PEAK OF FLIGHT NEWSLETTER

Issue 619 / February 13th, 2024

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Raster Graphics vs. Vector Graphics

By Ryan M. Conway

INTRODUCTION

When deciding on the visual design for a model rocket, there are a number of options available. Most of those options fall under: (1) paint design or (2) decal design. This article is going to focus on the design of decals using graphic imaging software.

If you are familiar with graphic design programs, the differences between raster & vector programs might seem elementary to you. However, if you don't have a lot of experience using graphic design software, understanding the differences between raster & vector graphics is an excellent place to begin.

Many people are aware of the existence of Adobe Photoshop. In fact - beyond being a tool for graphic designers and photo editors, it is a culturally-recognized term within our modern lexicon. "To photoshop" is a verb that is understood by almost everyone. Photoshop has permeated our society and culture as a means to manipulate visual data.

Adobe Photoshop has its strengths and weaknesses as a program. There are tasks that it was designed to do - and it does them well. However, other graphic tasks are better suited for other programs. While the average Joe might think of Photoshop as being the totality of all graphic programs, nothing could be further from the truth. There are many graphic programs out there.

The trinity of graphic design programs are:

(1) RASTER - Adobe Photoshop, Affinity Photo, Pixelmator Pro, Gimp, Corel Painter, Microsoft Paint

(2) VECTOR - Adobe Illustrator, Affinity Designer, Corel Draw, AutoCAD, Sketch, Vecteezy, Vectormator, Inkscape

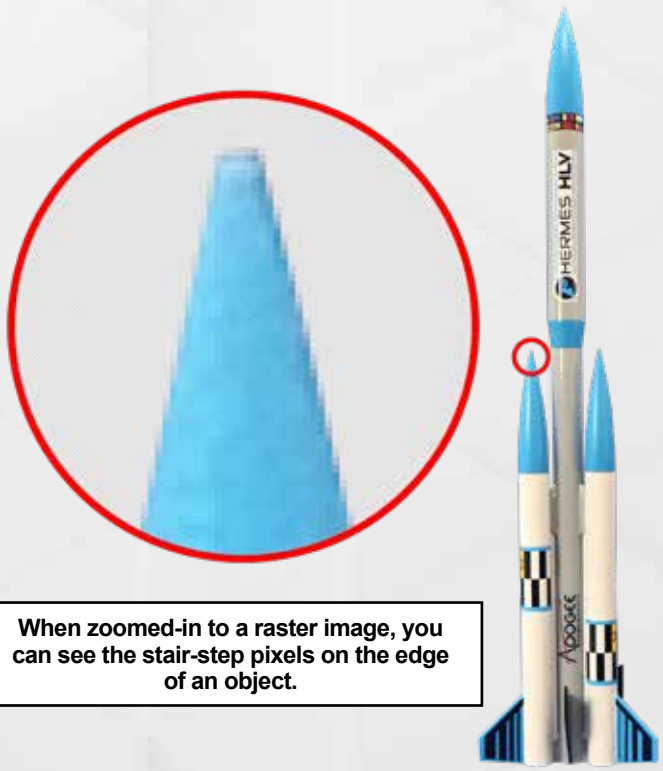
(3) PAGE LAYOUT - Adobe InDesign, Affinity Publisher, Quark XPress, Microsoft Publisher

For the purposes of model rocketry, we won't need to utilize any page layout programs for decal design. This article will focus on the differences between raster and vector graphics and how you can use both of them when designing decals.

RASTER GRAPHICS

To begin this discussion, let's define what raster graphics are. Plain & simple - raster graphics are pixel-based. The more specific definition of raster graphics is a graphic created from rows of different colored pixels that together form an image.

The other term that is interchangeable with raster is the word "bitmap." When you hear people discussing raster images or bitmapped images. . . they are indeed the



When zoomed-in to a raster image, you can see the stair-step pixels on the edge of an object.

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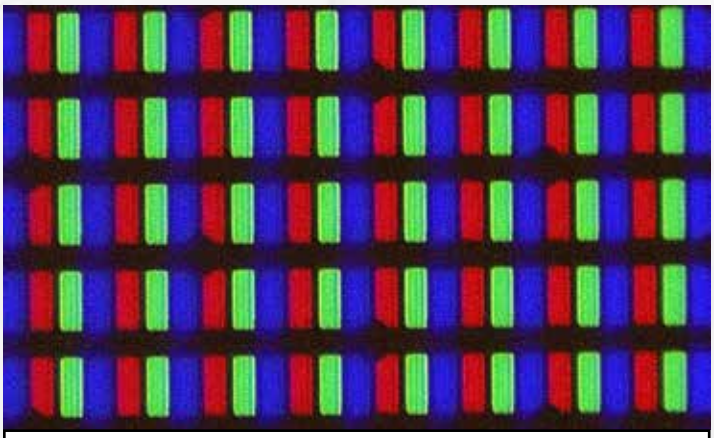
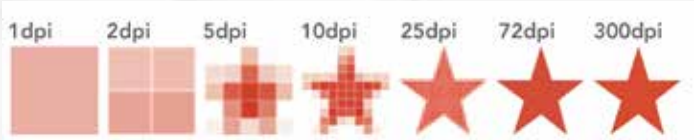
same thing. This can be somewhat confused by the fact that there is an early file-type called a bitmap file (with a file extension of .bmp). But in a larger sense, the word “bitmap” refers to pixel-based images in the same way the word “raster” does.

Raster/pixel-based graphics were created with the invention of the television. Each pixel on a screen is powered by light. This is an important distinction to make because color mixes differently as it manifests in light, as opposed to how color mixes in paint. A pixel is broken down into red, green, and blue sub-pixels that can illuminate at various intensities.



Ordered rows of pixels were first invented during the advent of the television.

Because raster graphics are based on the pixels within an image, the resolution of an image is based on how many pixels there are. We have all heard the terms high-resolution and low-resolution, and while these terms can be relative depending on the situation. . . high-resolution



The amount of pixels within a given space is called "resolution." Higher resolution = better quality.

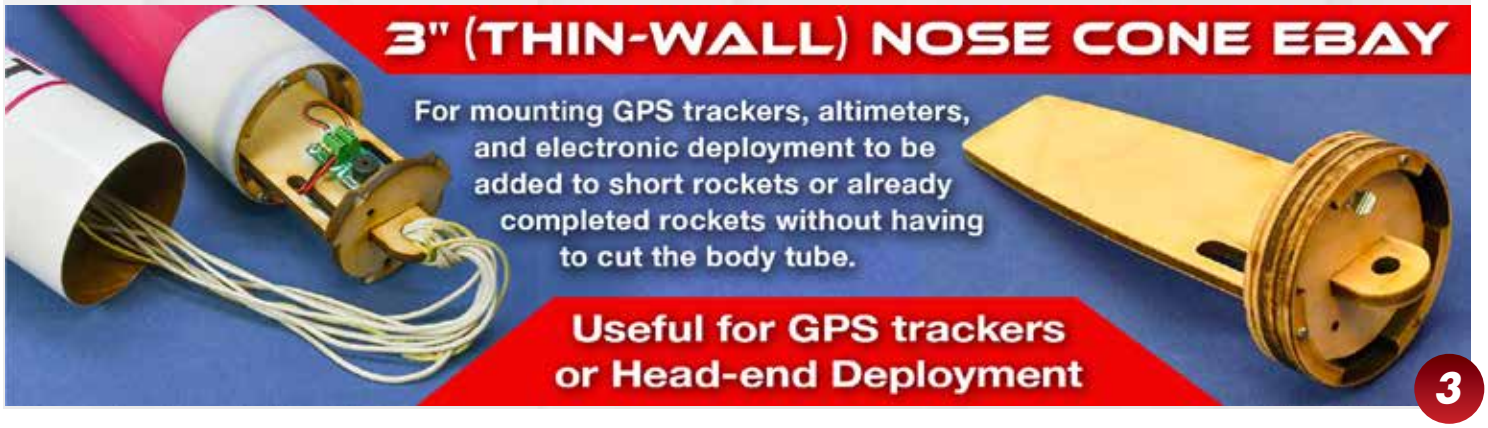
images have more pixels than a low-resolution image. The frequency of pixels within a given amount of space is called the DPI (Dots Per Inch). This sometimes also referred to as PPI (Pixels Per Inch).

As a rule of thumb, print requires 300 dpi for crisp/clear images, and screen-graphics require a minimum of 72dpi.

However, when you are trying to figure out the quality of an image, there are TWO factors that you need to know: (1) Size, and (2) Resolution. If someone just tells you that a file should be 300 dpi or 72 dpi. . . they have only relayed half of the information that is needed. You have to know the resolution AND the size.

The other thing to know about pixels is that they are square. If you look at a very low-resolution image (or if you stretch an image so large that it becomes low resolution), you will see a phenomenon known as pixelization. That is where you can notice the blockiness of the square pixels in an image. In a very high-resolution photograph, there are so many pixels that you will never notice the squareness of the pixels. If it is a really low-resolution image, you’ll be able to notice the blockiness of square pixels.

Pixels are square.



Resolution is a "One Way Street."

Another important rule to remember about resolution is that it is a one-way street. What I mean by that is that you can take a high-resolution image and convert it to a low-resolution with no problems. However, if you travel the other direction and take a low-res image and stretch it into much larger size, then you will immediately notice the negative effects as the image pixelizes and falls apart.

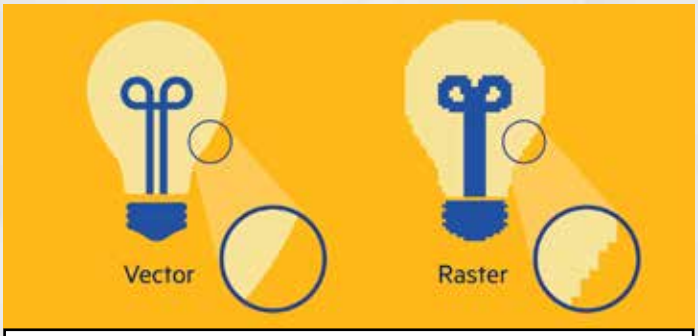
When dealing with raster graphics, you must always keep the resolution in mind. It is the most defining feature of pixel-based graphics.

In regards to computer programs that deal with raster graphics, the most well-known heavy-hitter is Adobe Photoshop. GIMP is a free, open-source alternative that has gained some ground in the past ten years. And recently Serif Affinity has released a photo editing program as well (Affinity Photo 2).

Raster File Types: PSD, JPG, PNG, TIFF, GIF, BMP

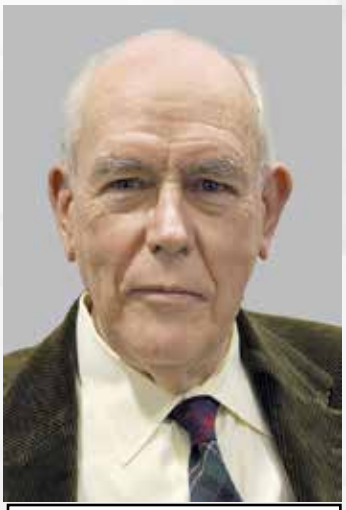
VECTOR GRAPHICS

Vector graphics are a completely different ballgame than raster graphics. Vectors are NOT based on pixels or resolution. They are based on mathematical equations that represent points, lines, and shapes on



Vector graphics provide much crisper edges than raster graphics. Vectors are based on mathematical equations.

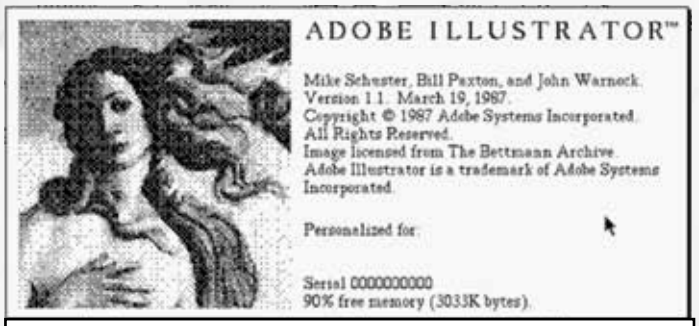
a Cartesian plane (x-axis & y-axis). Because vector graphics are based on mathematical equations, the edges are crisp and clean no matter what the size of the image is. There are no concerns over pixelization or being able to see square pixels. You could take your vector file and stretch it to the size of a semi trailer, and it will not lose any fidelity.



Ivan E. Sutherland, inventor of *Sketchpad*.

Vector graphics were created when Ivan Edward Sutherland developed the graphics software known as **Sketchpad** in 1963. It was the first program to ever use a "Graphical User Interface." Shortly thereafter a French engineer (Pierre Bezier) figured out how to proportionally scale curved lines. His name might be familiar to those who already use Adobe Illustrator - the tool to bend a line in Illustrator is called the Bezier tool. More than two decades after Sketchpad was invented, two commercial vector products would become available to professionals and consumers: Adobe Illustrator (1987) and CorelDRAW (1989).

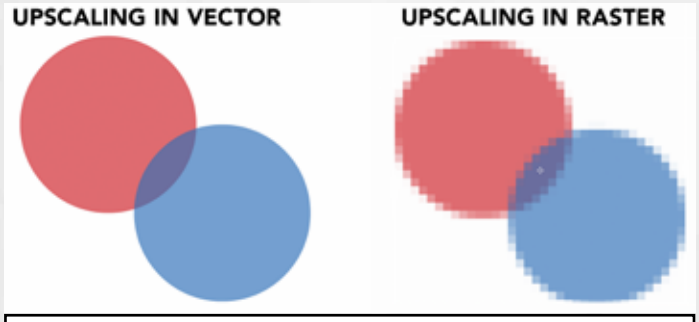
While today, Photoshop is Adobe's flagship product, it's important to remember that Adobe's first graphic program was Illustrator. Photoshop was a product created by a company called Aldus. Adobe purchased Aldus in 1994. I only highlight this history to underscore that Adobe's



Adobe released its first graphics program in 1987: Adobe Illustrator.

beginnings in the graphics industry were based in vector graphics.

What are some of the benefits associated with vector graphics? The main benefit is the ability to upscale an image with no negative effects. Beyond the scalability, precision is also an advantage to vector graphics. Their basis in mathematics makes them geometrically precise. Another great benefit about vector files is that they are not bloated in size. Vector files are streamlined and much smaller, when compared to their raster relatives.



Vector graphics are much higher quality than raster graphics. You can really see the difference if you upscale a raster file.

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Vector graphics have become a major building block in how we design imagery throughout the world. Their small file size, precise graphics, and scalability have made them indispensable.

Vector File Types: AI, EPS, SVG, CDR, DWG, WMF

WHEN TO USE RASTER OR VECTOR

So we have described the differences between these two types of graphics. Now let's explore when you should use each one.

Whenever you are dealing with a photograph, you will always want to use a raster program like Photoshop, to do the editing. A photograph is always based in pixels, and thus, you need a pixel-editing program to make those edits.

When you are designing a logo, wordmark, icon, or illustration. . . a vector program is most likely your best bet.

While you can draw or paint in both vector and raster programs. . . Vector graphics lend themselves to drawing, and raster graphics lend themselves to painting.

When it comes to the concept of drawing/painting, you could honestly use either raster or vector programs to accomplish either. However in a general sense, raster programs would be better for painting and vector programs would be better for drawing.

You also have to think of where the graphic will be used. Will it be printed small on a page? Will it be printed extremely large and go on the side of a building? The larger the scale of a project, vector graphics will probably be a better solution. That's not to say that you can't print large-scale raster graphics, you just need the resolution to pull it off.

So while the decal design for model rockets can exist on a wide spectrum of imagery, I would venture to guess that vector graphics would be the better way to go on most graphics related to rockets. . . and here's why. Most rocket graphics I have seen are pretty clean with hard edges: logos, wordmarks, pin-striping, roll patterns, numbers, or just shapes of color. The only time you would want to shift over to using a raster program would be if you need to edit something from a photograph (for placement on the rocket).

This discussion is made all the more confusing for beginners by the fact that there are now raster features within vector programs, and there are also vector features within raster programs. But while I will acknowledge that there is some overlap between raster and vector programs these days, the overall functionality described in this article can be used as a pretty solid guideline. And yes, you can place a raster graphic within a vector file, and it will not unravel the space-time continuum. Once you get to that stage, go ahead and try mixing the two together and see what kind of amazing designs you can create.

WHICH PROGRAM SHOULD I USE?

If you have never waded into the realm of graphic programs, it might be overwhelming to try and decide which program suite to use, or which combination of stand-alone programs will be the best for your use-case scenario.

Adobe® Creative Cloud™

I'll start at the top, with the sentinel of the industry. **Adobe's Creative Cloud** boasts some of the most powerful and effective graphic imaging tools that have ever been created for public use. Their Creative Cloud is a suite of over 20 apps/programs that covers most any graphic imaging task you would want to accomplish. If you just want one of their programs, it will cost you about $20 per month. If you would like the entire suite of programs, that costs about $60 per month (if you sign a year subscription). If you want to pay for the Creative Cloud suite without the year contract, it'll be $90 per month - OUCH! Adobe has some of (if not the most) professional tools in the industry, but they charge top dollar for those resources.

AFFINITY

A newcomer on the scene is a company named Serif that has released the **Affinity Suite**. They have three programs: Photo, Designer, and Publisher. These all compete with Adobe's holy triumvirate of Photoshop, Illustrator, and InDesign. The Affinity Suite attempts to have the same functionality of Adobe's programs, but they are just arranged/organized differently to avoid patent conflicts with Adobe. The main difference between Affinity's products and Adobe's products are the pricing structure. While Adobe operates on a subscription model, Affinity has a one-time fee of $165 to get all three programs outright. If you are looking for the cost-effective option that gives you professional publishing tools, you might want to give the Affinity suite a try.

Pixelmator Pro 1.1.4

Before I get to the free options, there is one more program that should be mentioned. **Pixelmator Pro** costs about $50 and it now has Vectormator embedded for no extra cost. So right there is a raster program AND a vector program all for the low price of $50. Definitely a cost-effective option for two quality programs.

Now, let's discuss some free options.

GIMP

The most popular free pixel editing software out there right now is called **GIMP** (available for Mac or PC). Reviews of GIMP say that it is a great program for basic raster editing, but it doesn't seem as intuitive as Photoshop, and it doesn't seem to have the ability for more advanced editing.

If you are on a Windows machine, you can utilize **Microsoft Paint** for raster edits. And that's where some of you will remember how clunky and awkward Paint used to be. Give it another shot. They have improved this program over the past decade or so. If you are on a Mac, you can use **Apple Photos** for some basic raster edits.

In regards to free vector programs, Inkscape seems to be the most popular free option. But you also might want to check out Vecteezy and Boxy SVG.

CONCLUSION

There is not one correct way to execute decal design for rockets (or anything else). However, there are some guidelines that help along the way. In this article I tried to explore one of those major distinctions: the difference between raster and vector graphics. I have no doubt that this information will be old news for some rocketeers, but I am also guessing that there are some beginners that are starting to think about designing decals for their rockets and could use some helpful hints on how to get started. Adding a visual identity to your rocket should be a rewarding and enjoyable task. No matter which program you use to design rockets . . . or whether you employ raster or vector graphics. . . just make sure to have fun.

SOURCES

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What is Vector Art (Adobe)
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Raster vs Vector (Adobe)
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Raster vs Vector Images: What's the Difference (ABC Printing Company)
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Rudinec & Associates
https://rudinec.com/?tag=how-does-resolution-work

Exploratorium
https://www.exploratorium.edu/snacks/pixels-pictures-phones

Craiyon
https://www.craiyon.com/image/SJiTIkp-RUy4hr8Co3Zlmw

National Inventors Hall of Fame
https://www.invent.org/inductees/ivan-e-sutherland

ABOUT THE AUTHOR

Ryan Conway's expertise is in graphic design, illustration, and video production. Having recently moved back to Colorado Springs, Ryan has been working at Apogee Components since September of 2023. Graduating from Colorado State University with a degree in graphic design, Ryan has worked for a variety of companies and clients, including his favorite band, Blind Melon. He is also an abstract painter and had his first gallery showing at CityArts in Wichita (in 2021). He enjoys hiking trails in the foothills, drawing in his sketchbook, and playing guitar & singing at open mics.

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KSR-420S (KSR-I) Rocket Plan

By Martin Jay McKee

Fitting a plan design for this particular issue in between the other product development tasks I've been busy with proved challenging so I decided to stick with a simple option this time around. This is what I'm calling an Alway-Scale version of the South Korean KSR-420S (or KSR-I) sounding rocket, as it is dimensionally based on Peter Alway's drawing from the 2001 "Rockets of the World" supplement, and little else. Still, I like the result. It's a quick and easy build with a fairly unique and bold paint scheme and the interesting graphic design which comes from the Korean characters (hangul).

The KSR-420S (also known as the KARI KSR-I) was a small, solid-fueled, sounding rocket developed by the Korean Aerospace Research Institute (KARI) first launched in June of 1993. With a 420 mm (16.5") diameter, it is of similar size as a typical single-stage Black Brant V class sounding rocket, allowing the KSR-420S to lift 30 kg (66 lbs) up to 75 km (45 mi). The two flights of the KSR-I included atmospheric monitoring equipment as well as microgravity observation equipment.

The plan is 1:12.3 scale which results in a 1.32" (33.6 mm) diameter (BT-55) rocket that stands 22" (559 mm) and flies well on 18mm motors from B to D. The build itself requires a minimum of parts, and the paint is relatively simple when paired with decals and thin silver mylar tape. All in all, it's a fun sport rocket that closely matches the real-life prototype.

Note on the recovery system:
The prototype used an Apogee parachute protector and 15" printed nylon parachute. This makes for a rugged and easy to fly system, but these could be replaced with recovery wadding and a 15" plastic parachute if desired for reduced cost.

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By Martin Jay McKee

Parts:

Item #	Item Name	Qty
10086	AT-18/18" Body Tube (6 pack) – 2.75" section	1
10131	AT-33/18" (BT-55) Body Tube (6 pack) – 15.875" section	1
13028	CR-13/18 (6 pack) – need one ring for the engine block	1
13032	CR-18/24 (6 pack) –need one ring for the shock cord support	1
13052	1/8" x 1" Launch Lug - need 1	1
13404	CR-18/33 (4 pack) – need two rings for motor mount	1
14093	3/32"x3"x24" Basswood Sheet – need about 2/3 of a sheet	1
24046	Regular Crimped Engine Hook – need 1	1
29091	15" Printed Nylon Parachute	1
29370	3" Parachute Protector	1
30326	300# Kevlar Cord x 5 ft	5
	Appropriate self-adhesive decal paper	
	White and Red Spray Paint	
	Silver Tape	

Recommended Motors (at a built mass of 65 g / 2.6 oz):

Manufacturer	Model	Altitude (ft)	Altitude (m)
Estes	B4-2	262	80
Estes	B6-2	266	81
Quest	C12-4	821	250
Quest	C18W-6	890	271
Estes	C5-3	638	195
Estes	C6-5	754	230
Aerotech	D13W-7	1615	492
Quest	D16-6	1096	334
Quest	D20W-6	1197	365
Aerotech	D24T-7	1534	468

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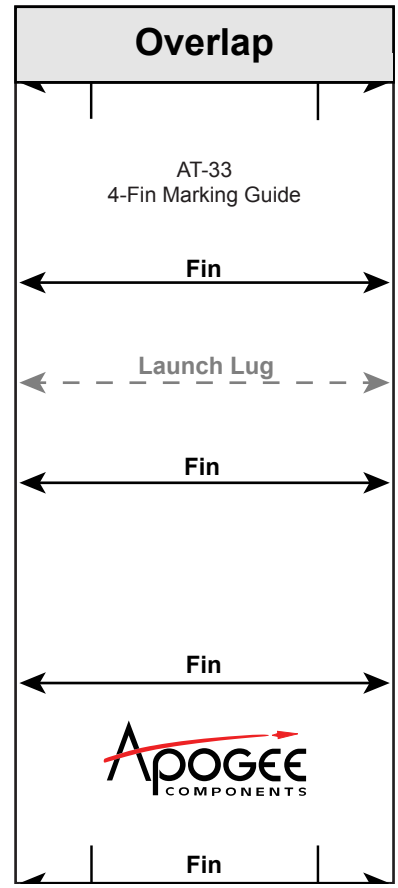

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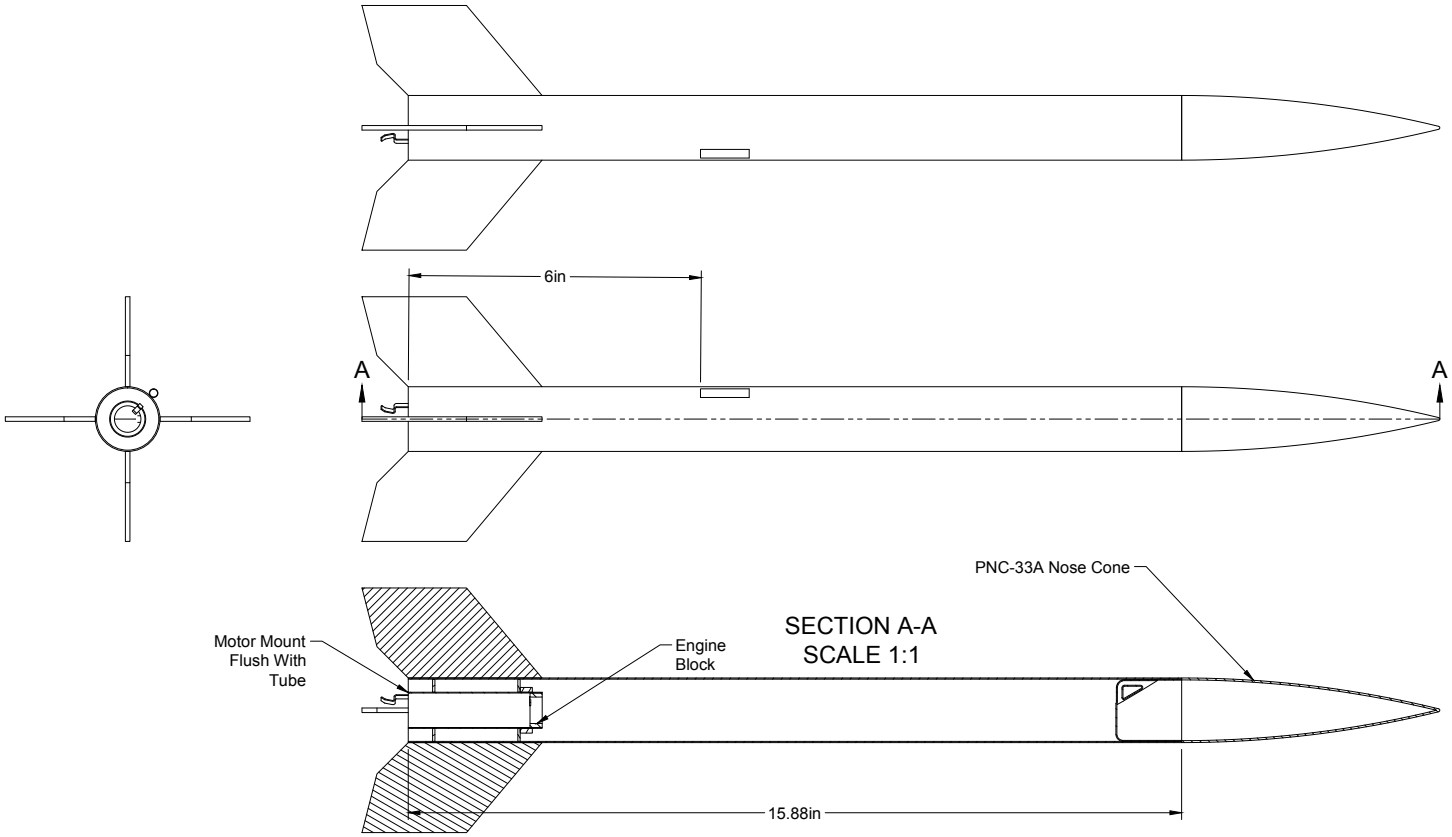

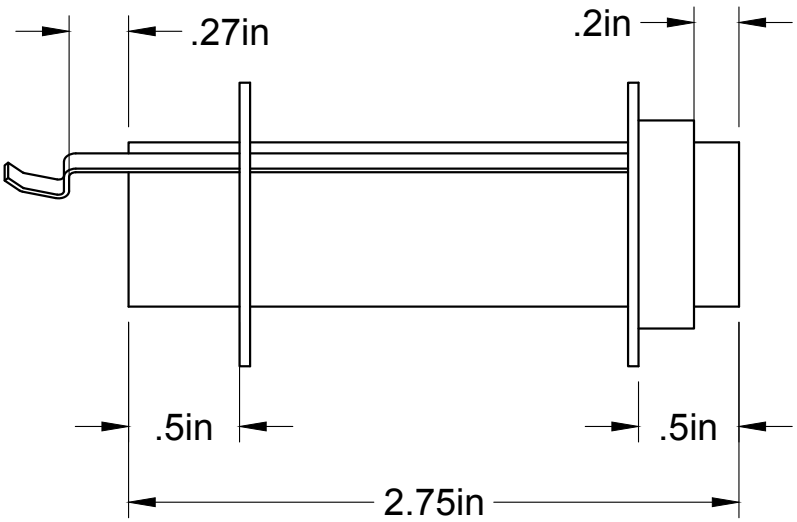

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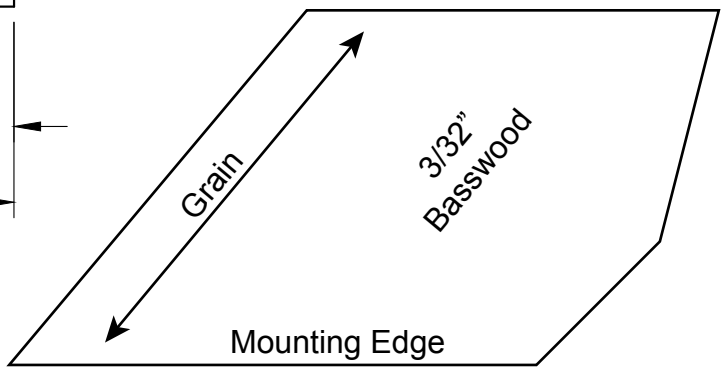

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