help you with the installation of the floor plate assembly.

Set the floor plate onto the airframe as it would be mounted. Now climb into the seat and rest your feet on the rudder pedals as if you were flying. Slide the floor plate along the airframe until it's in a position that best fits you. Carefully mark the location of the holes with a fine point marker – both sides of the airframe. Remove the floor plate assembly and drill 4 holes in the airframe which will be for mounting the floor plate assembly. You can drill these holes with an electric hand drill. Do not attempt to drill through both sides of the airframe tube from one side. You run the risk of damaging the keel tube, and if you score the inside of the tube, you'll have to make that part all over again.

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ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	70-00012	HORNET - AIRFRAME
2	1	03-00001	COMPOSITE SEAL ASSEMBLY
3	1	56-00036	JOY STICK ASSEMBLY
4	1	02-00001	FLOOR PLATE ASSEMBLY
5	2	70-00051	1.5 X 1W X 1.5D X 0.3125 DIA X 0.25 MNT TWIN ST
6	2	63-00001	MAIN GEAR ASSEMBLY
7	8	27-00021	LONG SPACER
8	4	27-00022	MAIN GEAR SHORT SPACER
9	1	67-00010	NOSE WHEEL ASSEMBLY
10	1	63-00002	TAIL WHEEL ASSEMBLY
11	1	05-00001	FUEL TANK ASSEMBLY
12	52	27-00002	AN960-416 WASHER
13	32	26-00014	NUT MS21042-4 (1/4-28)
14	13	26-00086	AN4-25A BOLT
15	4	08-00017	NYLON BUSHING, AS&S 04-05730
16	11	26-00052	AN4-8A BOLT
17	14	27-00016	AN960-516 WASHER
18	5	26-00107	ANS-25A BOLT
19	2	26-00105	ANS-15A BOLT
20	2	26-00087	AN4-27A BOLT
21	7	26-00015	NUT MS21042-5 (5/16-24)
22	4	26-00108	AN4-37A BOLT
23	1	27-00023	SHOULDER BELT ANCHOR



73-00001		AUTOGYRO, HORNET	
UNLESS OTHERWISE SPECIFIED		73 - Top Level Assemblies & Finished Products	
LENGTH	ANGULAR	ALL DIMENSIONS ARE IN	
XXX	801	INCHES [MM]	
XXXX	803	"XXX" 851"	
XXXXX	80001		
Div. Customer Services/Documentation/Prod. Assembly Phone 254-0999			
DO NOT SCALE DRAWING		SolidWorks	
		D. SHOEBRIDGE	1/8 D
			1 OF 1

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