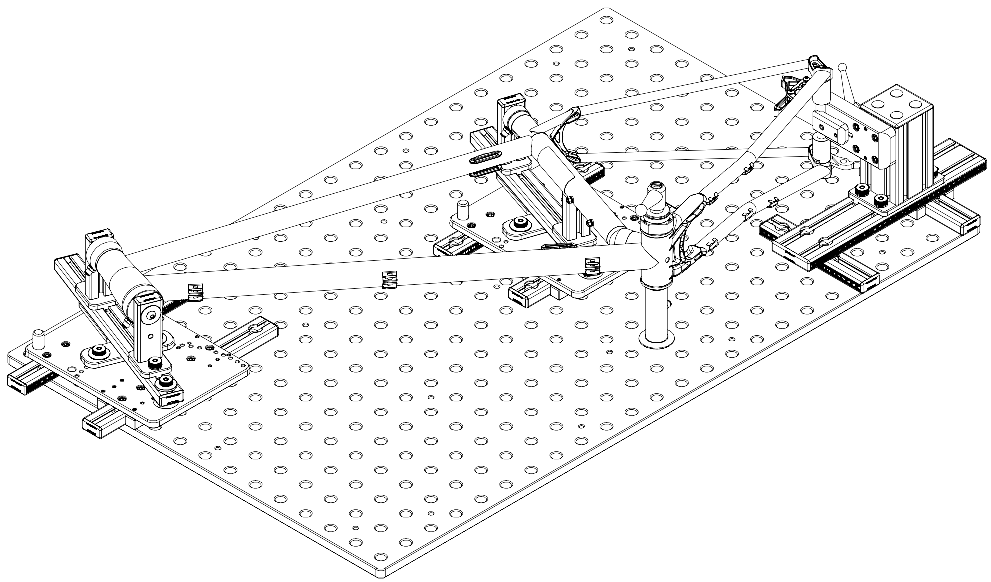
SKYNET

A BICYCLE CHASSIS FIXTURE



PETER VERDONE DESIGNS, FAIRFAX, CA 94930

REV:2022-02-18-1

Project definition:

- A bicycle chassis fixture that is simple to use.
- Easy to produce in a basic machine shop by non-professional machinists.
- The cost should be as low as reasonable.
- The result be capable of producing high quality, modern construction.

Ranges:

Head Tube Angle:
8.9 to 92.2 degrees (as shown, modified angle plates for additional range)

Seat Tube Angle:
8.9 to 92.2 degrees (as shown, modified angle plates for additional range)

Front Center:
0 to +∞ (Limited only by table or ganged table sizes)

Seat Tube Offset:
-∞ to +∞ (Limited only by table or ganged table sizes)

Chainstay x:
0 to +∞ (Limited only by table or ganged table sizes)

Chainstay y:
-∞ to +∞ (Limited only by table or ganged table sizes)

Crank Shell:
0mm to 270mm Symmetric (as shown, modified centerline height for additional range)

Axle Spacing:
60mm to 197mm (as shown, modified centerline height for additional range)

This is the PVD SKYNET bicycle frame fixture!

It is a project inspired by several types of people:

- The novice/enthusiast looking to get started building frames. They need a fixture and it needs to be inexpensive.
- The experienced builder that is looking for maximum control over their build and the ability to do advanced constructions.
- The development program that requires a flexible platform for projects outside of the norm.
- The experienced metal fabricator looking a frame fixture that exploits their existing tooling.
- Me.

After development of the PVD Cyberdyne System, a high-end toolroom-grade chassis fixture, discussions began for others to replicate that fixture in a more practical and inexpensive way. The original construction relied on expensive tools, processes, and was costly. Another option needed to exist.

Ben Land (ShieldMaiden Bikes) was one of those interested in this new design. Ben is an inspired beginning framebuilder who, several frames in, with terrible tooling, really needed a proper fixture. We discussed his situation and I agreed to redesign the Cyberdyne fixture in a way that was cheap and easy to make but still functional and high performance.

This was going to be a clean sheet re-design of the proven system.

Ben would build the prototype of this new fixture, SKYNET. In doing so, proving that an inexperienced 'machinist' with basic tools could produce the fixture and that the quality of the end product would be suitable for use. Ben would also be able to catch any issues with the design before these documents were released to the public. Ben contributed in other ways to this project: The BOM, some initial drawings and tolerances, discussions of challenges, costing, and YouTube content are products of Ben's work. Be sure to thank Ben for this document's existence.

While Ben was building the prototype in North Carolina, modeling and improvements continued here in California. Hence, this document is a detailed set of plans for a further evolved and refined version of what Ben produced and shows in his video series.

The functioning of this fixture is remarkably simple and flexible. It can be used to produce classic road frames, as well as state of the art downhill racing chassis. It will work great for singles, tandems, triples, tall bikes, and choppers. Really, there are few limitations on what can be built using this tool.

The hope is that these plans will inspire young and energized people to start building honestly progressive bicycle designs in their garages and workshops.

SKYNET is the virus.

How it Works:

Working from a very rigid plane and Cartesian raster, we construct holding tools for the head tube, seat tube, crank shell, and axle that are both rigid and precisely positioned as defined by their numerical coordinates.

We employ positioning rails for the tooling that gives the builder flexibility to construct varied sizes and styles of bikes. This gives the adjustment needed in the range we tend to use. Because these rails are easy to move to different locations on the table, that range can be extended as needed.

Since positioning of the head tube and seat tube are nearly identical, we use almost identical tooling for them. The seat and head tubes are held along a beam that is positioned on their respective axii in the design. That beam pivots to match the angle these tubes take with respect to the fixture's x-axis. The beam pivot moves along the x-axis guided by the rail. The rail fixes the distance on the y-axis that the holding beam pivot runs along. That y-axis position of the beam pivot axis is a tooling input in spreadsheet calculations. The intersection of the head tube or seat tube axis as they intersect the beam pivot slide axis is calculated and used to position the tool. Further calculations produce the distance from the beam pivot to the bottom of the head tube along the head tube axis.

To set the angles most accurately, a 9.000" cosine bar is constructed as part of the tool. This is one of the most precise methods known for working with angles in tooling. The user simply sets the gap between the face of the beam and a reference pin in the angle plate to set an angle. To understand the precision, an example, a 0.05 degree change in head angle from 65° changes the gap 0.007”.

For positioning the rear axle, a simple X/Y stage is used. Other methods for this are possible but, all things considered, this is one of the best in this location.

Unlike almost all other fixtures, SKYNET supports the crank shell rigidly on both sides. This is accomplished by a 1” precision steel shaft held perpendicular to the table surface. Close tolerances and accurate fit-up of the parts in this system combined with significant welding distortion in the shell could bind the reducing cups on the shaft, causing problems removing the tacked or partially welded frame from the fixture. Thus, a pulling device is built into the top shell reducer to separate it from the shaft if force is needed. While the Cyberdyne System used a conical interface for this (a superior method), a cylindrical interface is used on the SKYNET to make fabrication simpler for those less experienced. It is encouraged that experienced machinists modify prints for a conical interface.

An optional pair of reference pins have been included in this package that allows the user to place them in any open hole on the table for convenient caliper measure of the components to the table raster.

Additional special tooling with precise positioning can be designed and constructed for use within the coordinate system on which the frame is built. An obvious example of this would be suspension pivots and shock mounts, parts that require very specific placement. Simply establish the coordinates and interface on the raster to set precise position. In this way, highly complex suspension systems can be fabricated with precise locations that no other fixture allows.

The intention of this design is to be a starting point. There is plenty of room to add precision or adjustment for whatever the designer needs constructed. Modifications and additions are encouraged and should be shared.

What You Need:

This is a project of significant scale. If this is your first time attempting a project of this size, it is recommended that you find a local mentor or team with some experience that will be able to advise you, help you plan, and manage what will be needed to complete this work. Project management is a learned skill and it is an expensive and failure-prone skill to acquire on your own on your first try. Find good people to help you!

It is estimated that this tool will involve a minimum cash outlay of $800.00 for a version that will sit on an MDF sheet. More is discussed on this later.

Almost all material and components can be obtained from McMaster-Carr, 8020, and Oregon Rule. Informed substitutions in suppliers can be made to significantly reduce cost or to work with local suppliers. Often, it can be quicker and easier to obtain some 8020 materials and rules from McMaster-Carr even if the cost is somewhat higher than ordering direct. A few items will require an 8020 order regardless, so plan on that. Oregon Rule has a minimum purchase requirement. Be aware that some suppliers will have lead times longer than you might expect.

8020 profiles can be ordered cut to length at an additional cost. I suggest that you do not make use of this service. 8020 is easily cut to length with a common chop saw and will be precisely finished on the mill per print so it isn't really worth the added cost and lead time for cut parts. Also, as this material is so handy in the shop, buying six foot lengths will give you remainder material for use on future projects.

There is at least one special tool (90°, ¾" mill-drill) used for a critical cut on some of these parts. Other special tools may be helpful (e.g. 82°, ¾" Spotting Drill, extended length drill bit) but may not be required depending on existing shop tooling. You should review all of the enclosed drawings prior to starting any work and order all necessary tooling when ordering your material. You don't want to get surprised right in the middle of making a crucial piece.

The parts described here were specifically designed to be constructed using very basic machine shop tooling. A manual lathe, manual mill, and saw are required. The mill preferably is one with a 10"+ x-axis digital read out. The machines should be in good working order and the vises and chucks should be set true to the axii. It is wise to check lubrication and adjust your gibs and ways before you start all this work. It is expected that the most common cutting and drilling tools are inventoried in the shop. Ensure this is done.

The work here will not require a high level of shop experience, but knowing basic operations and common tooling required to do each process are necessary. It should be understood how to drill, tap, use edge finders, mill stock to size, bore holes, etc. There are no truly advanced operations but there is often more to the basics than novices realize. YouTube will be your friend here.

If you are limited in skills and abilities, it is encouraged to use scrap material when available and prudent. It is wise to save your money for when you are more skilled and can make finer and more precise parts. It will be easy to improve this fixture with small investments of time after the fixture is complete. If you are able to produce anything close to what is described in this text, it will be a highly usable tool for making bicycle frames. Later investments can bring the fixture up to spec. That said, the work required here is a perfect opportunity to learn and begin to master the basics of machine shop work, improving your skills for later projects.

Because of the number of tapped holes in the plates, it is recommended that you learn to 'rigid tap' on the manual mill using a 'gun tap'. This will save considerable time. Some of the precision counter bores in the parts are intended to be 'bored' using a ¾" or ⅝" end mill. Pre-drill, use the feed mechanism, quill stop, and make sure to rough out the cut with an undersized end mill. This will give you an excellent finish and size.

The Table:

A fundamental component of this system is the rastered welding table surface. Significant value is gained in using one of these in the fixture design since most of the financial investment is in the table itself. That tool will help with any fabricated project, not just bicycle frames. There are many different welding tables that users may already have in their shops. It is highly recommended that you buy one of these tables if do not have one and are serious about building bicycle frames or any other fabricated projects.

Imperial and metric raster welding tables exist in the marketplace. The design enclosed is for the 2.000" x 2.000" x ⅝" raster that

almost all imperial tables in the United States use. If you are in a metric environment and have a 50mm x 50mm x 16mm raster table, a metric version of this tool should be simple enough to derive and a print package may later
be produced.

Acquiring a welding table like a Seigmund, SHT BuildPro, or SHT RhinoCart will cost at least $2100 if purchased new. Thus, calculating a total project budget in the range of $3000 would make sense. This is money well spent for this type of tooling. Buying a used table locally can reduce this cost significantly.

The Langmuir ArcFlat cast iron weld block is well priced and seems very nice but is a bit small to comfortably work with this design.

Some budget welding tables are sold online that are made of very thin steel, such as CertiFlat or Klutch. It is recommended to avoid these, but if one is used, a modification to the locating pin or some spacer washers will be required.

To reduce total uptime costs for hobbyists and school kids, the use of an MDF surface material can be considered as an option to the expense of a rastered welding table. This brings the surface cost down to under $50. Some precise layout and setup are required to go this route, so it is preferred that raster holes be cut on a CNC router if one is available. With some planning, support ribs can be cut from the remainder of the MDF sheet to construct a 'torsion box' structure that will hold the surface very flat. This could work well for quite a while if the work is performed correctly.

When using MDF building this fixturing system, lacking a CNC router and needing to do real accurate layout and boring of the 13 holes, doubt arose that this could be done perfectly on the first try. For that reason, a bail has been built into the rails. Should accurate positioning become a real problem on the MDF board, bore the holes slightly oversized and position the rails with the pins clamping them in place but enough to nudge into position. Once the rails are aligned and all measures are confirmed, 1/16" holes are predrilled and the rails are screwed into place using #6 x 3/4" flat head screws for particleboard and fiberboard. A little wood glue in the hole before the screw goes in is a gangster move.

Welding:

It is intended that a fixture of this type be used for TIG welded construction. Open flame construction such as brazed lugs or fillet brazing are not recommended.

Purging:

To reduce cost, complexity, and difficulty in making the parts for this fixture, provisions for purging may be omitted. Most novice builders are working with steel and back purging isn't an absolute requirement. If you require back purging for projects, such as titanium construction, those features should be straightforward to produce as shown.

Anodizing:

For durability and best appearance, it is recommended that *black anodized* 8020 materials be used. Clear anodized 8020 can be used if it is more convenient or much less costly, but it is not optimal. Black anodizing is a very durable coating that will help the tool resist wear and marring over long periods of use. There can be additional lead time with this purchase so plan accordingly.

It would be wise to look into anodizing of the finished 6061 Al parts that are made in this package. Gang them in on a run at your local anodizer as pricing tends to be by the batch rather than each.

Pin Fit and 'Tuning' of Dimensions:

It cannot be stressed enough that the fixture shown here is the bare minimum of design and will work quite well in virtually all cases. That doesn't mean that the informed constructor should follow blindly. There are opportunities to improve the fit and precision of the tool by fully understanding the design.

Different tables will have dimensions that vary from nominal. Each manufacturer has a different way of specifying their holes. As such, 0.625" was used as a nominal figure for the rail pins and their accompanying bore fit in the extrusion. A Seigmund table may have holes upward of 0.633". While the design here will work fine in that case, a user can improve the accuracy of their end product by increasing the pin diameter and the bore in the extruded rails. This will require the use of micrometers and boring head on the mill. This will be a simple correction for those experienced in shop work but may be a little over the heads of those that aren't. For them, a slow feed of a ⅝" end mill will produce adequate results.

The width of the slot in the 8020 extrusions can deviate significantly from what has been specified by the manufacturer. Some measures of material on hand got up to 0.327". It would be wise to measure the slots for your mating parts with pins and adjust accordingly. The specification here is just over the theoretical design in models shared by 8020. That is because the slot tends to run wide, even wider than has been shown for the slides here. Still, a looser fit should still provide for a very precise fixture while keeping the parts running smooth.

The standoff spacer for the crank shell tower was made to a smaller diameter (1¼") than optimal. That was to ensure that the part is easier to make in some common lathes. If you can produce a quality part at a larger diameter (1½"), that would improve the rigidity of the structure. Certainly, the tower should be inspected for perpendicularity upon completion.

It would be wise to confirm the height of the base of the tower components as it is possible that the height of the platform that they sit on may deviate due to stack up of the rails. Those parts are marked 'calibrate'.

Depending on the quality of the parts produced, shimming of parts can be done to bring various parts into alignment. Shim stock of 0.0005" can be ordered and placed in a way that will work well.

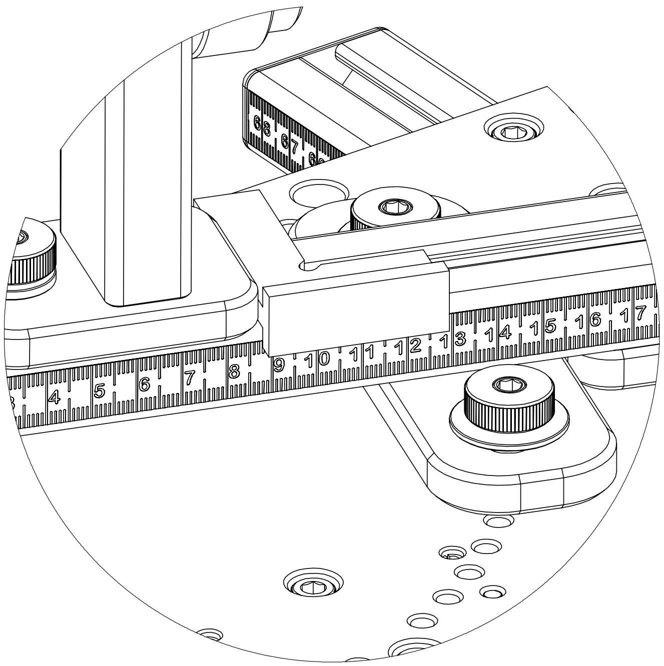
Center Plane Height:

The fixture shown here is designed at a 160mm center plane height. That is more than enough room for almost any known crank or axle standard that exists in 2021. However, everything changes. In fact, folks working with heavyweight e-bikes or ultra-light motorcycles could use a higher plane height. It is encouraged that this be considered and adjustments made for outliers. Only a very few parts need modification for any imagined height.

Tools for use:

For ease of use, adjustments when using the fixture can be made with thumb screws, handles, or a 3/16” hex wrench.

To read the scales, a small machinist square with base (Amazon #B08D3D34M2) is pushed against the sliders to hang over the edge of the rail.



Calculation:

To build a tool that works in an efficient manner and takes some mechanical shortcuts, we employ some mathematics. This reduces the cost and complexity of the tool without diminishing functionality in any way. The math necessary is basic trigonometry and algebraic manipulation. While that math is accessible enough for most people, the calculations can get elaborate and would otherwise be difficult to keep track of, so we use computer spreadsheet programs to manage the work. The spreadsheet is used to take design values and calculate the proper positions that the fixture needs to be set.

A computer spreadsheet is a powerful tool in the shop. It is especially useful when calculation complexity is involved. Most common spreadsheet programs will work to 15 significant figures within a single calculation. This may seem excessive but some of these calculations can use over 20 parameter values and many are scaled with trigonometric functions. It is important to use the calculations correctly so that return values don’t deviate significantly from platonic ideals. For this reason, it is recommended that all calculations refer directly to defining parameter fields rather than sub-calculations. Confidence in these numbers is essential when doing this work.

While it is most common to use *Microsoft Excel* software, other spreadsheet programs are freely available namely, *Google Sheets* and *OpenOffice Calc*. Any of these programs are suitable for this application.

To set a frame fixture, a bicycle frame design can be reduced to 17 fundamental driving parameters, for most hardtail mountain bikes (in most recent studies). That number goes down to 10 parameters for bicycles with similar sized wheels and tires, rigid forks, and without an offset seat tube (like a traditional road bike). All of the frame parameters needed to calculate the fixture settings are in the fields on the table shown later in this text. In addition, a definition for most of the trigonometric functions and some other useful definitions are shown. I believe that all of the calculations needed can be derived from what is contained in this document.

Seven calculated values are needed to set the entire fixture in a way that is difficult to make mistakes. While we need the utmost precision within the calculation, on the table, working values beyond one decimal place (in millimeters, or two in inches) are generally imaginary in bicycle production. We strive for perfection but do our best in an imperfect world.

While these construction documents to produce the SKYNET fixture are being provided, the math for the spreadsheet is not. It is my opinion that it is critical that the user understand the math done to design a bike and to set the fixture. To properly modify the tooling, the calculations need to be understood. This exercise is crucial and exactly why I leave it to the user.

Don't mistake this process as drudgery. Instead, understand that it is actually very exciting. Many rush forward in the construction process of a bicycle frame and give little attention to the mathematical component in design. The process you learn and use here will help you produce not only better bicycles but better tools and more complex project possibilities. Real life trigonometric calculations are extremely powerful tools for those that know how to use them.

Share what you learn:

It is requested that any errors in this document or improvements in the fixture that fit the project goals be communicated ASAP so the document can be revised and updated for all others. Because the design is always being updated, some details can get missed.

Simply send a note, photo, or sketch via email to peterverdone@gmail.com.

	Frame Driving Parameters (mm)	***PVD All-Road (2021)***	***PVD Warbird***	***PVD Supermarine Spitfire***
1	Front Center	805.0	850.0	845.0
2	Rear Center	410.0	425.0	410.0
3	Crank Height	281.0	300.0	305.0
4	Head Angle (°)	69.0	65.0	65.0
5	Seat Tube Angle (°)	71.4	69.8	68.5
6	Seat Tube Diameter	34.9	34.9	34.9
7	Front Rim ISO/E.T.R.T.O. Size	622.0	622.0	622.0
8	Front Tire Height	40.0	64.0	76.2
9	Rear Rim ISO/E.T.R.T.O. Size	622.0	622.0	622.0
10	Rear Tire Height	40.0	64.0	64.0
11	Max Rear Tire Height	53.3	66.0	66.0
12	Rear Tire Gap	10.0	12.0	8.0
13	Fork Length	412.0	591.0	440.0
14	Fork Offset	50.0	51.0	42.0
15	Fork Travel	0.0	180.0	0.0
16	Sag (%)	0.0	30.0	0.0
17	Lower Headset Stack	1.0	1.0	1.0
	Fixture Inputs			
1	Fixture Centerline Height	150.0	150.0	150.0
2	Head Tube Pivot Y from BB	355.6	457.2	355.6
3	Seat Tube Pivot Y from BB	152.4	152.4	152.4
4	Cosine Arm Radius	228.6	228.6	228.6
5	Cosine Pin Angle Shift (°)	9.0	9.0	9.0
6	Cosine Pin Diameter	15.9	15.9	15.9
7	Centerline from Beam Face	19.1	19.1	19.1
	Fixture Settings			
1	Seat Tube Pivot X from BB	18.3	13.7	3.9
2	Head Tube Pivot X from BB	638.8	612.2	667.2
3	Head Tube Bottom From Pivot (Minimum: 79mm)	87.89	92.51	119.75
4	Rear Axle X	404.0	418.3	404.0
5	Rear Axle Y	70.0	75.0	70.0
6	Head Tube Cosine Spacer	87.31	100.84	100.84
7	Seat Tube Cosine Spacer	78.92	84.57	89.04
	Important Value for BikeCAD			
1	Seat Tube Offset	31.2	39.8	52.2

CIRCULAR TRIGONOMETRY

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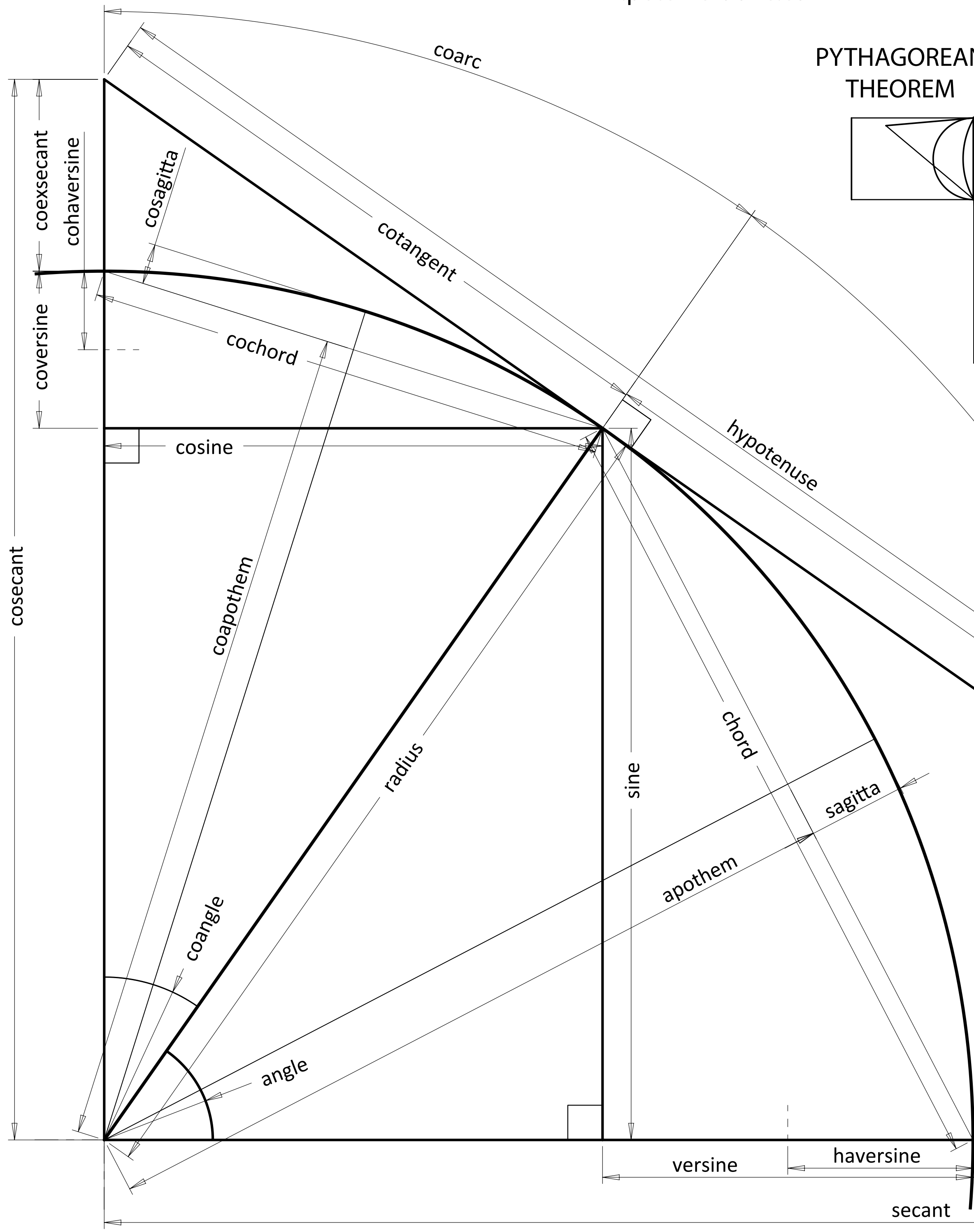
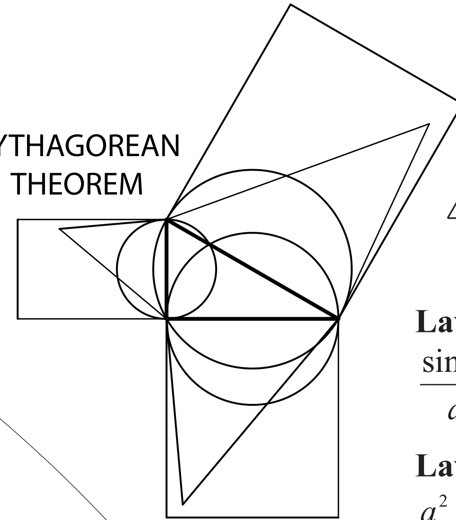
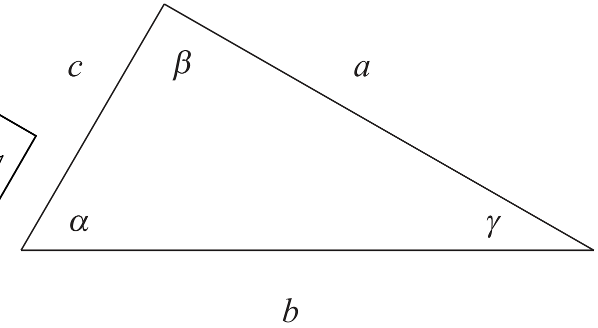


PYTHAGOREAN THEOREM





Law of Sines

$$\frac{\sin\alpha}{a}=\frac{\sin\beta}{b}=\frac{\sin\gamma}{c}$$

Law of Cosines

$$a^2=b^2+c^2-2bc\cos\alpha$$

$$b^2=a^2+c^2-2ac\cos\beta$$

$$c^2=a^2+b^2-2ab\cos\gamma$$

Law of Tangents

$$\frac{a-b}{a+b}=\frac{\tan\frac{1}{2}(\alpha-\beta)}{\tan\frac{1}{2}(\alpha+\beta)}$$

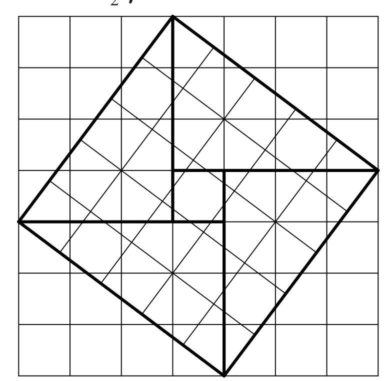
$$\frac{b-c}{b+c}=\frac{\tan\frac{1}{2}(\beta-\gamma)}{\tan\frac{1}{2}(\beta+\gamma)}$$

$$\frac{a-c}{a+c}=\frac{\tan\frac{1}{2}(\alpha-\gamma)}{\tan\frac{1}{2}(\alpha+\gamma)}$$

Mollweide's Formula

$$\frac{a+b}{c}=\frac{\cos\frac{1}{2}(\alpha-\beta)}{\sin\frac{1}{2}\gamma}$$

180 degrees = π radians



Gougu theorem

SKYNET

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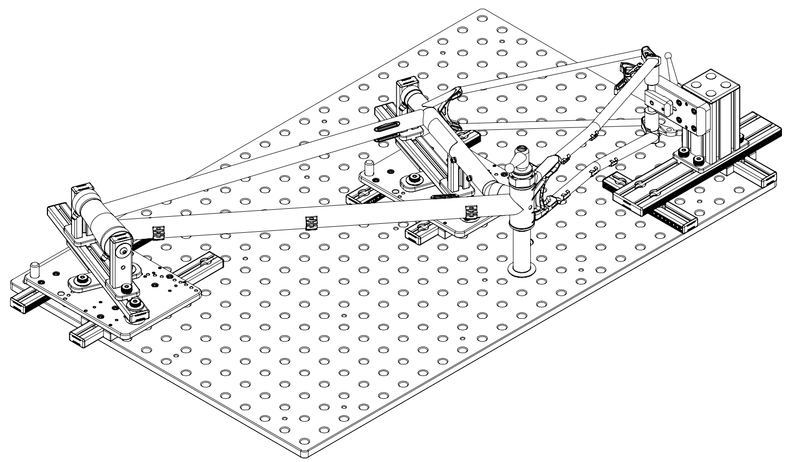
Bill of Materials



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Required								
Supplier	QTY	Supplier Part Number	Description	QTY Required	QTY per Package	Cost per Package	Total Cost	Cost Required
McMaster-Carr	8	3408A79	Slotted Spring Plunger with 440C Stainless Steel Ball-Nose, Steel Body, 3/8"-16 Thread, 2.5-5 lb. Nose For	8	1	$3.85	$30.80	$30.80
McMaster-Carr	2	98704A625	Plastic-Head Thumb Screw with Hex Drive, 1/4"-20 Thread Size, 7/8" Long	14	10	$11.43	$22.86	$16.00
McMaster-Carr	2	93886A104	Reinforced Plastic Knurled-Head Thumb Nut, 1/4"-20 Thread Size, 1" Head Diameter	12	10	$10.00	$20.00	$12.00
McMaster-Carr	1	6271K46	Zinc Adjustable-Position Handle with 1/2"-13 Threaded 1-3/16" Long Stud, 2-5/8" Projection, Black	1	1	$9.81	$9.81	$9.81
McMaster-Carr	1	6271K38	Zinc Adjustable-Position Handle with 5/16"-18 Threaded 1-3/4" Long Stud, 1-13/16" Projection, Black	1	1	$9.05	$9.05	$9.05
McMaster-Carr	2	3408A8	Slotted Spring Plunger with 440C Stainless Steel Ball-Nose, Steel Body, 3/8"-16 Thread, 5-10 lb. Nose Forc	2	1	$3.85	$7.70	$7.70
McMaster-Carr	1	92196A543	18-8 Stainless Steel Socket Head Screw, 1/4"-20 Thread Size, 1-1/8" Long	12	25	$9.49	$9.49	$4.56
McMaster-Carr	2	92210A583	18-8 Stainless Steel Hex Drive Flat Head Screw, 82 Degree Countersink Angle, 5/16"-18 Thread Size, 1" Lon	12	10	$3.60	$7.20	$4.32
McMaster-Carr	1	91525A119	316 Stainless Steel Washer, Oversized, 1/4" Screw Size, 0.266" ID, 0.875" OD	12	25	$8.44	$8.44	$4.05
McMaster-Carr	1	92373A252	18-8 Stainless Steel Slotted Spring Pin, 3/16" Diameter, 1 1/8" Long	18	50	$11.07	$11.07	$3.99
McMaster-Carr	1	92196A539	18-8 Stainless Steel Socket Head Screw, 1/4"-20 Thread Size, 5/8" Long	16	50	$10.47	$10.47	$3.35
McMaster-Carr	1	90377A157	Black-Oxide 18-8 Stainless Steel Washer, Oversized, 1/4" Screw Size, 0.266" ID, 1" OD	4	10	$7.79	$7.79	$3.12
McMaster-Carr	1	90377A158	Black-Oxide 18-8 Stainless Steel Washer Oversized, 1/4" Screw Size, 0.266" ID, 1.25" OD	2	10	$7.79	$7.79	$1.56
McMaster-Carr	1	92196A542	18-8 Stainless Steel Socket Head Screw, 1/4"-20 Thread Size, 1" Long	4	50	$16.07	$16.07	$1.29
McMaster-Carr	1	92196A274	18-8 Stainless Steel Socket Head Screw, 10-32 Thread Size, 1" Long	10	100	$11.48	$11.48	$1.15
McMaster-Carr	1	92210A580	18-8 Stainless Steel Hex Drive Flat Head Screw, 82 Degree Countersink Angle, 5/16"-18 Thread Size, 5/8" L	4	25	$5.86	$5.86	$0.94
McMaster-Carr	1	94355A707	18-8 Stainless Steel Flat-Tip Set Screws, 1/4"-20 Thread, 5/8" Long	3	10	$2.81	$2.81	$0.84
McMaster-Carr	1	92373A250	18-8 Stainless Steel Slotted Spring Pin, 3/16" Diameter, 7/8" Long	5	50	$8.12	$8.12	$0.81
McMaster-Carr	1	92196A624	18-8 Stainless Steel Socket Head Screw, 3/8"-16 Thread Size, 1" Long	1	10	$7.98	$7.98	$0.80
McMaster-Carr	1	92949A581	18-8 Stainless Steel Button Head Hex Drive Screw, 5/16"-18 Thread Size, 3/4" Long	3	25	$6.04	$6.04	$0.72
McMaster-Carr	1	92210A303	18-8 Stainless Steel Hex Drive Flat Head Screw, 82 Degree Countersink Angle, 10-32 Thread Size, 5/8" Lon	8	100	$8.06	$8.06	$0.64
McMaster-Carr	1	92210A539	18-8 Stainless Steel Hex Drive Flat Head Screw, 82 Degree Countersink Angle, 1/4"-20 Thread Size, 5/8" Lo	4	50	$6.37	$6.37	$0.51
McMaster-Carr	1	98019A390	18-8 Stainless Steel Mil. Spec. Washer, Passivated, 5/16" Screw Size, MS/NASM 15795-813	1	25	$11.90	$11.90	$0.48
McMaster-Carr	1	90313A108	18-8 Stainless Steel Oversized Washer for 1/4" Screw, 0.281" ID, 1.250" OD, 0.043"-0.057" Thick	3	50	$7.65	$7.65	$0.46
McMaster-Carr	1	90107A011	316 Stainless Steel Washer for Number 10 Screw Size, 0.203" ID, 0.438" OD	10	100	$3.64	$3.64	$0.36
McMaster-Carr	1	90313A114	18-8 Stainless Steel Oversized Washer for 3/8" Screw, 0.406" ID, 1.250" OD, 0.043"-0.057" Thick	1	25	$5.11	$5.11	$0.20
McMaster-Carr	1	8975K222	Multipurpose 6061 Aluminum, 1/2" Thick x 8" Wide	20.5	24	$75.61	$75.61	$64.58
McMaster-Carr	1	88915K75	Tight-Tolerance Easy-to-Machine 303 Stainless Steel Rod, 1" Diameter (Crank Shell Tower)	8.1	12	$42.90	$42.90	$28.96
McMaster-Carr	1	8663K21	Black Delrin® Acetal Resin Bar, 3/4" Thick, 3/4" Wide	22.0	24	$18.92	$18.92	$17.34
McMaster-Carr	1	8975K39	Multipurpose 6061 Aluminum, 1" Thick x 2-1/2" Wide	6.0	6	$16.20	$16.20	$16.20
McMaster-Carr	1	8984K91	Easy-to-Machine 303 Stainless Steel Rod, 3/4" Diameter (Table Pins)	8.9	12	$18.12	$18.12	$13.41
McMaster-Carr	1	8975K78	Multipurpose 6061 Aluminum, 3/4" Thick x 2" Wide	9.0	12	$16.41	$16.41	$12.31
McMaster-Carr	1	8984K52	Easy-to-Machine 303 Stainless Steel Rod, 1-7/8" Diameter (Crank Tower Reducer Puller)	1.3	6	$50.82	$50.82	$10.67
McMaster-Carr	1	8975K41	Multipurpose 6061 Aluminum, 3/8" Thick x 1-1/2" Wide	22.0	24	$11.28	$11.28	$10.34
McMaster-Carr	1	8975K224	Multipurpose 6061 Aluminum, 5/8" Thick x 3" Wide	5.0	6	$12.17	$12.17	$10.14
McMaster-Carr	1	89535K12	Multipurpose 304/304L Stainless Steel Rod, 3/4" Diameter	8.9	12	$11.85	$11.85	$8.77
McMaster-Carr	1	9056K77	Multipurpose 6061 Aluminum Round Tube, 0.083" Wall Thickness, 1-1/4" OD	4.0	12	$19.57	$19.57	$6.52
McMaster-Carr	1	8984K57	Easy-to-Machine 303 Stainless Steel Rod, 2" Diameter (Crank Tower Standoff End)	0.4	6	$57.67	$57.67	$3.60
McMaster-Carr	1	8984K87	Easy-to-Machine 303 Stainless Steel Rod, 5/8" Diameter (Cosine & Pivot Pin)	2.7	6	$7.91	$7.91	$3.55
McMaster-Carr	1	8984K39	Easy-to-Machine 303 Stainless Steel Rod, 1-1/2" Diameter (Crank Tower Standoff End)	0.4	6	$35.57	$35.57	$2.22
8020	113	1575-Black-FB	1.50" X .75" Smooth Surface T-Slotted Profile - Single Open T-Slot	112.0	1	$0.53	$59.89	$59.37
8020	15	2036	15 Series End Cap with Molded Push-In Stem	15.0	1	$1.70	$25.50	$25.50
8020	2	8900-36	15 Series Standard Slide-in T-Nut (Order blank, no holes)	50.0	36	$15.15	$30.30	$21.04
8020	14	3075-Black-FB	3.00" X .75" Smooth Surface T-Slotted Profile - Two Adjacent Open T-Slots	14.0	1	$1.09	$15.26	$15.26
8020	6	3030-S-Black	3.00" X 3.00" Smooth T-Slotted Profile - Eight Open T-Slots	5.3	1	$1.73	$10.38	$9.24
8020	2	2037	15 Series End Cap with Molded Push-In Stem	2.0	1	$1.80	$3.60	$3.60
8020	1	2050-Plain	15 Series End Cap with Push-In Fastener	1.0	1	$1.95	$1.95	$1.95
Oregon Rule	2	0.5" CN LtR, .5m	0.5 " Wide – "CN" – Centimeter Narrow, Adhesive Polyester Rule (substitute to metal improved quality)	2	1	$3.00	$6.00	$6.00
Oregon Rule	2	0.5" CN RtL, .5m	0.5 " Wide – "CN" – Centimeter Narrow, Adhesive Polyester Rule (substitute to metal improved quality)	2	1	$3.00	$6.00	$6.00
Oregon Rule	1	0.5" CN RtL, 1m	0.5 " Wide – "CN" – Centimeter Narrow, Adhesive Polyester Rule (substitute to metal improved quality)	1	1	$5.75	$5.75	$5.75
Oregon Rule	1	0.5" CN RtL, 1m	0.5 " Wide – "CN" – Centimeter Narrow, Adhesive Polyester Rule (substitute to metal improved quality)	1	1	$5.75	$5.75	$5.75
Zoro	1	G4991380	Drill Mill, Hss, 90 deg., 3/4" x 1-11/16, Melin A-2424-DP	1	1	$38.79	$38.79	$38.79
			Totals - Required					$526.37

There are many optional purchases that need to be decided on. Every user has different specification that others aren't interested, thus they have been broken out. They have been referenced below. Combining stock orders and adjusting some sizes is wise and will save considerable amounts of funds.

Optional										
Supplier	**QTY**		**Supplier Part Number**		**Description**	**QTY Required**	**QTY per Package**	**Cost per Package**	**Total Cost**	**Cost Required**
McMaster-Carr	1		8984K57		Easy-to-Machine 303 Stainless Steel Rod, 2" Diameter (Option: Conical Seat Tube Pin)	2.1	6	$57.67	$57.67	$20.38
McMaster-Carr	1		8984K63		Easy-to-Machine 303 Stainless Steel Rod, 2-3/8" Diameter (Option: IS52 Head Tube Lower Pin)	1.4	6	$78.56	$78.56	$17.81
McMaster-Carr	1		8984K39		Easy-to-Machine 303 Stainless Steel Rod, 1-1/2" Diameter (Option: Cylindrical Seat Tube Pin)	2.8	6	$35.57	$35.57	$16.66
McMaster-Carr	1		8984K57		Easy-to-Machine 303 Stainless Steel Rod, 2" Diameter (Option: EC44 Head Tube Lower Pin)	1.4	6	$57.67	$57.67	$13.07
McMaster-Carr	4		5779K108		Push-to-Connect Tube Fitting for Air, Straight Adapter, for 1/4" Tube OD x 1/8 NPT Male (Option: Purge)	4	1	$3.16	$12.64	$12.64
McMaster-Carr	1		89535K37		Multipurpose 304/304L Stainless Steel Rod, 1" Diameter (Optional, for reference Pins)	4.0	6	$10.37	$10.37	$6.91
McMaster-Carr	1		8984K59		Easy-to-Machine 303 Stainless Steel Rod, 2-1/8" Diameter (Option: TH47 Top)	0.6	6	$65.11	$65.11	$6.41
McMaster-Carr	1		8984K59		Easy-to-Machine 303 Stainless Steel Rod, 2-1/8" Diameter (Option: TH47 Bottom)	0.6	6	$65.11	$65.11	$6.41
McMaster-Carr	1		8984K59		Easy-to-Machine 303 Stainless Steel Rod, 2-1/8" Diameter (Option: PF46 Top)	0.6	6	$65.11	$65.11	$6.41
McMaster-Carr	1		8984K59		Easy-to-Machine 303 Stainless Steel Rod, 2-1/8" Diameter (Option: PF46 Bottom)	0.6	6	$65.11	$65.11	$6.41
McMaster-Carr	1		8984K52		Easy-to-Machine 303 Stainless Steel Rod, 1-7/8" Diameter (Option: TH35 Top)	0.6	6	$50.82	$50.82	$5.00
McMaster-Carr	1		8984K52		Easy-to-Machine 303 Stainless Steel Rod, 1-7/8" Diameter (Option: PF41 Top)	0.6	6	$50.82	$50.82	$5.00
McMaster-Carr	1		8984K52		Easy-to-Machine 303 Stainless Steel Rod, 1-7/8" Diameter (Option: PF41 Bottom)	0.6	6	$50.82	$50.82	$5.00
McMaster-Carr	1		8984K45		Easy-to-Machine 303 Stainless Steel Rod, 1-5/8" Diameter (Option: TH35 Bottom)	0.6	6	$40.38	$40.38	$3.97
McMaster-Carr	1		90252A104		Flat Head Screws for Particleboard and Fiberboard, Black-Oxide Steel, Number 6 Size, 3/4" Long (Option: MDF)	18	100	$6.79	$6.79	$1.22
Zoro	1		G8588151		NC Spotting Drills, 82 deg., RH, 5in., HSS, KEO 38342 (Optional)	1	1	$73.96	$73.96	$73.96

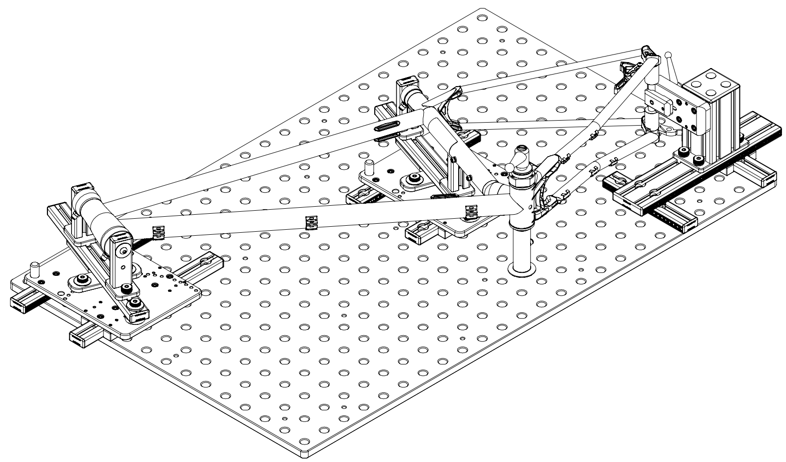
QTY	PART
2	Angle Slide Plate
2	Angle Beam
2	Angle Beam Clamp
2	Angle Beam Pivot Spacer
2	Angle Beam Spacer
2	Angle Beam Pin
1	Axle Bracket
1	Axle Clamp
1	Bearing, Reference -Long
4	Bearing, Reference -Short
1	Bearing, Tension -Long
4	Bearing, Tension -Short
2	Cosine Reference Pin
1	Crank Tower Reducer Puller
3	Crank Tower Reducer Spacer
1	Crank Tower
1	Crank Tower Standoff - Bottom
1	Crank Tower Standoff - Top
12	Rail Pin
1	Slide Plate - Axle Tower
4	Slide Plate - Tube Pins
3	8020 Slide Tower - Cones
1	8020 Axle X Rail
2	8020 Axle Y Rail
2	8020 Head Tube Rail
2	8020 Seat Tube Rail
1	8020 Slide Tower - Axle
2	8020 T-Nut - Long, 1/4-20
14	8020 T-Nut - Short, 1/4-20
2	8020 T-Nut - Short, 5/16-18
2	8020 Tube Beam

OPTIONS
Head Tube Top Cone
Seat Tube Cone
Seat Tube Stepped Cylinder
IS52 Head Tube Puck
EC44 Head Tube Puck
EC34 Head Tube Puck
EC49 Head Tube Puck
EC56 Head Tube Puck
IS41 Head Tube Puck
Crank Tower Standoff - PF41/PF46/TH47 - 89.5
Crank Tower Standoff - PF41/PF46/TH47 - 86
Crank Tower Standoff - TH35/TH47/PF46 - 73
Crank Tower Standoff - TH35/TH47/PF46 - 68
Crank Tower Reducer - PF41 Bottom
Crank Tower Reducer - PF41 Top
Crank Tower Reducer - PF46 Bottom
Crank Tower Reducer - PF46 Top
Crank Tower Reducer - TH35 Bottom
Crank Tower Reducer - TH35 Top
Crank Tower Reducer - TH47 Bottom
Crank Tower Reducer - TH47 Top
8020 Slide Tower - Tube, 1 1/8"
8020 Slide Tower - Tube, 1 1/4"
8020 Slide Tower - Tube, 1 3/8"
8020 Slide Tower - Tube, 1 1/2"
Reference Pin

SKYNET

A BICYCLE CHASSIS FIXTURE

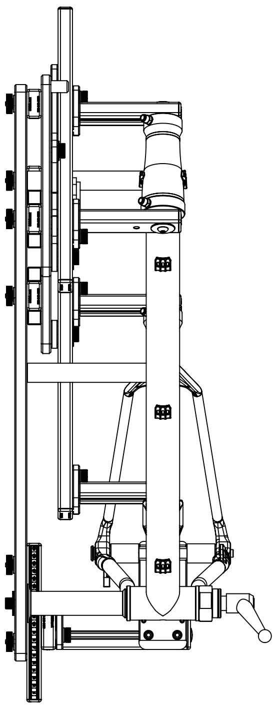
ASSEMBLIES AND SUB-ASSEMBLIES

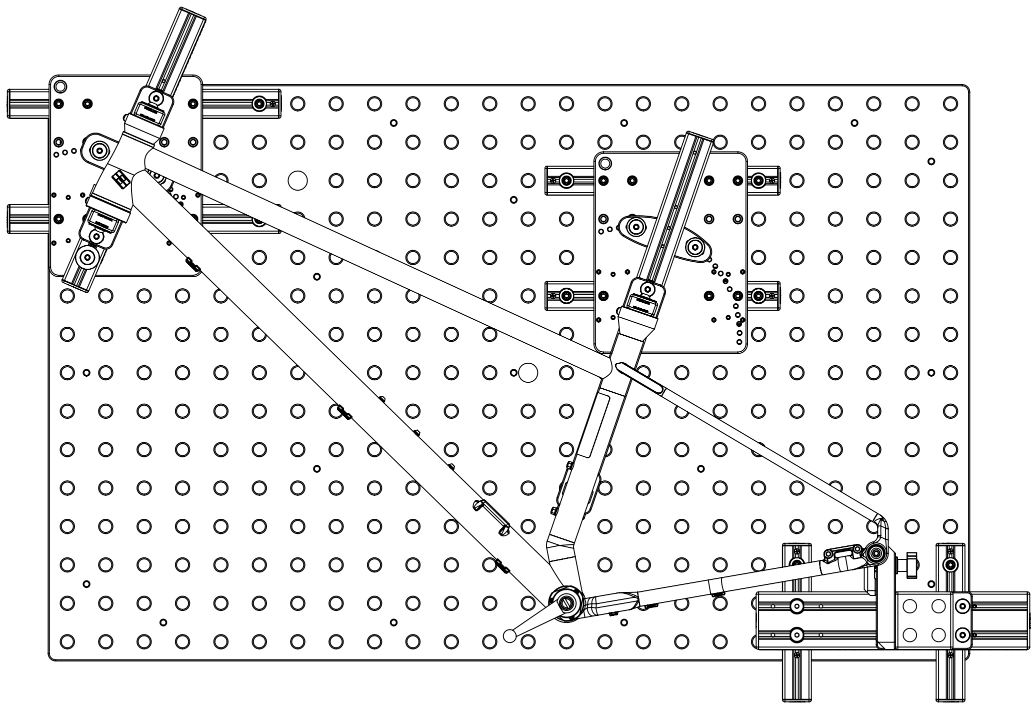


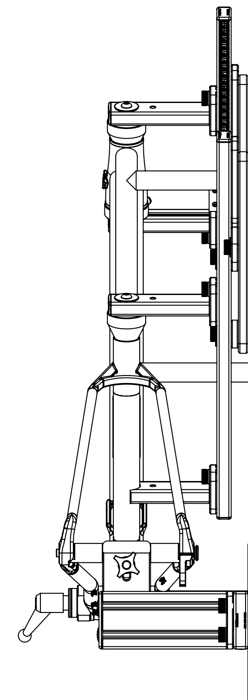
pvd

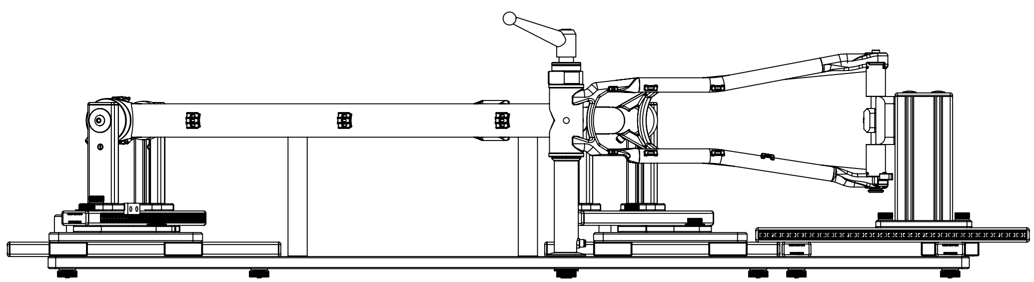
PETER VERDONE DESIGNS, FAIRFAX, CA 94930

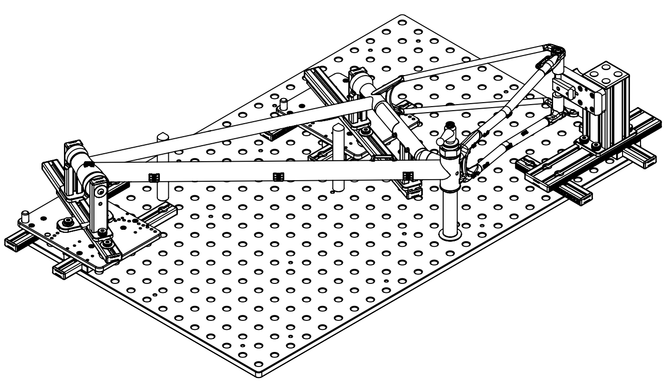
REV:2022-02-18-1











Fixture shown with Seigmund table (preferred) and a very modern geometry frame.

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
PVD SKYNET
Frame Fixture

PETER VERDONE DESIGNS
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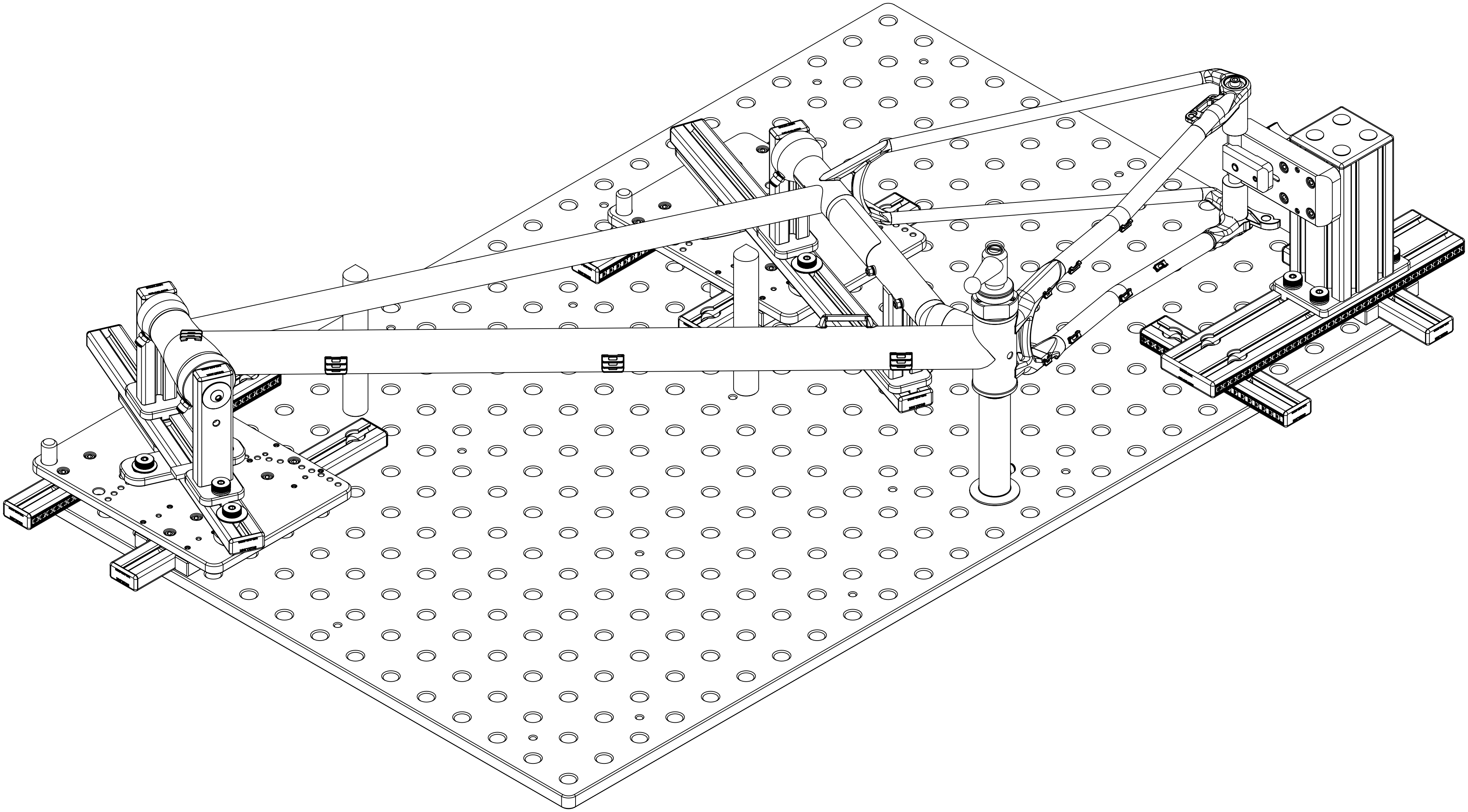
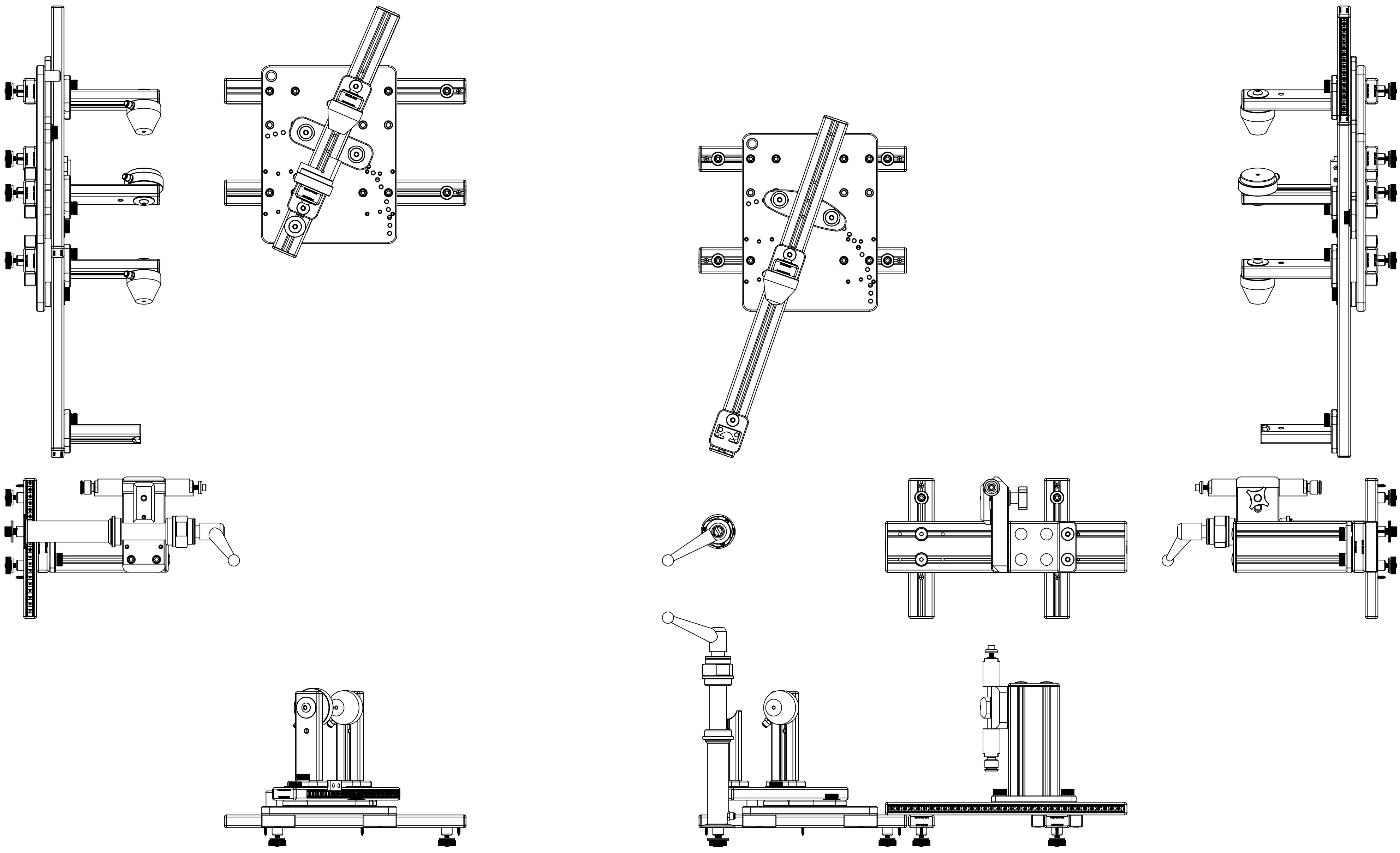
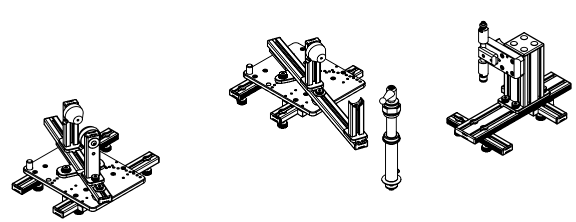
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 1:10 | 2023-01-07 | REV

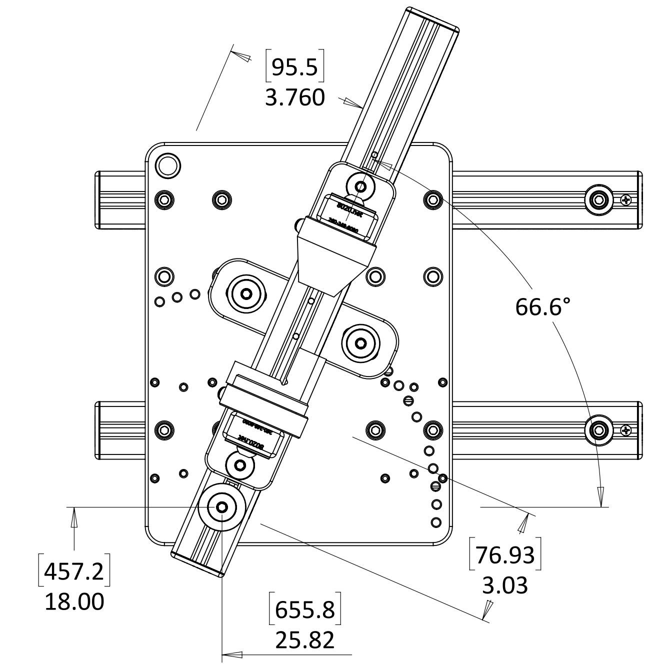


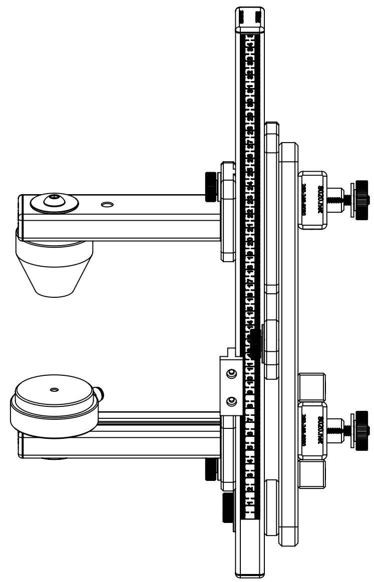
PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: SKYNET on RhinoCart
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF PETER VERDONE DESIGNS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF PETER VERDONE DESIGNS IS PROHIBITED.	TOLERANCES: ANGULAR: MACH X ±.5 BEND X ±1 ONE PLACE DECIMAL X.X ±.1 TWO PLACE DECIMAL X.XX ±.01 THREE PLACE DECIMAL X.XXX ±.005	PETER VERDONE DESIGNS FAIRFAX, CA 94930 (415) 686-0257 PETERVERDONE@GMAIL.COM WWW.PETERVERDONE.COM
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:		
COMMENTS:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 7:40 | 2023-01-07 | REV

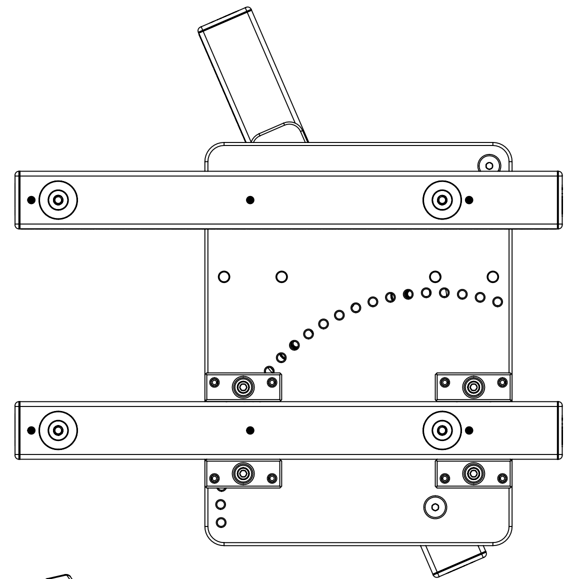




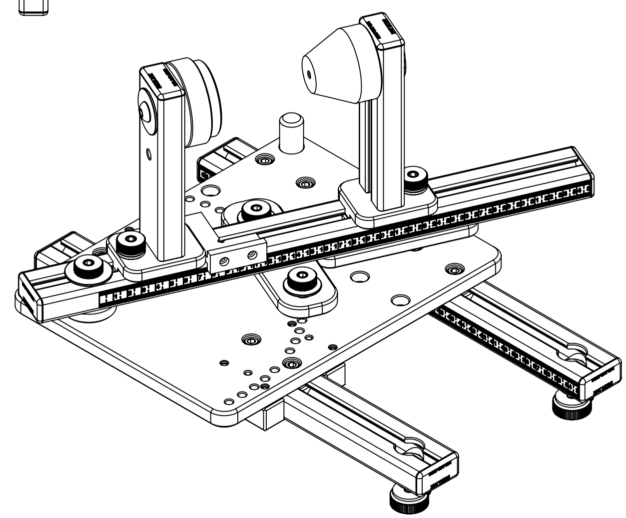
PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: PVD SKYNET Frame Fixture
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF PETER VERDONE DESIGNS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF PETER VERDONE DESIGNS IS PROHIBITED.	TOLERANCES: ANGULAR: MACH X ± .5 BEND X ± 1 ONE PLACE DECIMAL X.X ± .1 TWO PLACE DECIMAL X.XX ± .01 THREE PLACE DECIMAL X.XXX ± .005	PETER VERDONE DESIGNS FAIRFAX, CA 94930 (415) 686-0257 PETERVERDONE@GMAIL.COM WWW.PETERVERDONE.COM
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 5:40
COMMENTS:		2023-01-07 REV

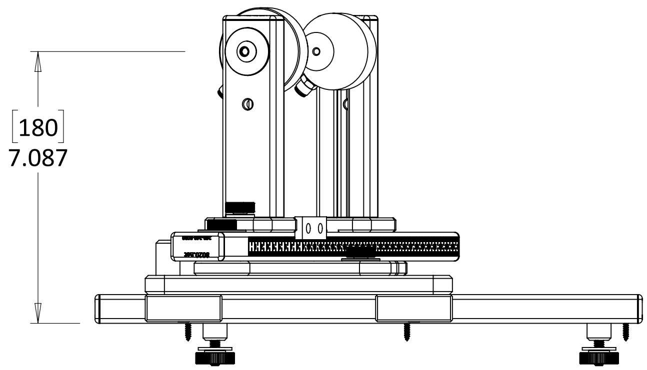






Angle Adjustment =
COS(66.6 - 9) * 9.000 - (1.500 + .625) / 2
= 3.760" (95.5mm)





MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X $\pm$.5	BEND X $\pm$1
ONE PLACE DECIMAL	X.X $\pm$.1
TWO PLACE DECIMAL	X.XX $\pm$.01
THREE PLACE DECIMAL	X.XXX $\pm$.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE: Head Angle Slide

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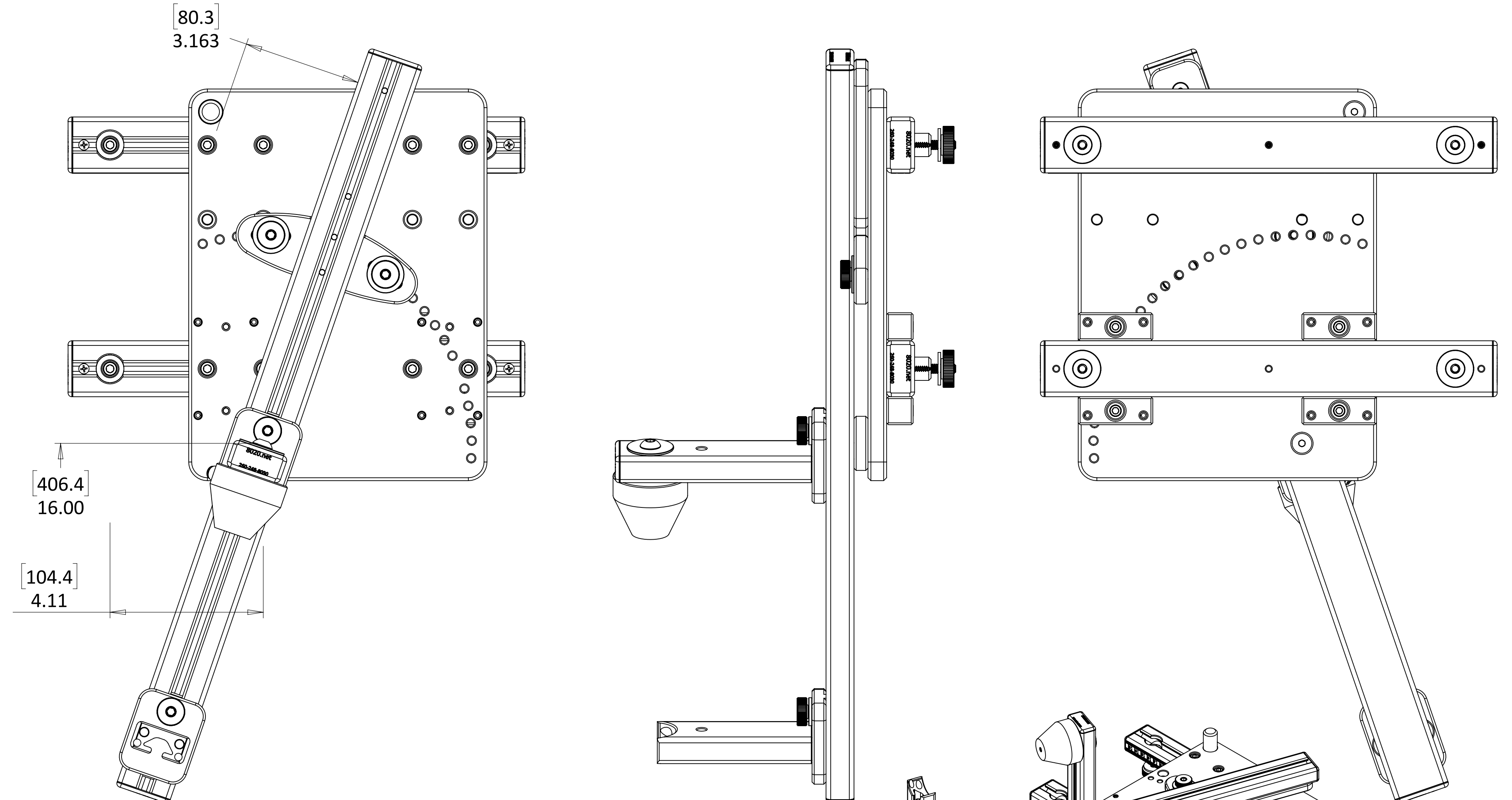
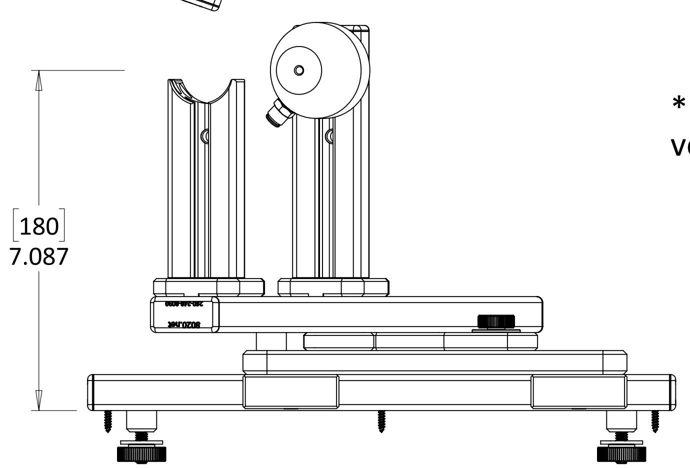
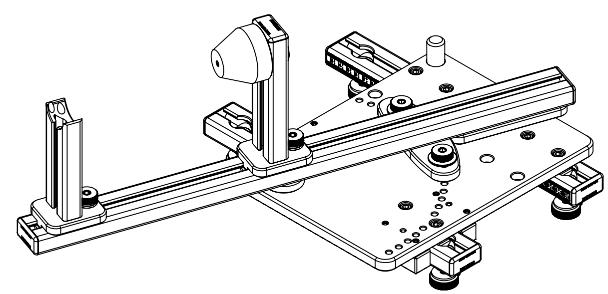
WWW.PETERVERDONE.COM

SCALE: 4:20 | 2023-01-07 | REV





* Shown with optional CNC version angle clamp plate.



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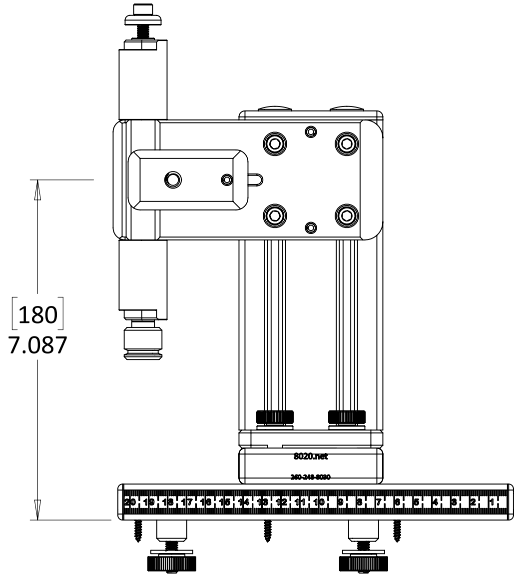
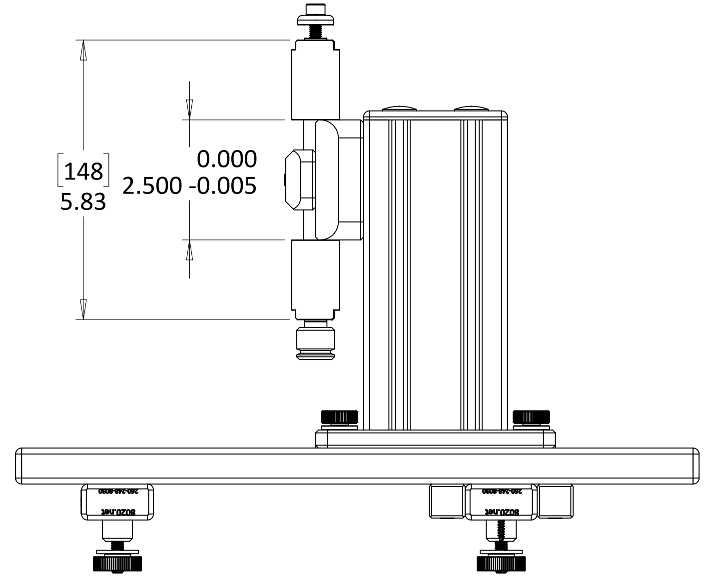
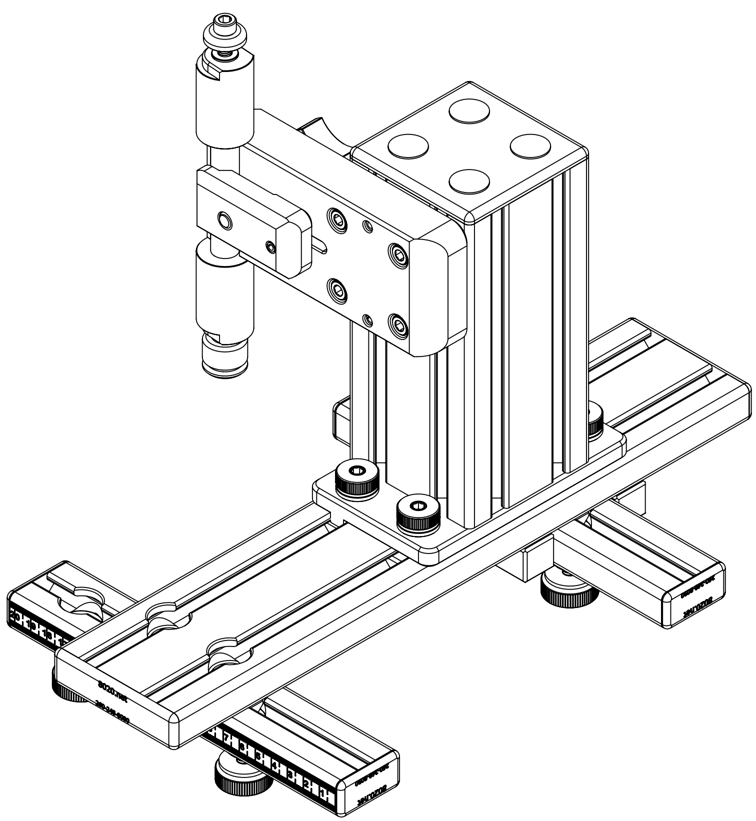
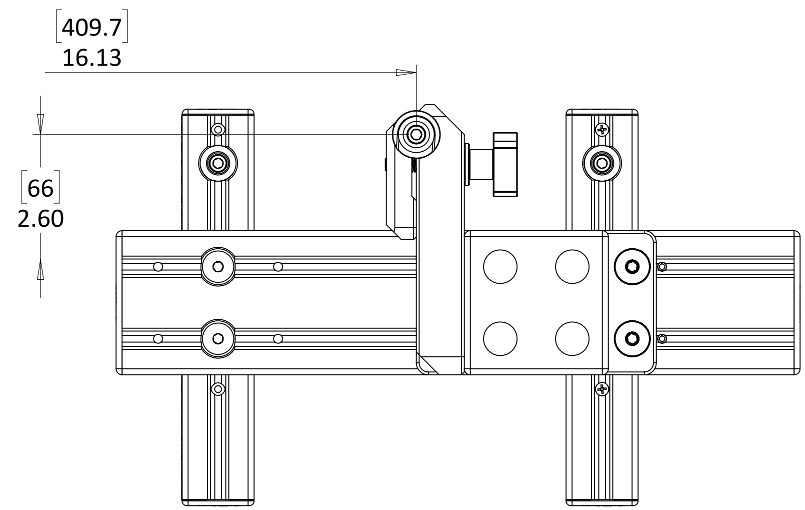
MATERIAL:	TOLERANCES: ANGULAR: MACH X ± .5 BEND X ± 1 ONE PLACE DECIMAL X.X ± .1 TWO PLACE DECIMAL X.XX ± .01 THREE PLACE DECIMAL X.XXX ± .005	PETER VERDONE DESIGNS FAIRFAX, CA 94930 (415) 686-0257 PETERVERDONE@GMAIL.COM WWW.PETERVERDONE.COM
FINISH:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
COMMENTS:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 1:4 / 2023-01-07 / REV









MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

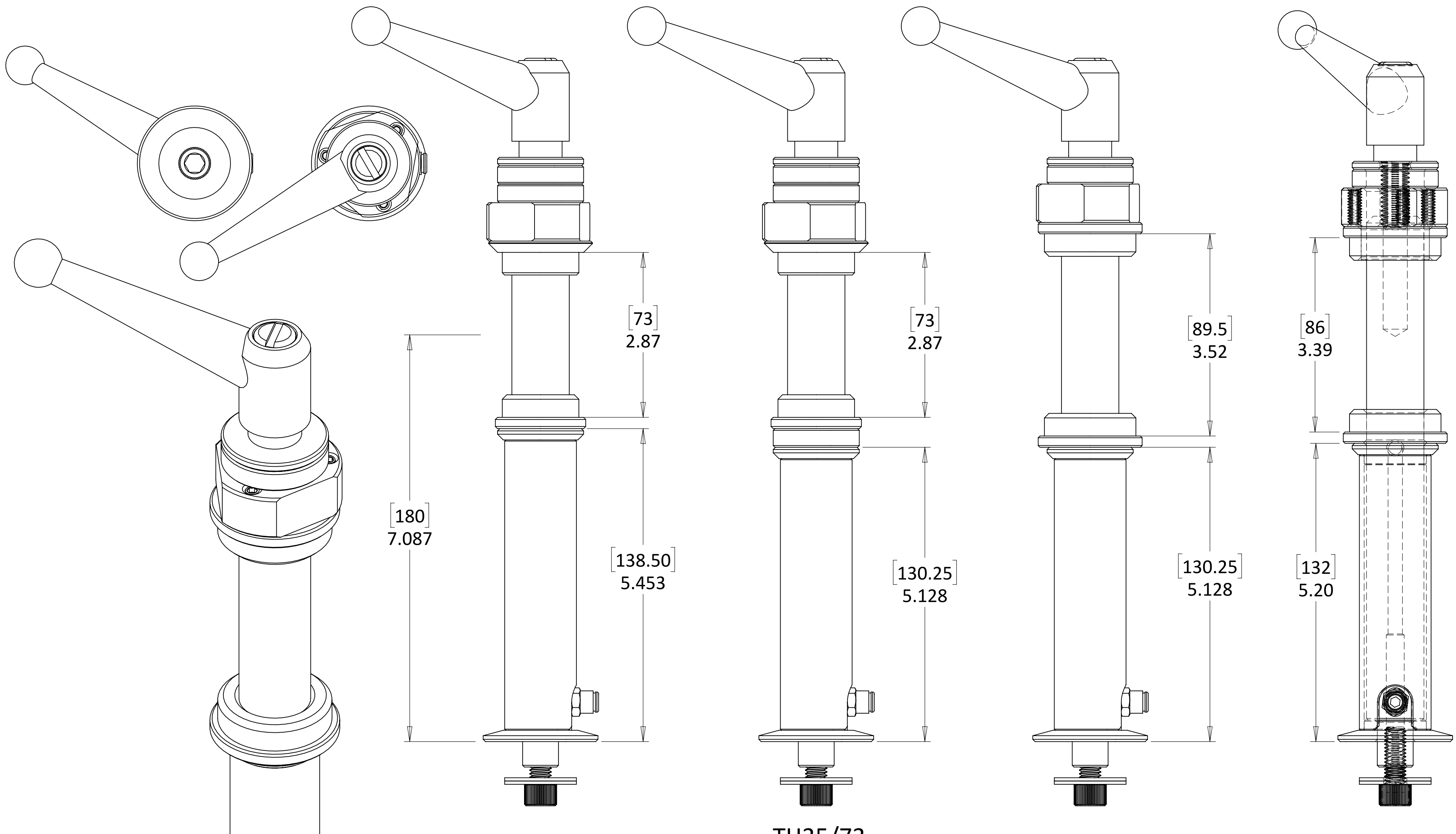
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Rear Axle Holder

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

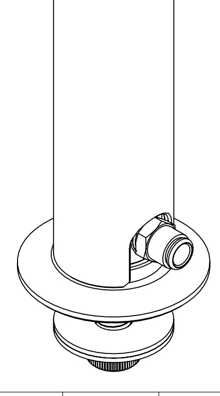
SCALE: 5:20 | 2023-01-07 | REV



TH35/73

TH35/73 Optionally Spaced

PF41/89.5



MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Crank Shell Tower

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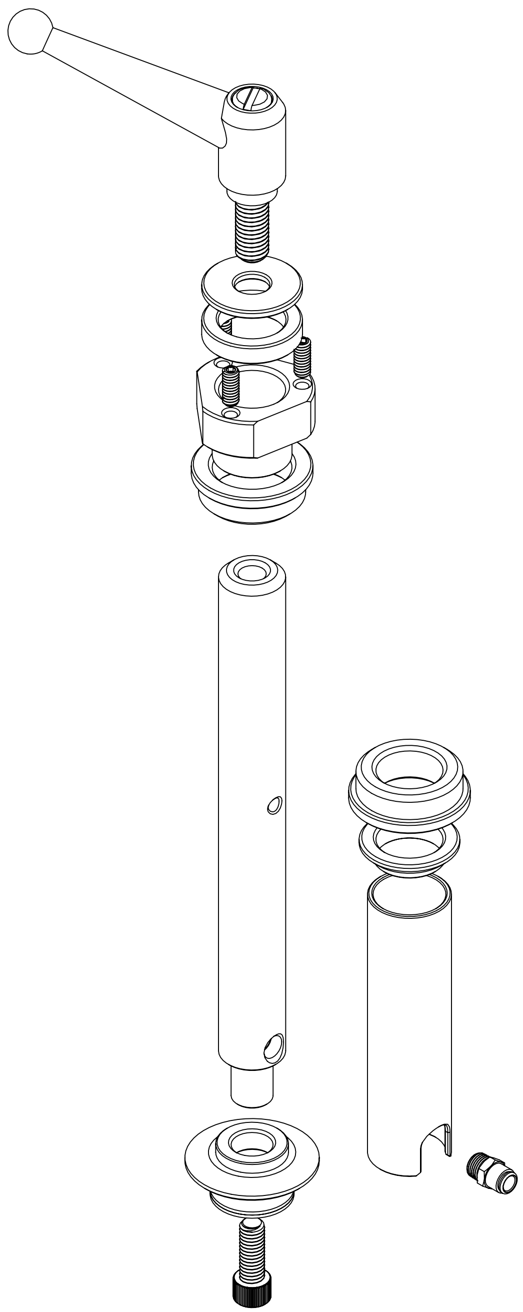
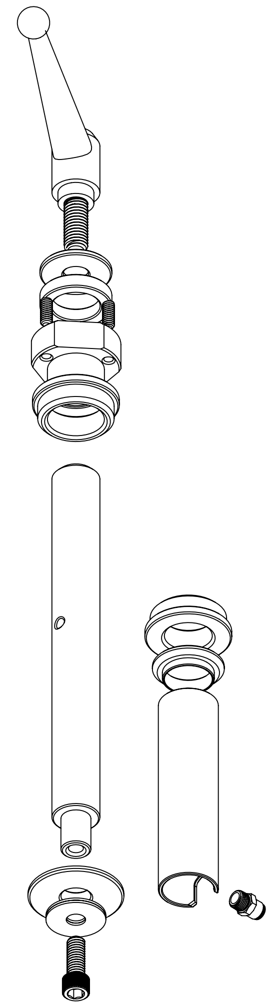
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 2:5

2023-01-07

REV





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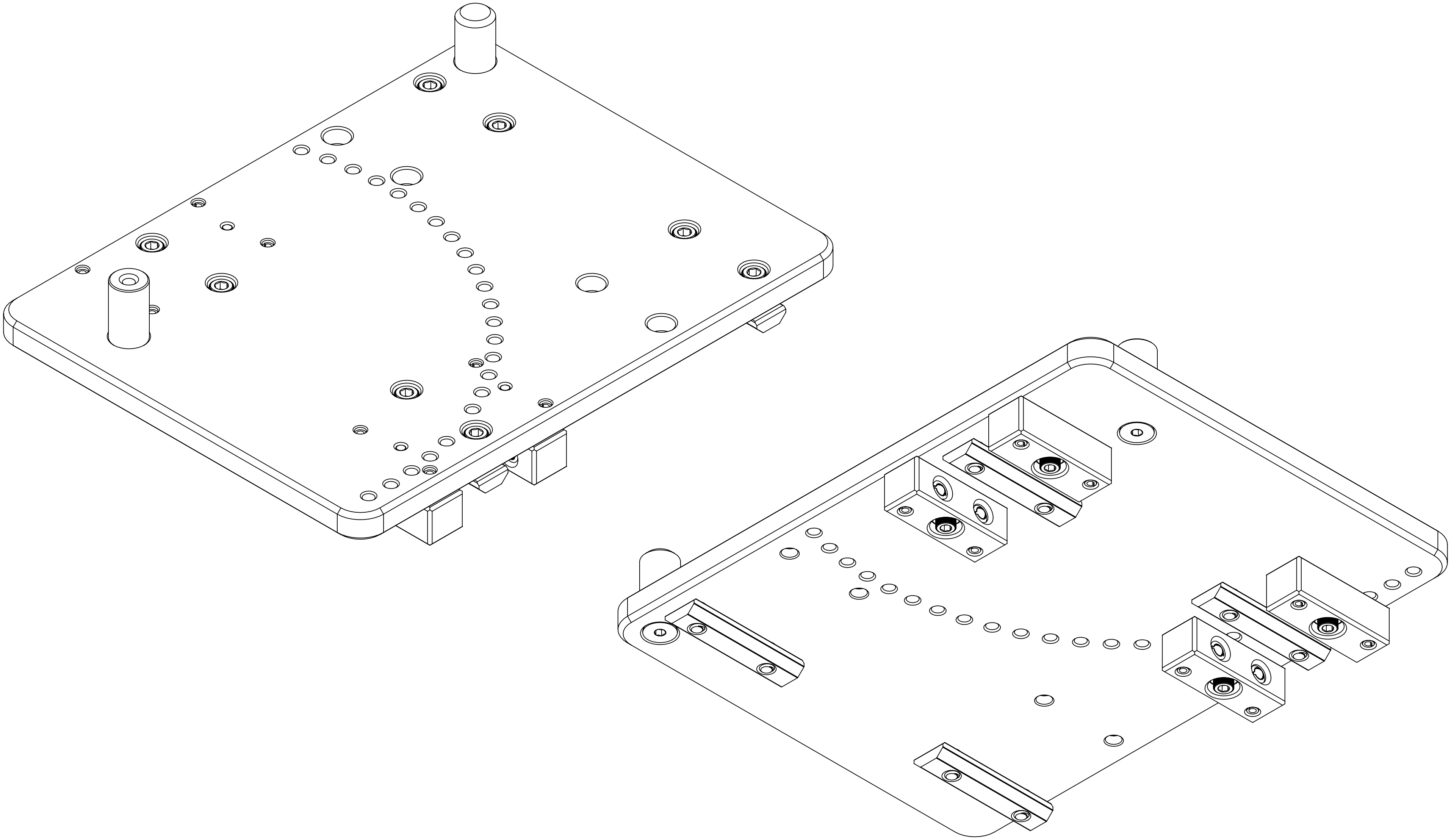
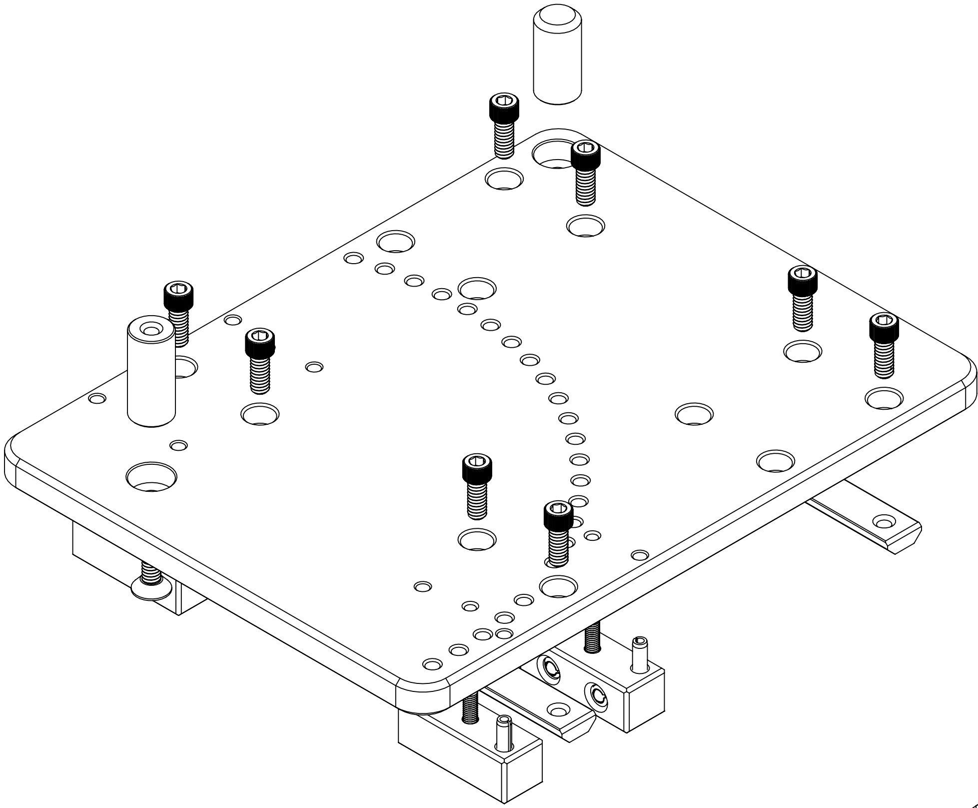
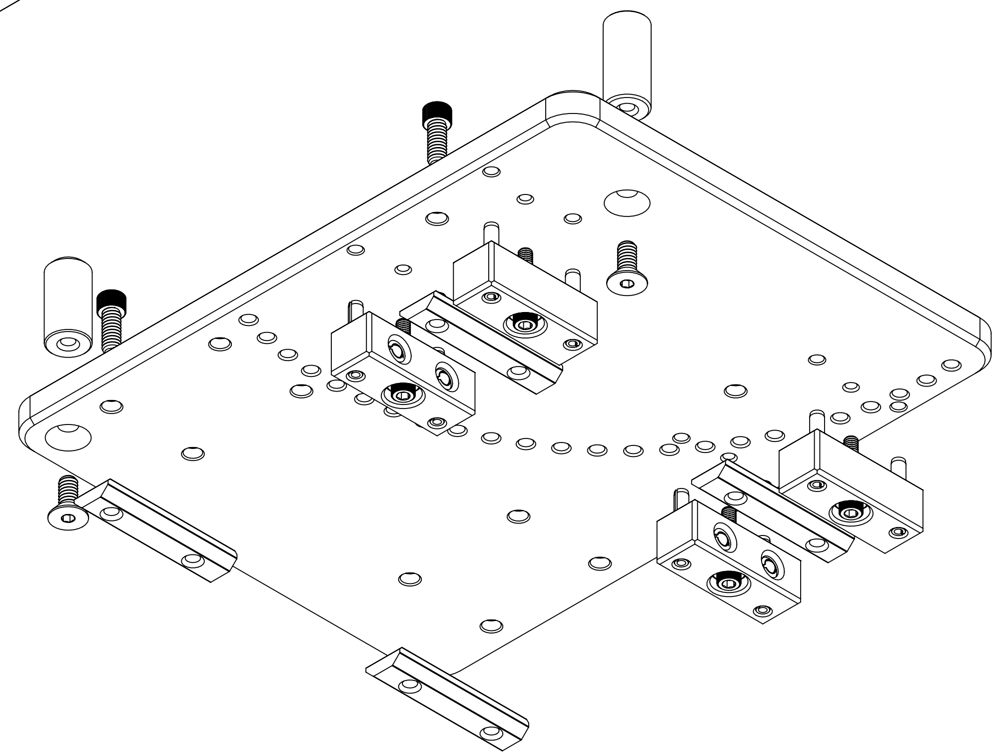
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	PETER VERDONE DESIGNS FAIRFAX, CA 94930 (415) 686-0257 PETERVERDONE@GMAIL.COM WWW.PETERVERDONE.COM
FINISH:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 7:20
COMMENTS:		2023-01-07 REV



PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: Angle Slide Base
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF PETER VERDONE DESIGNS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF PETER VERDONE DESIGNS IS PROHIBITED.	TOLERANCES: ANGULAR: MACH X ±.5 BEND X ±1 ONE PLACE DECIMAL X.X ±.1 TWO PLACE DECIMAL X.XX ±.01 THREE PLACE DECIMAL X.XXX ±.005	PETER VERDONE DESIGNS FAIRFAX, CA 94930 (415) 686-0257 PETERVERDONE@GMAIL.COM WWW.PETERVERDONE.COM
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:		
COMMENTS:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 9:20 | 2023-01-07 | REV





MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ± .5	BEND X ± 1
ONE PLACE DECIMAL	X.X ± .1
TWO PLACE DECIMAL	X.XX ± .01
THREE PLACE DECIMAL	X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Angle Slide Base

PETER VERDONE DESIGNS
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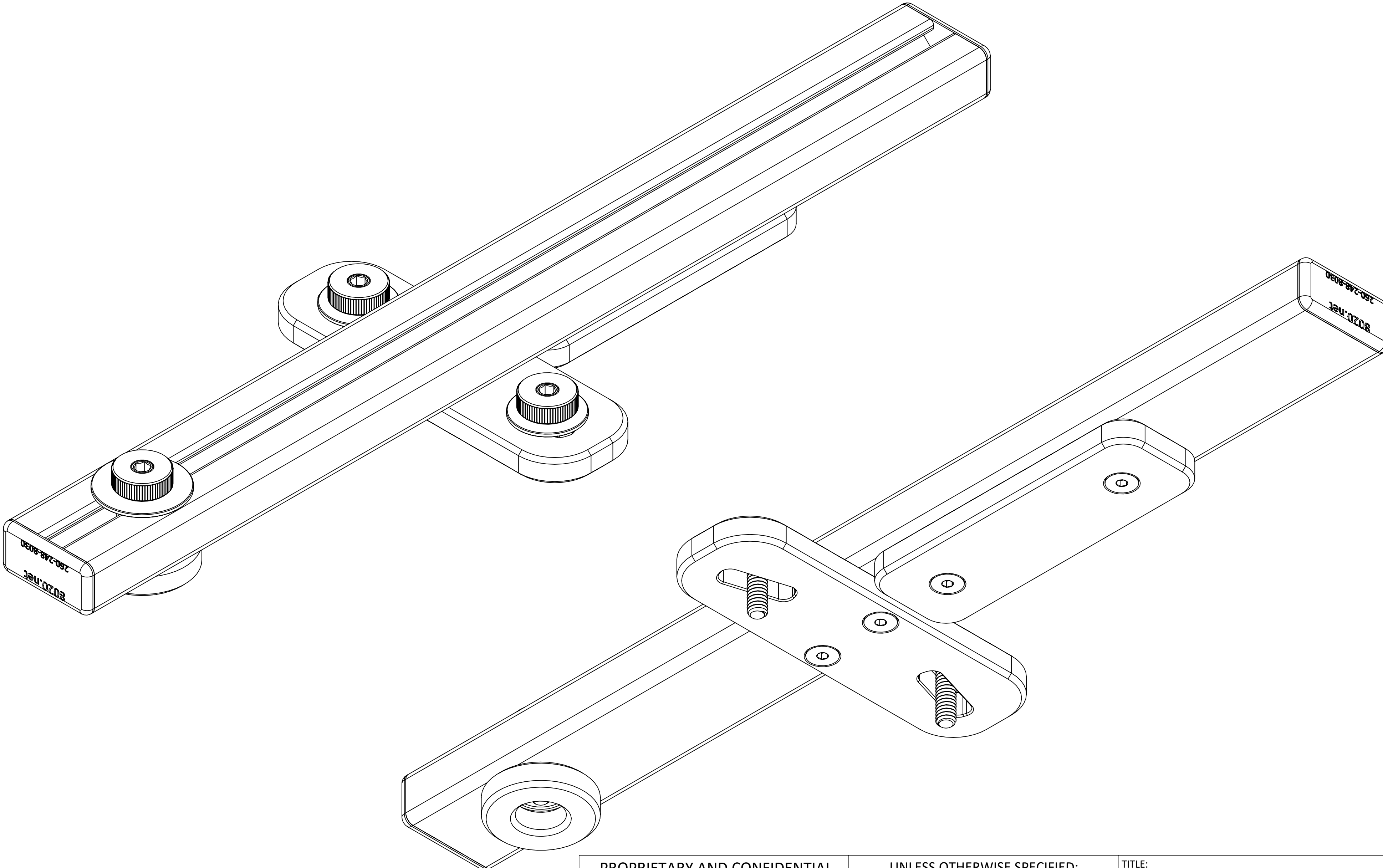
SCALE: 8:20 | 2023-01-07 | REV



Note:
1. Seat tube beam does not get a scale.
2. Increase beam length for more range.

PROPRIETARY AND CONFIDENTIAL
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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
Angle Slide Beam

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(415) 686-0257
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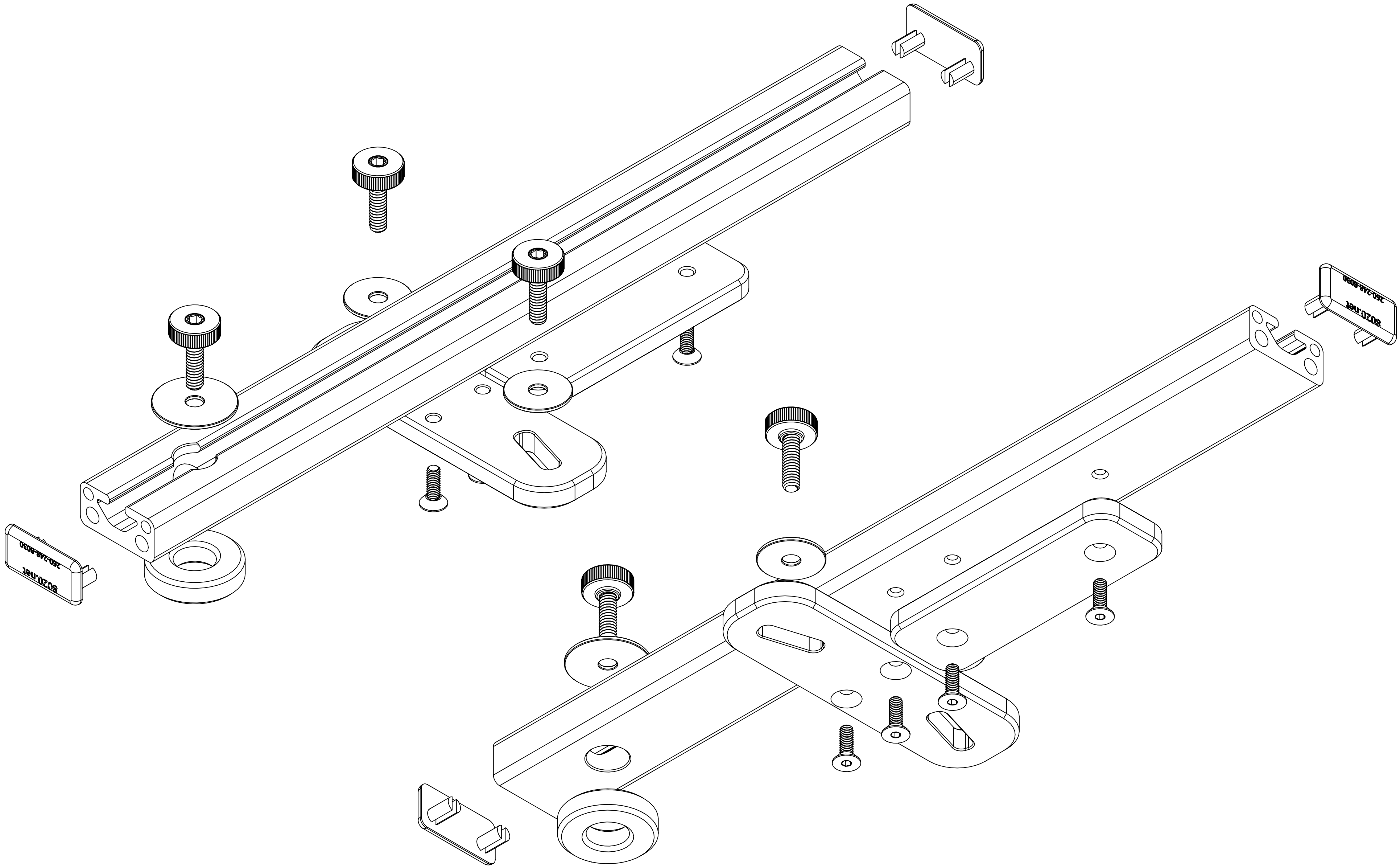
SCALE: 12:20 | 2023-01-07 | REV



Note:
1. Seat tube beam does not get a scale.
2. Increase beam length for more range.

PROPRIETARY AND CONFIDENTIAL

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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X $\pm$.5	BEND X $\pm$1
ONE PLACE DECIMAL	X.X $\pm$.1
TWO PLACE DECIMAL	X.XX $\pm$.01
THREE PLACE DECIMAL	X.XXX $\pm$.005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Angle Slide Beam

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
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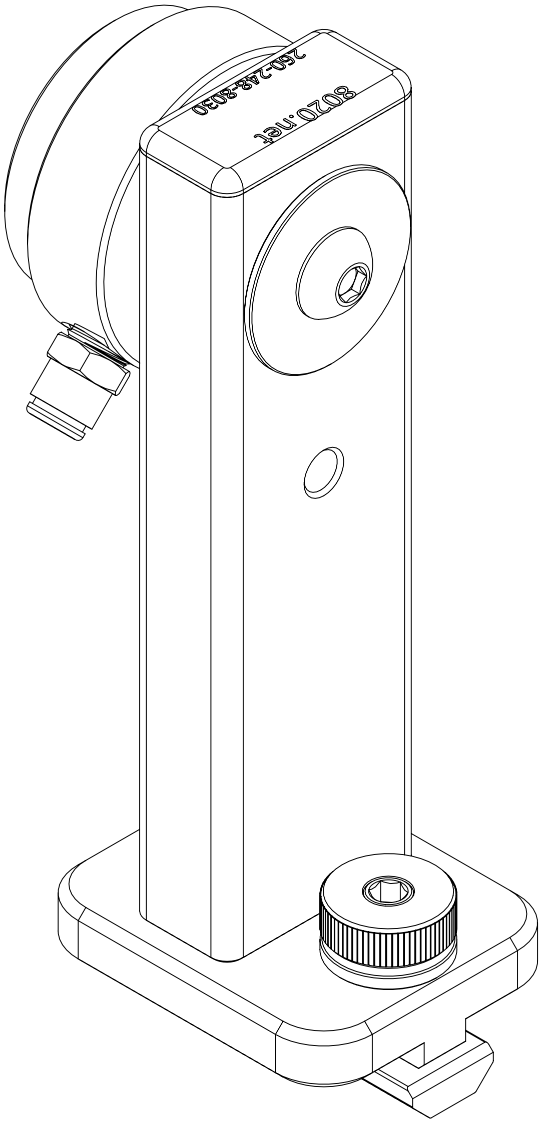
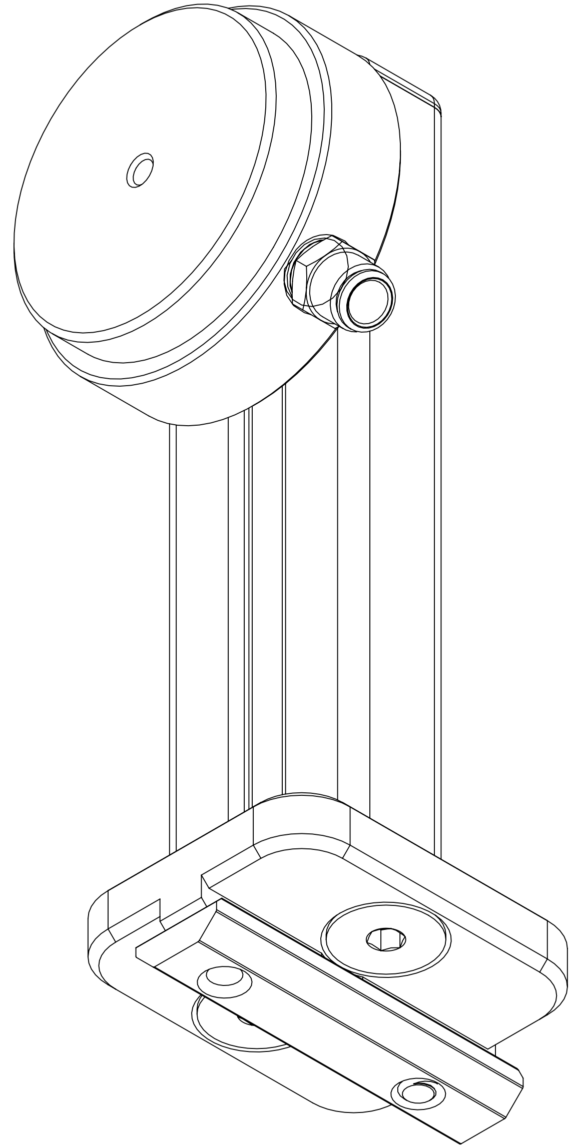
SCALE: 10:20 | 2023-01-07 | REV





MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Slider Block

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
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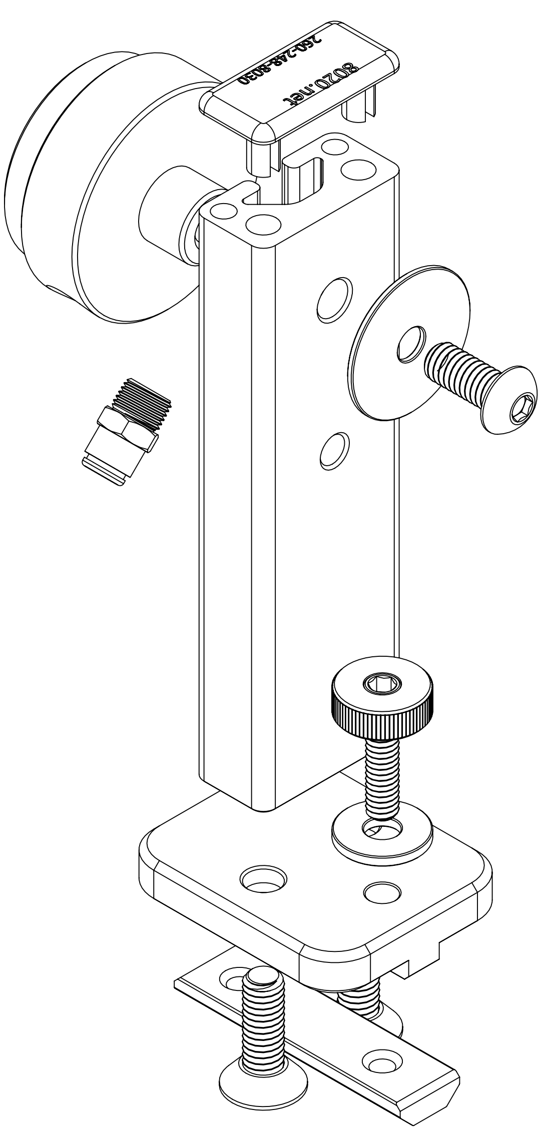
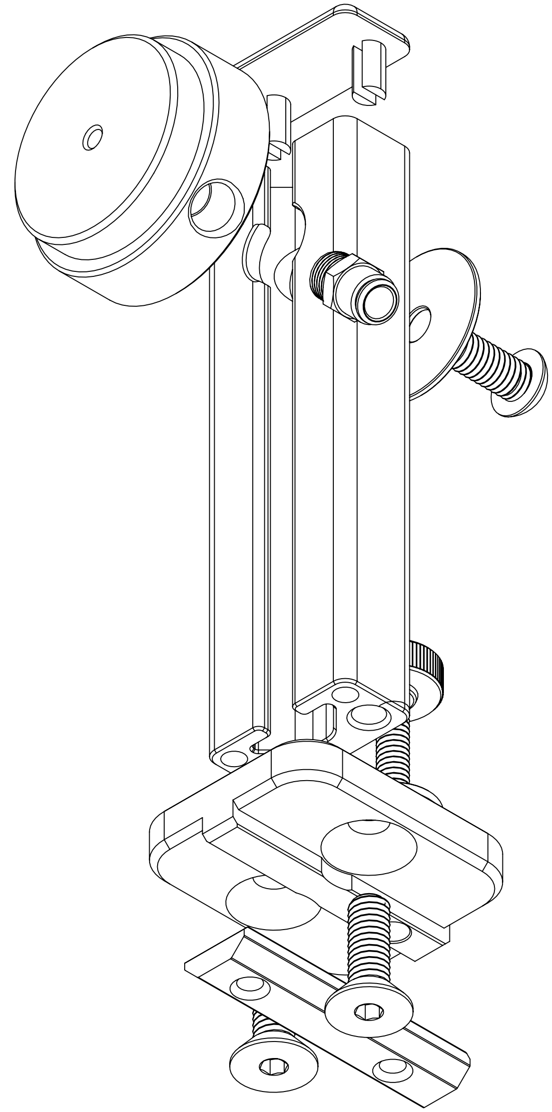
SCALE: 19:20 | 2023-01-07 | REV





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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Slider Block

PETER VERDONE DESIGNS
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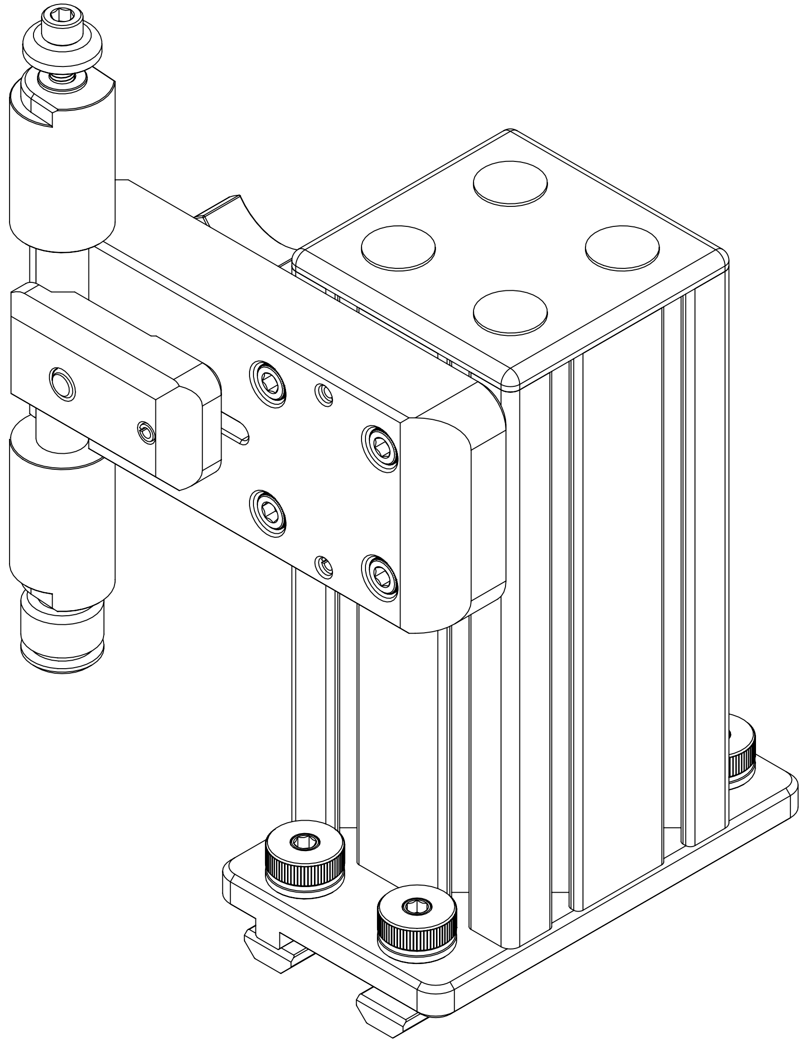
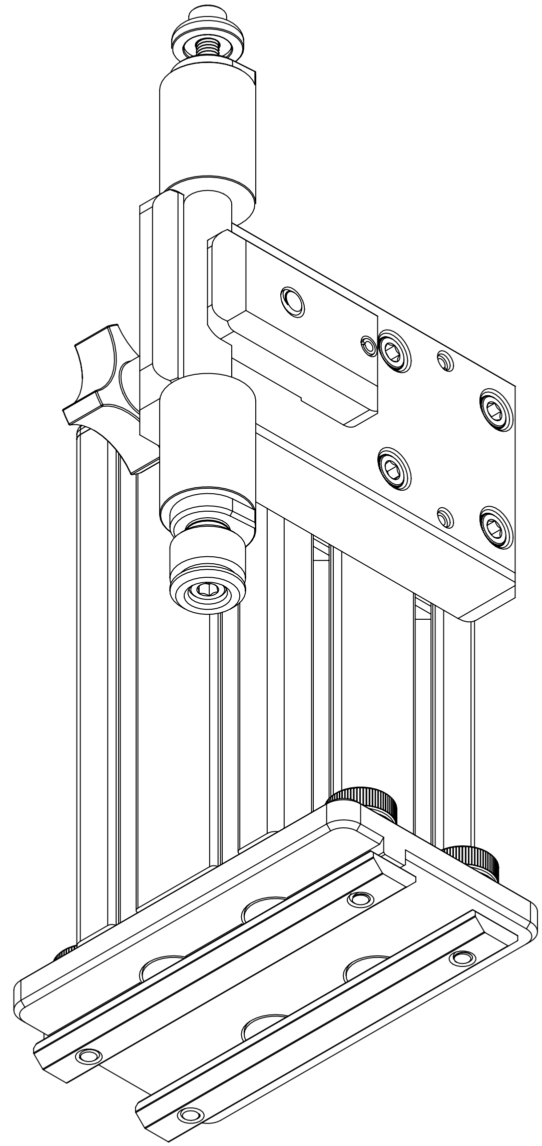
SCALE: 14:20 | 2023-01-07 | REV





MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Rear Axle Tower

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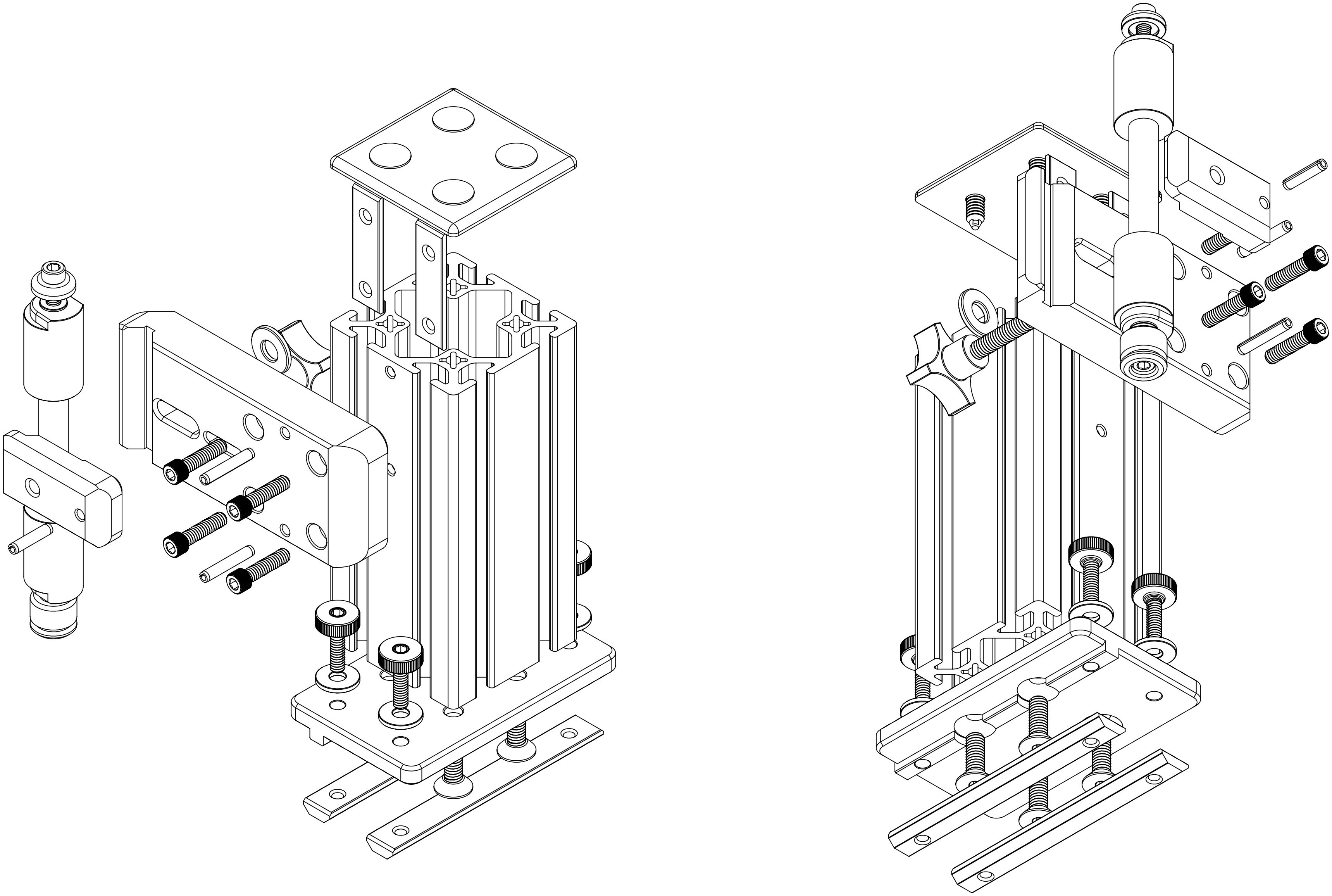
SCALE: 11:20 | 2023-01-07 | REV



PROPRIETARY AND CONFIDENTIAL

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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X $\pm$.5	BEND X $\pm$1
ONE PLACE DECIMAL	X.X $\pm$.1
TWO PLACE DECIMAL	X.XX $\pm$.01
THREE PLACE DECIMAL	X.XXX $\pm$.005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

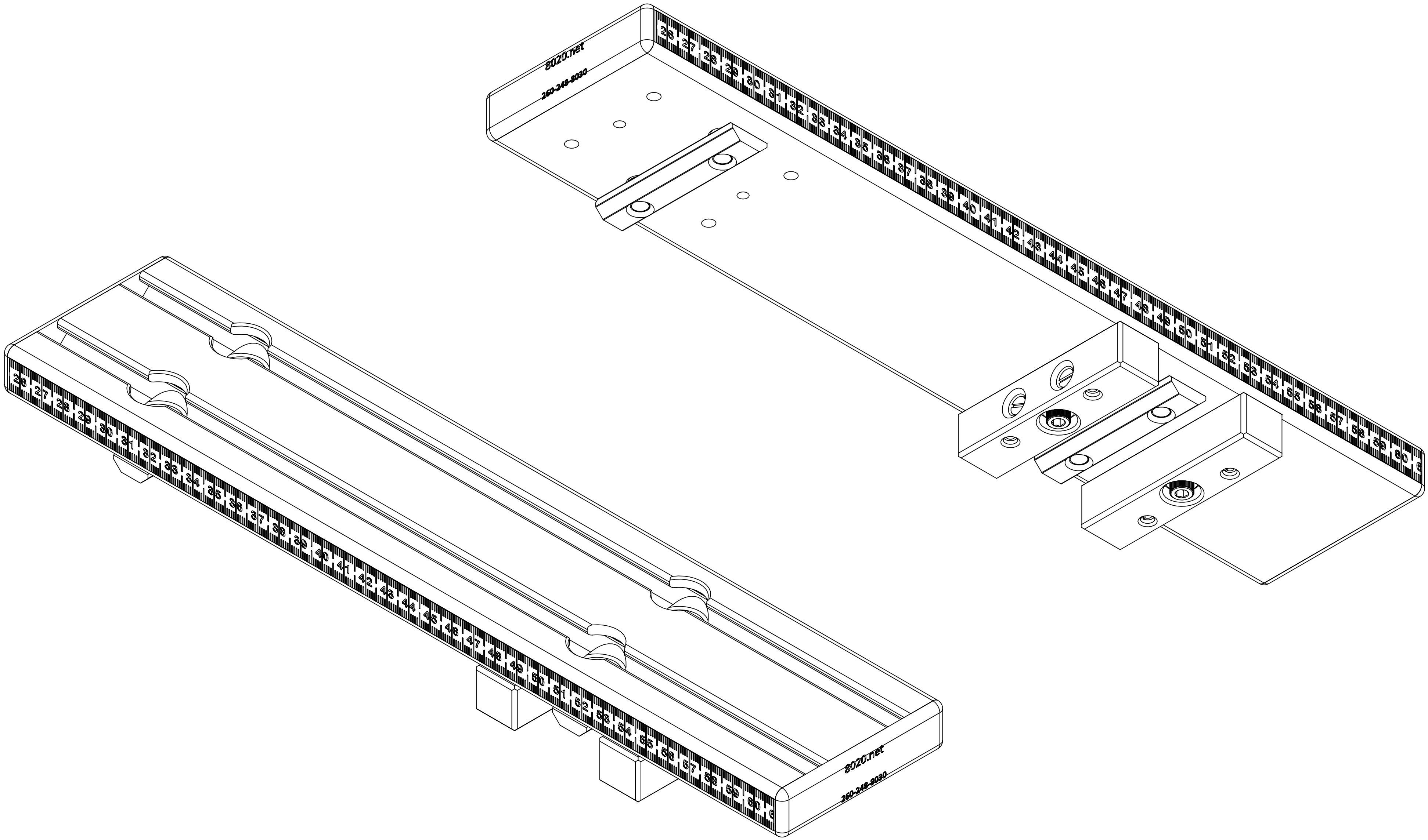
Rear Axle Tower

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 8:20

2023-01-07

REV



MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Rear Axle X Rail

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(415) 686-0257
PETERVERDONE@GMAIL.COM
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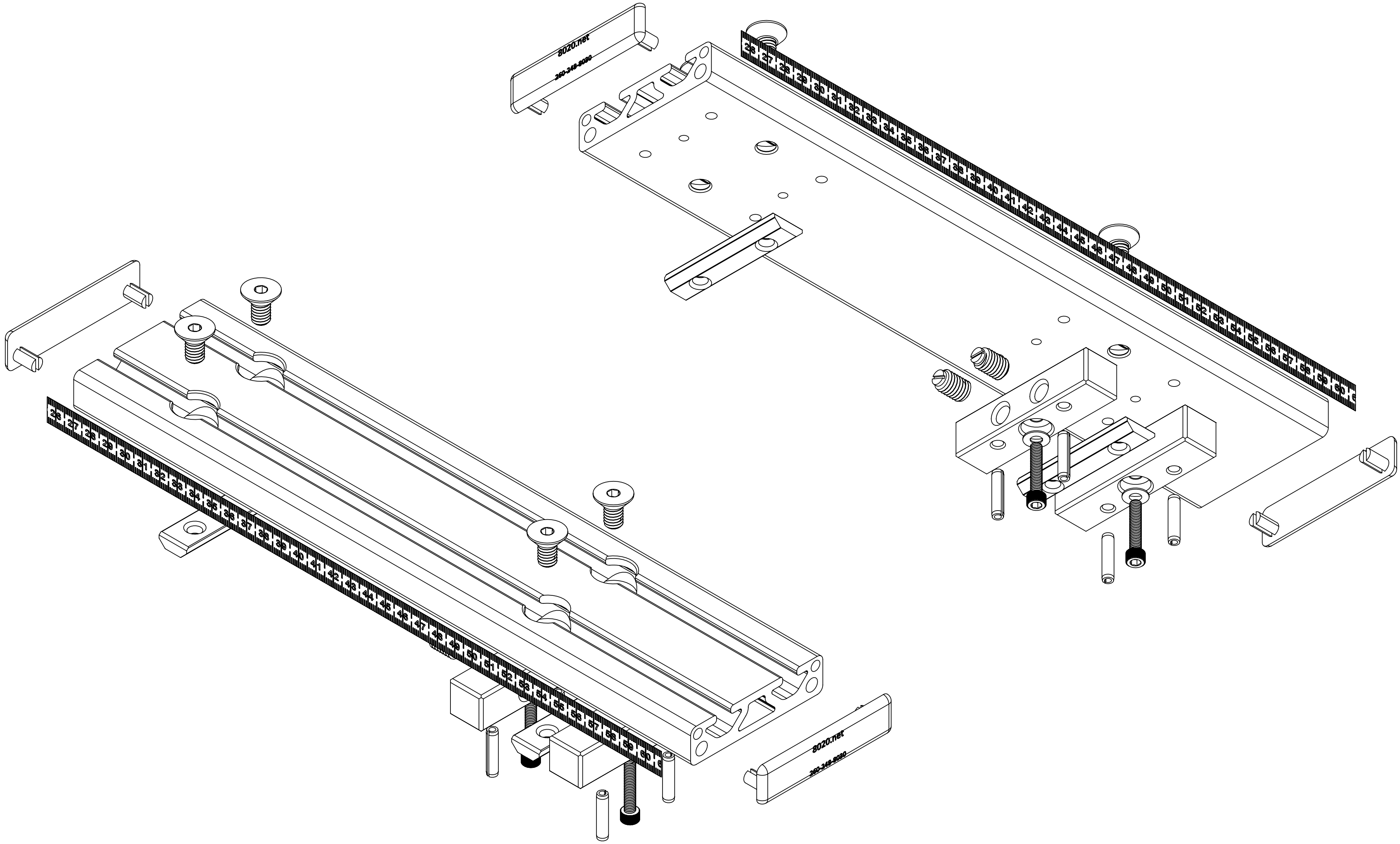
SCALE: 11:20 | 2023-01-07 | REV



PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: Rear Axle X Rail
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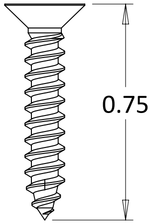
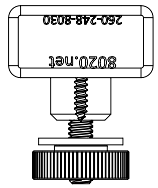
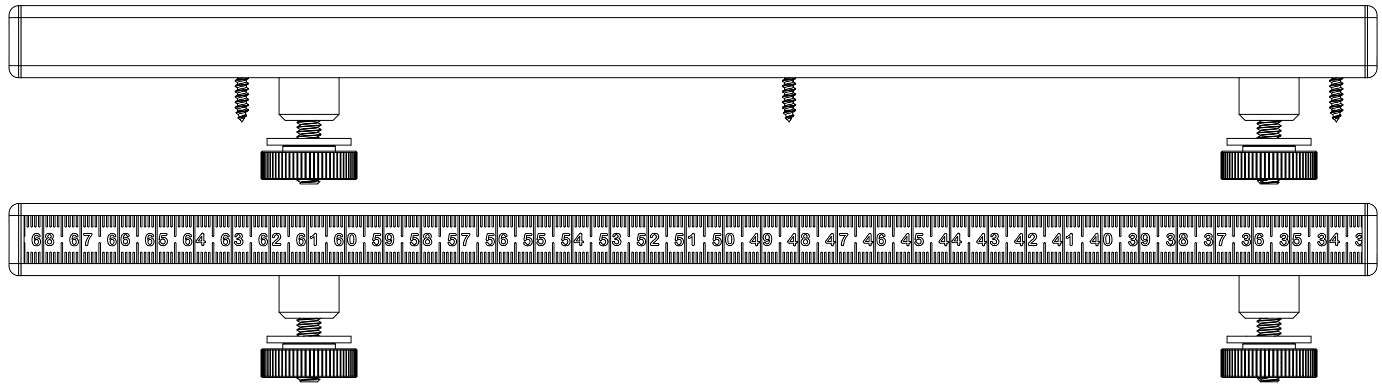
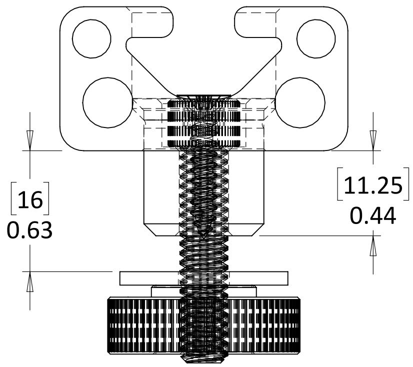
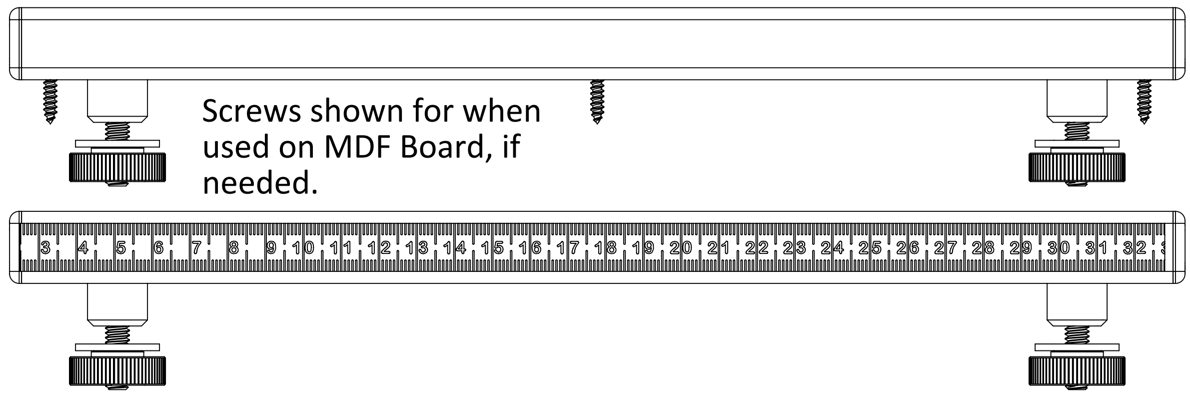
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 9:20 | 2023-01-07 | REV
COMMENTS:		



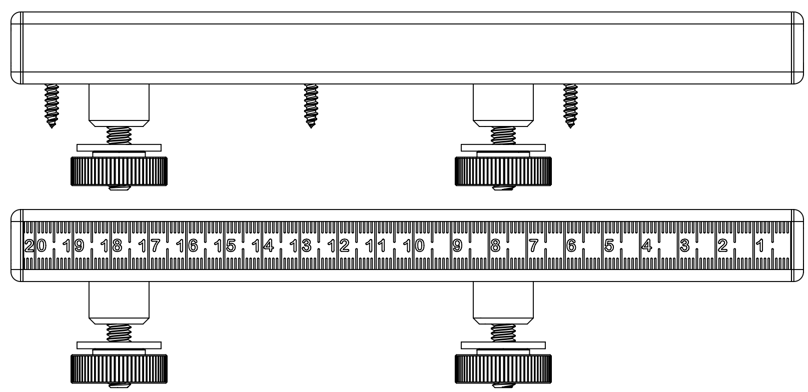


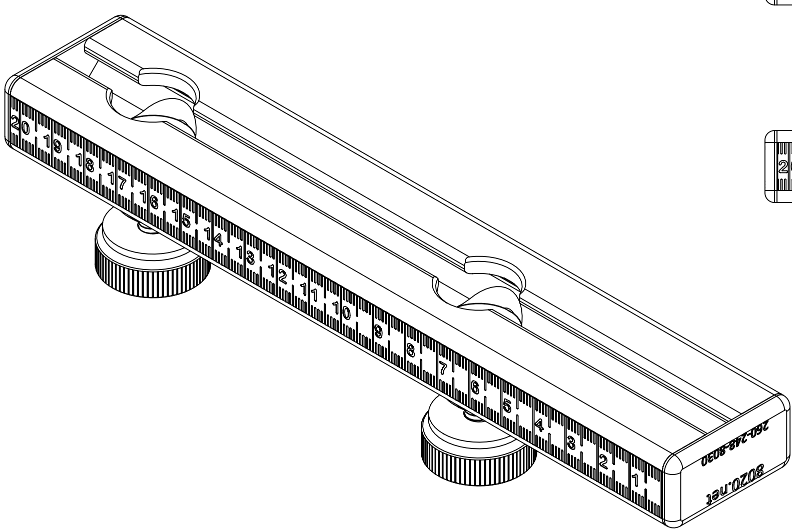






Screws shown for when used on MDF Board, if needed.





MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X $\pm$.5	BEND X $\pm$1
ONE PLACE DECIMAL	X.X $\pm$.1
TWO PLACE DECIMAL	X.XX $\pm$.01
THREE PLACE DECIMAL	X.XXX $\pm$.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Rail Assembly

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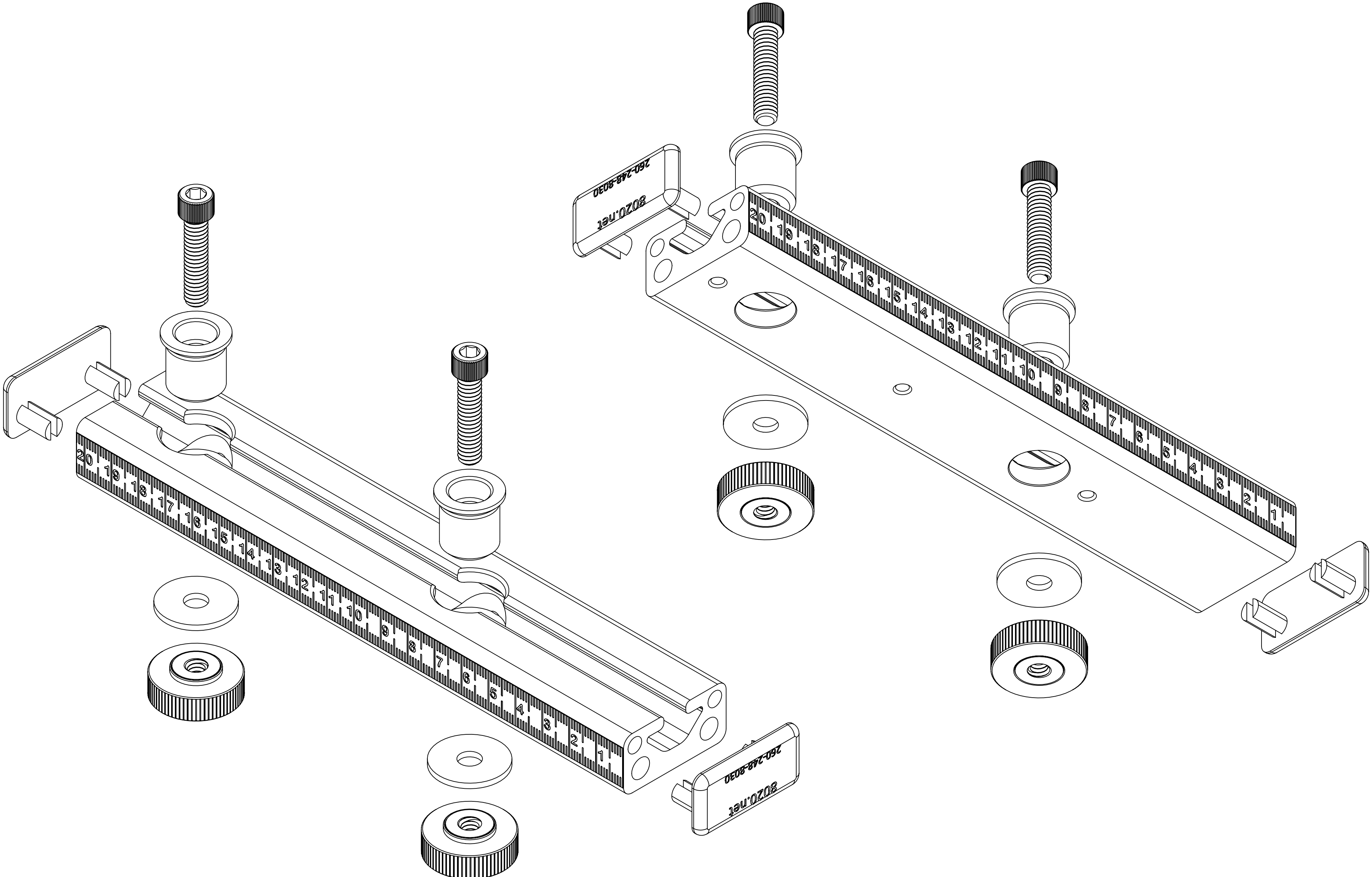
SCALE: 1:2 | 2023-01-07 | REV



MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
Rail - Exploded

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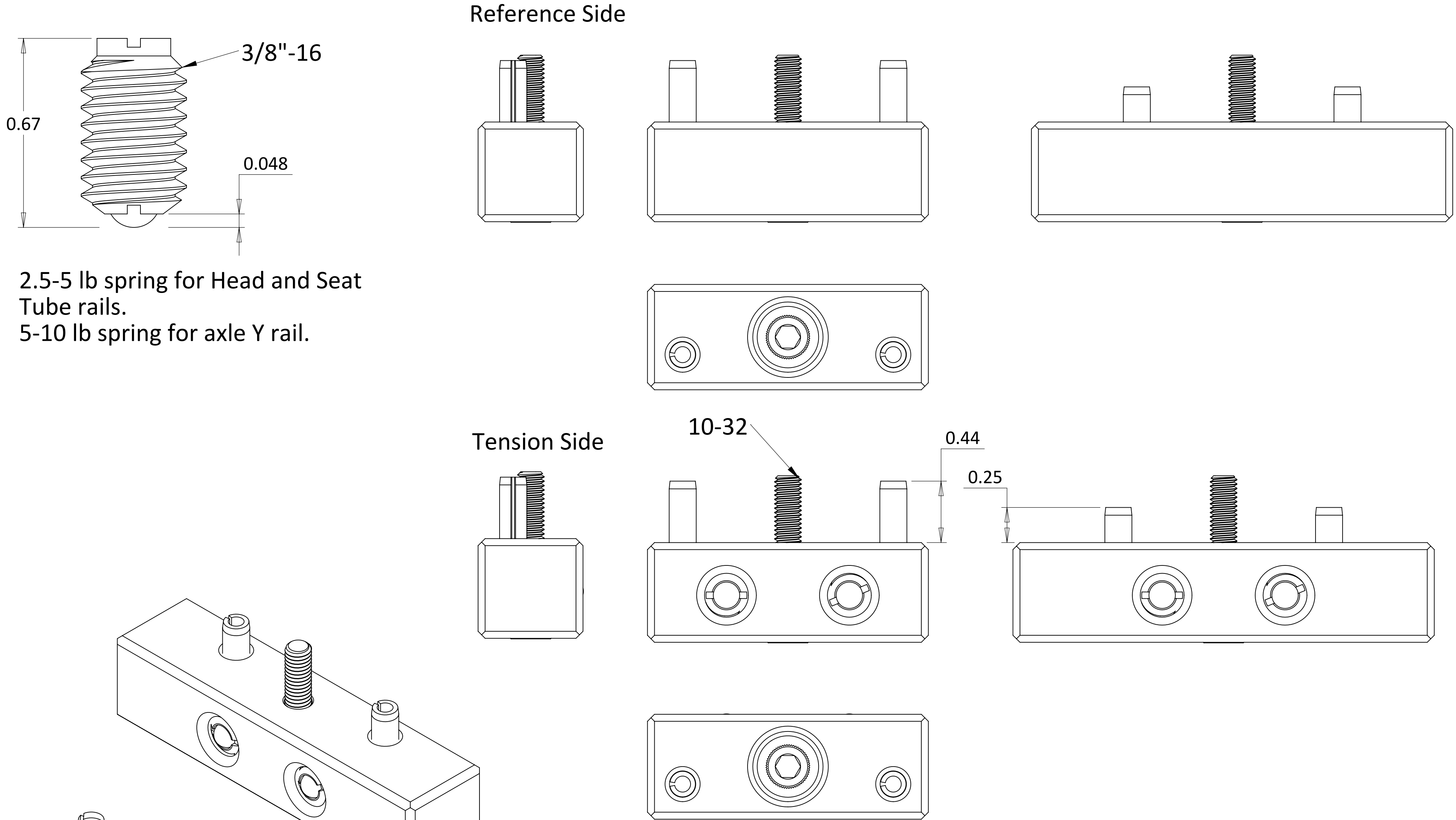
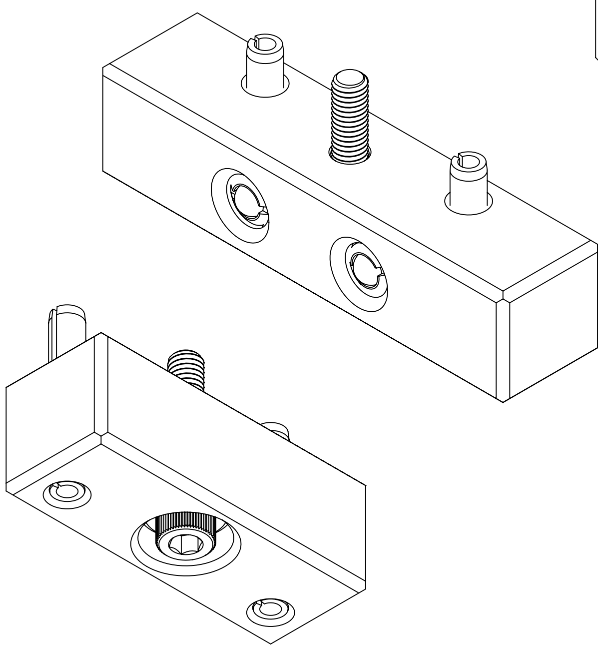
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 14:20 | 2023-01-07 | REV





PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ± .5	BEND X ± 1
ONE PLACE DECIMAL	X.X ± .1
TWO PLACE DECIMAL	X.XX ± .01
THREE PLACE DECIMAL	X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Rail Bearing

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(415) 686-0257
PETERVERDONE@GMAIL.COM
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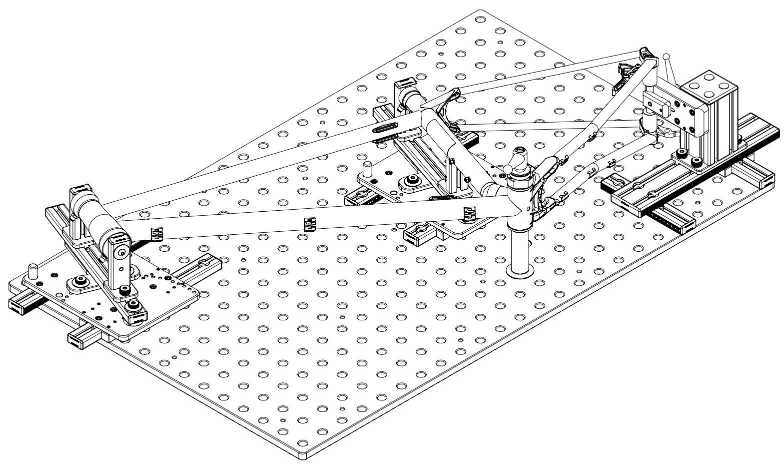
SCALE: 1:1 | 2023-01-07 | REV

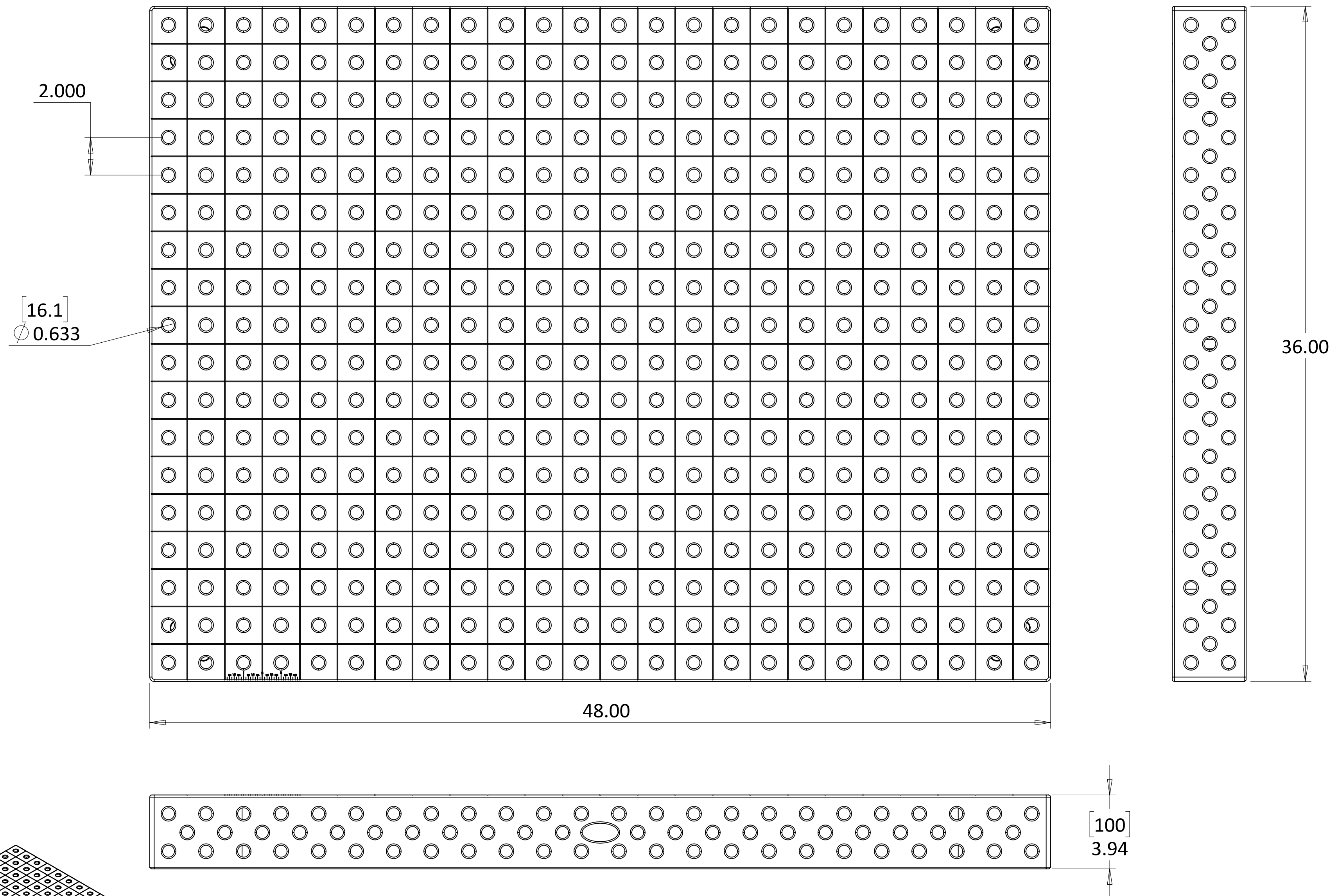
SKYNET

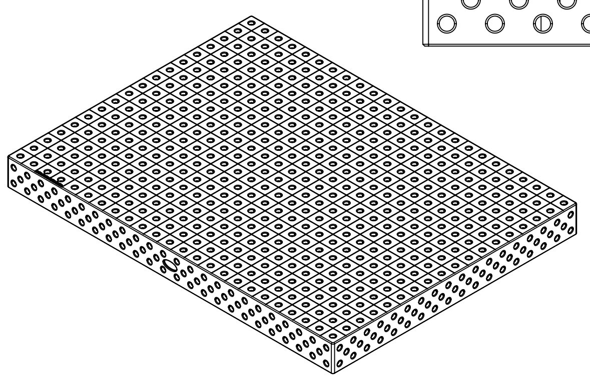
A BICYCLE CHASSIS FIXTURE

PART PRINTS



PETER VERDONE DESIGNS, FAIRFAX, CA 94930
REV:2022-02-18-1





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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Seigmund US160025.X7

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FAIRFAX, CA 94930
(415) 686-0257
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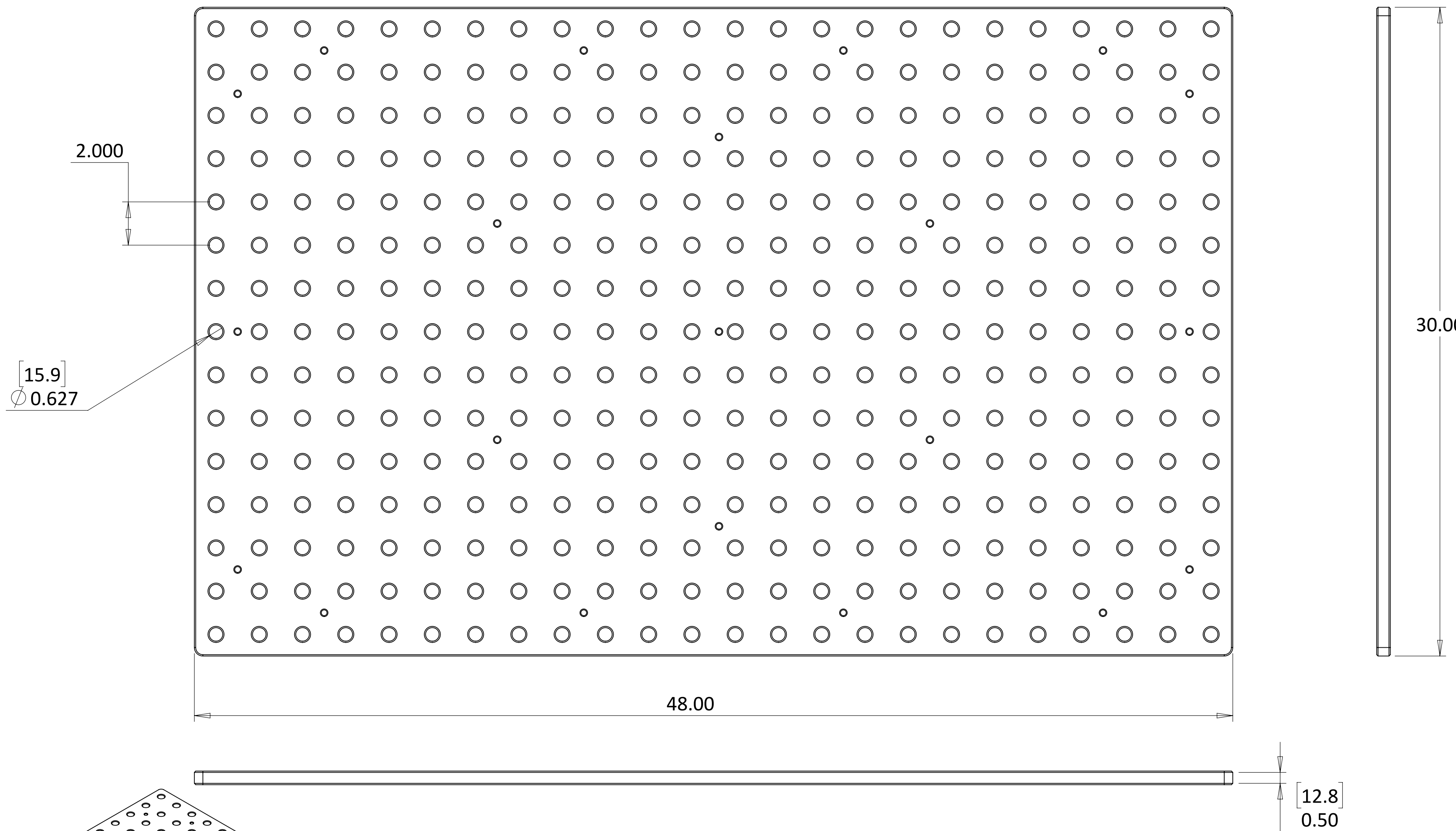
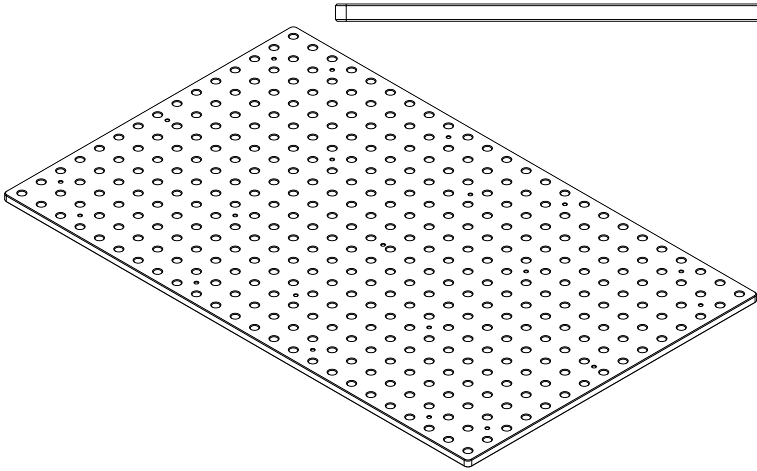
WWW.PETERVERDONE.COM

SCALE: 1:8 | 2022-02-18 | REV





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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

SHT RhinoCart

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
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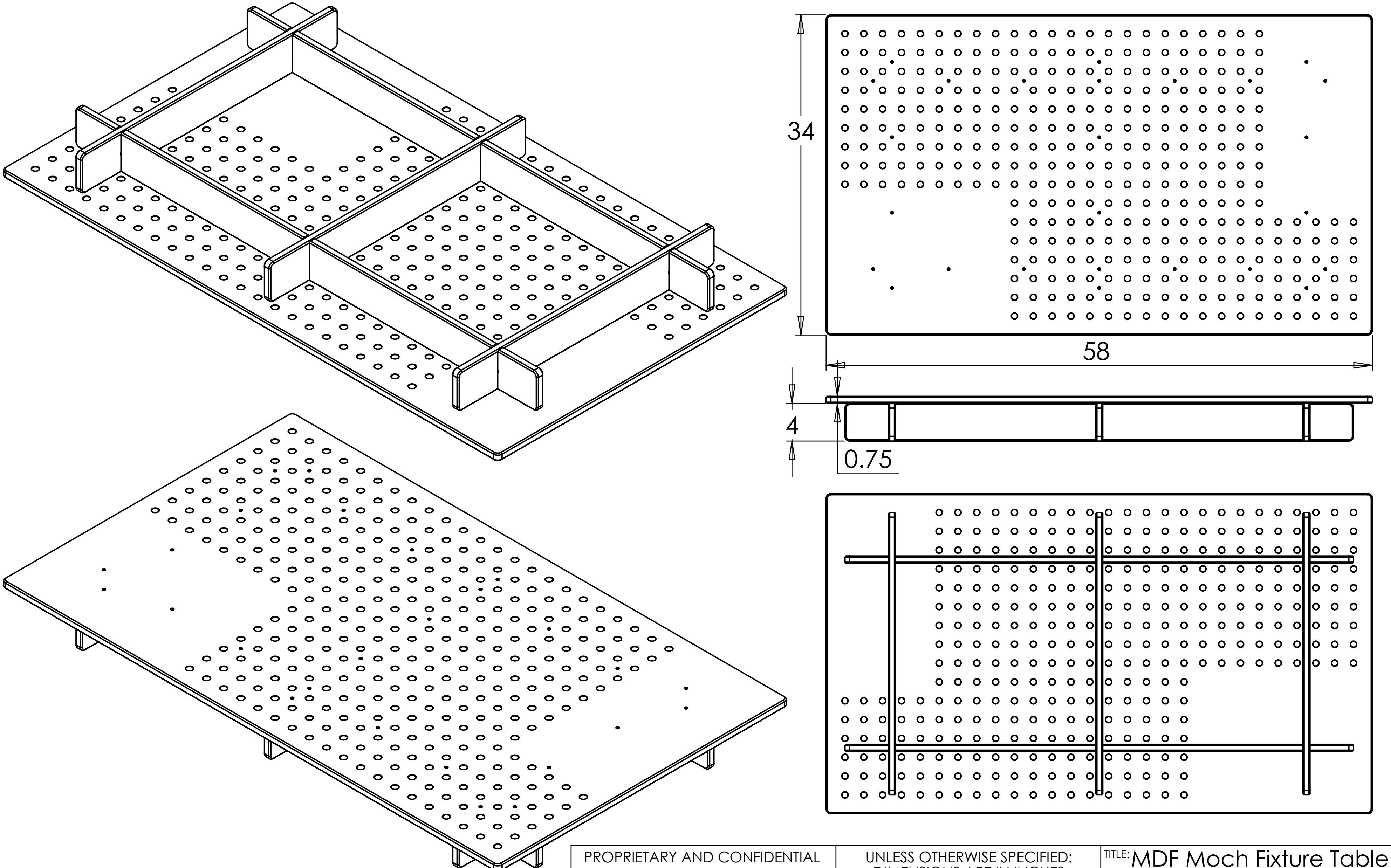
SCALE: 1:7 | 2022-02-18 | REV



1. Using thick epoxy similar to JB Weld. Glass bead aggrigate may add stability.
2. Cement support ribs in place while clamped to flat surface.
3. Once fully dry....
4. Screw in place with #6 MDF screws

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X±.5 BEND X±1
ONE PLACE DECIMAL X.X±.1
TWO PLACE DECIMAL X.XX±.01
THREE PLACE DECIMAL X.XXX±.005

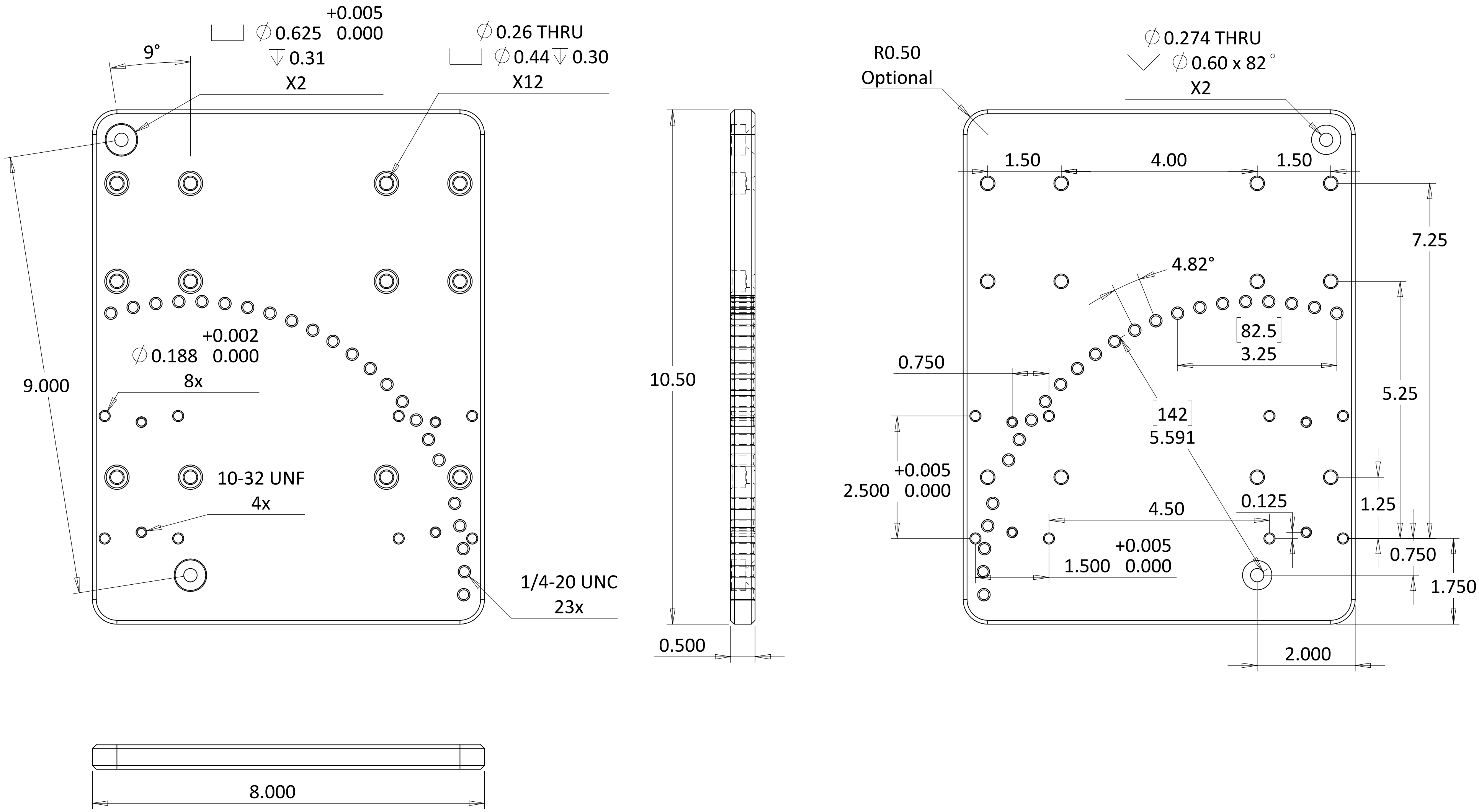
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

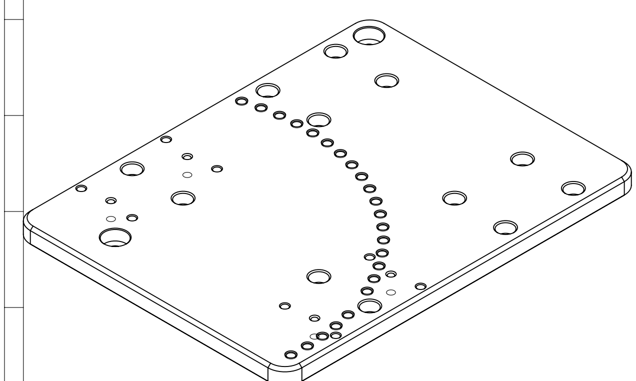
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE: MDF Moch Fixture Table Torsion Box

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

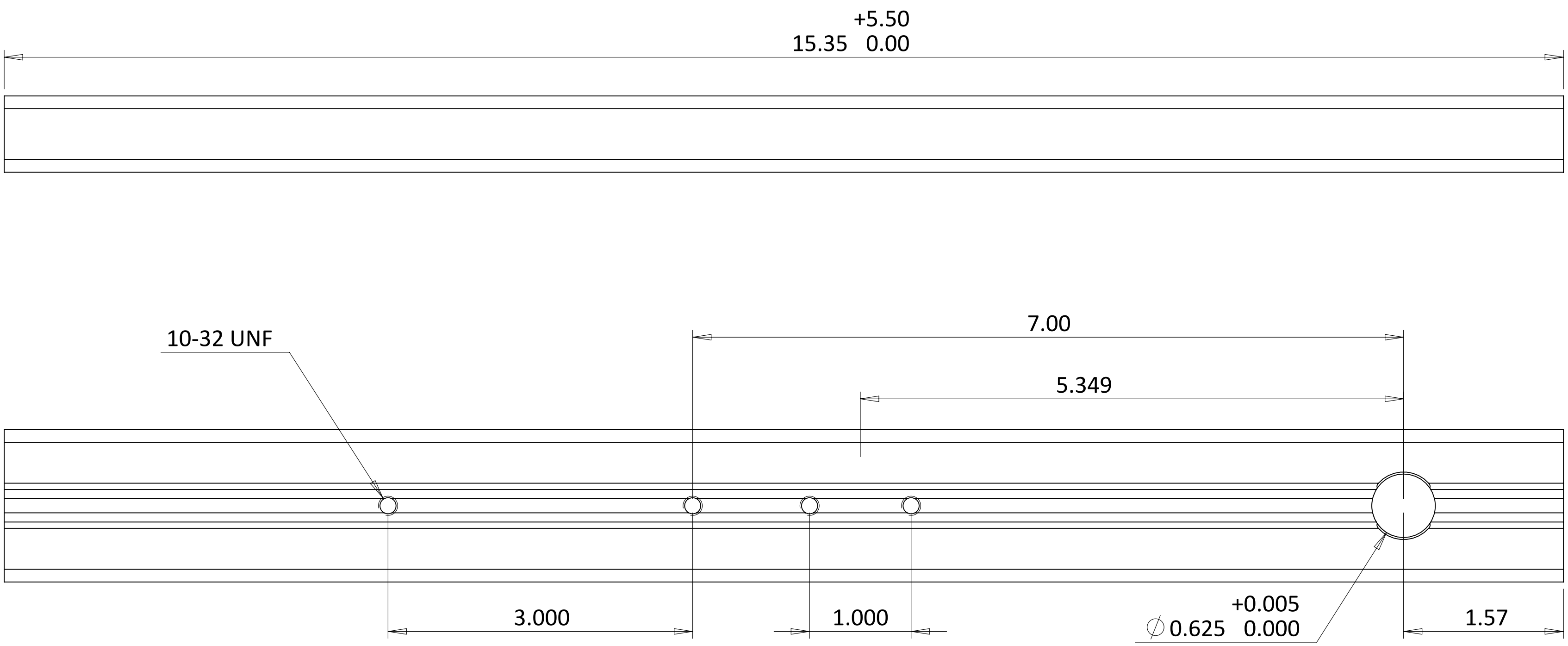
SCALE: 7:100 | 2023-01-07 | REV

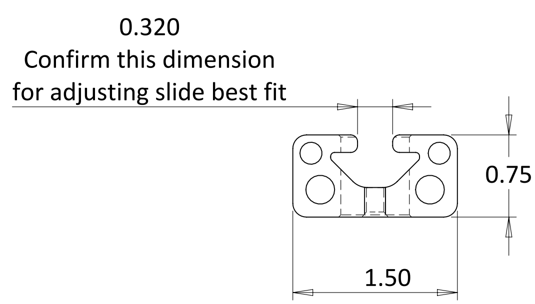


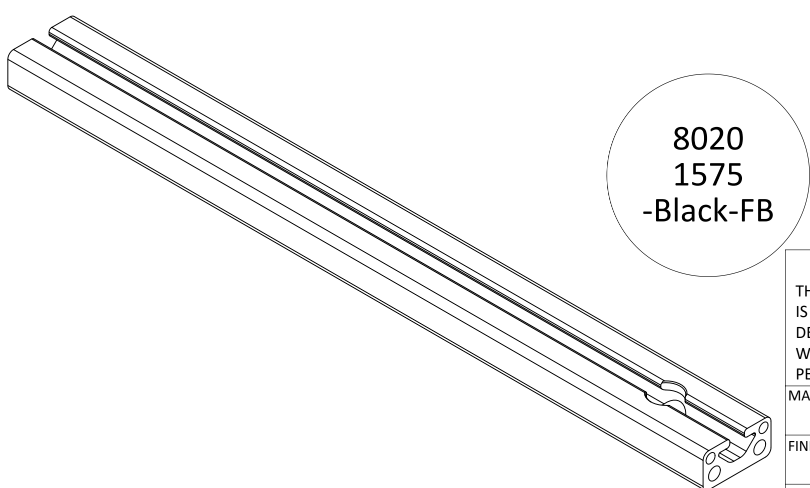


6061 Al

PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: Angle Plate
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF PETER VERDONE DESIGNS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF PETER VERDONE DESIGNS IS PROHIBITED.	TOLERANCES: ANGULAR: MACH X ±.5 BEND X ±1 ONE PLACE DECIMAL X.X ±.1 TWO PLACE DECIMAL X.XX ±.01 THREE PLACE DECIMAL X.XXX ±.005	PETER VERDONE DESIGNS FAIRFAX, CA 94930 (415) 686-0257 PETERVERDONE@GMAIL.COM WWW.PETERVERDONE.COM
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 2:6
COMMENTS:		2023-01-07 REV







MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

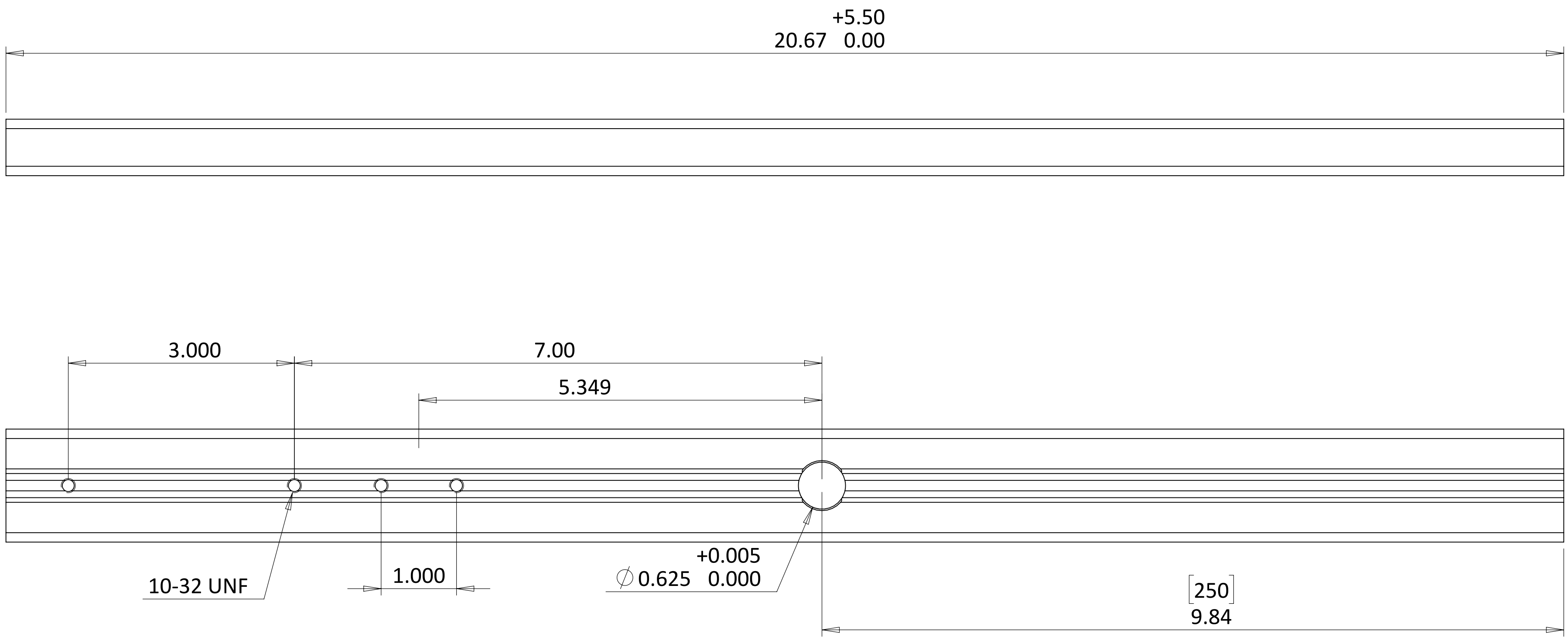
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

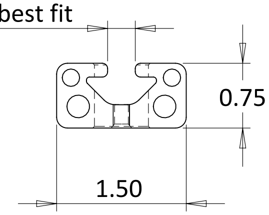
TITLE:

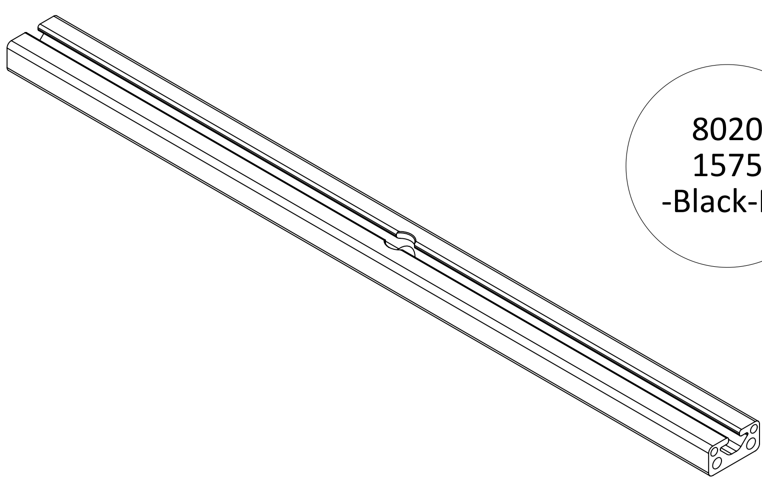
Angle Beam - Head

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 1:1.75 | 2023-01-07 | REV







8020
1575
-Black-FB

PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ± .5	BEND X ± 1
ONE PLACE DECIMAL	X.X ± .1
TWO PLACE DECIMAL	X.XX ± .01
THREE PLACE DECIMAL	X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

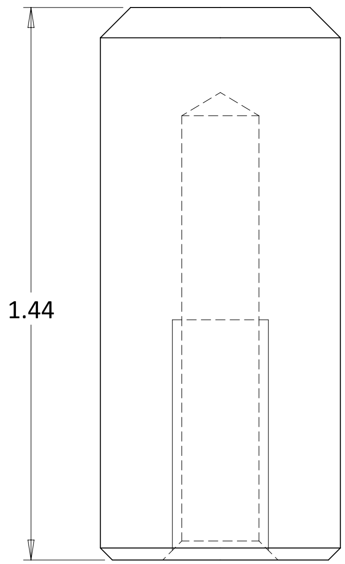
Angle Beam - Seat

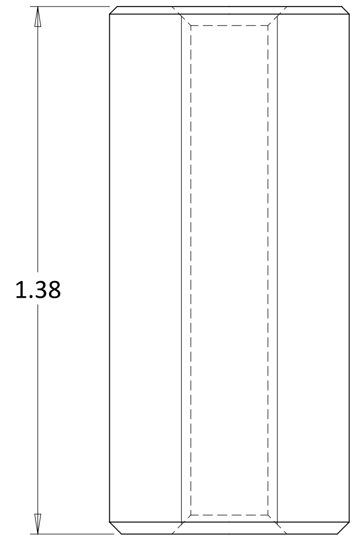
PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

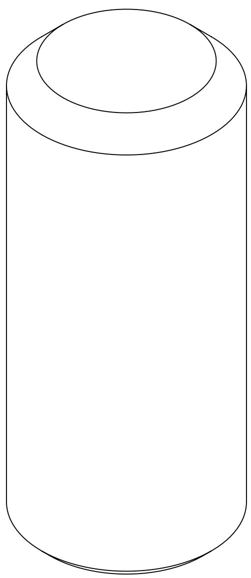
SCALE: 9:20	2023-01-07	REV

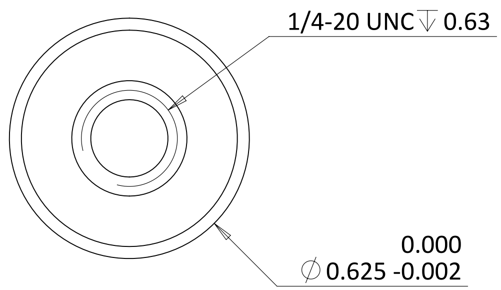
Cosine Reference Pin

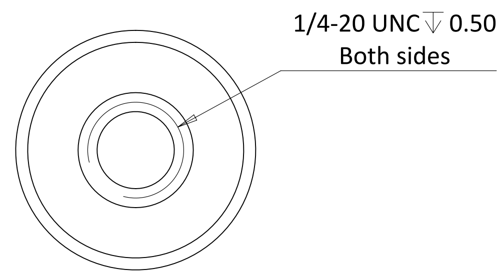
Angle Beam Pin

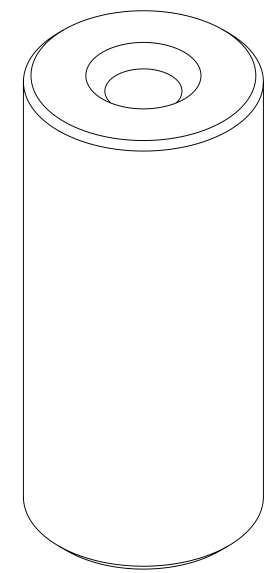












303
Stainless
Steel

PROPRIETARY AND CONFIDENTIAL

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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ± .5		BEND X ± 1
ONE PLACE DECIMAL	X.X ± .1	
TWO PLACE DECIMAL	X.XX ± .01	
THREE PLACE DECIMAL	X.XXX ± .005	

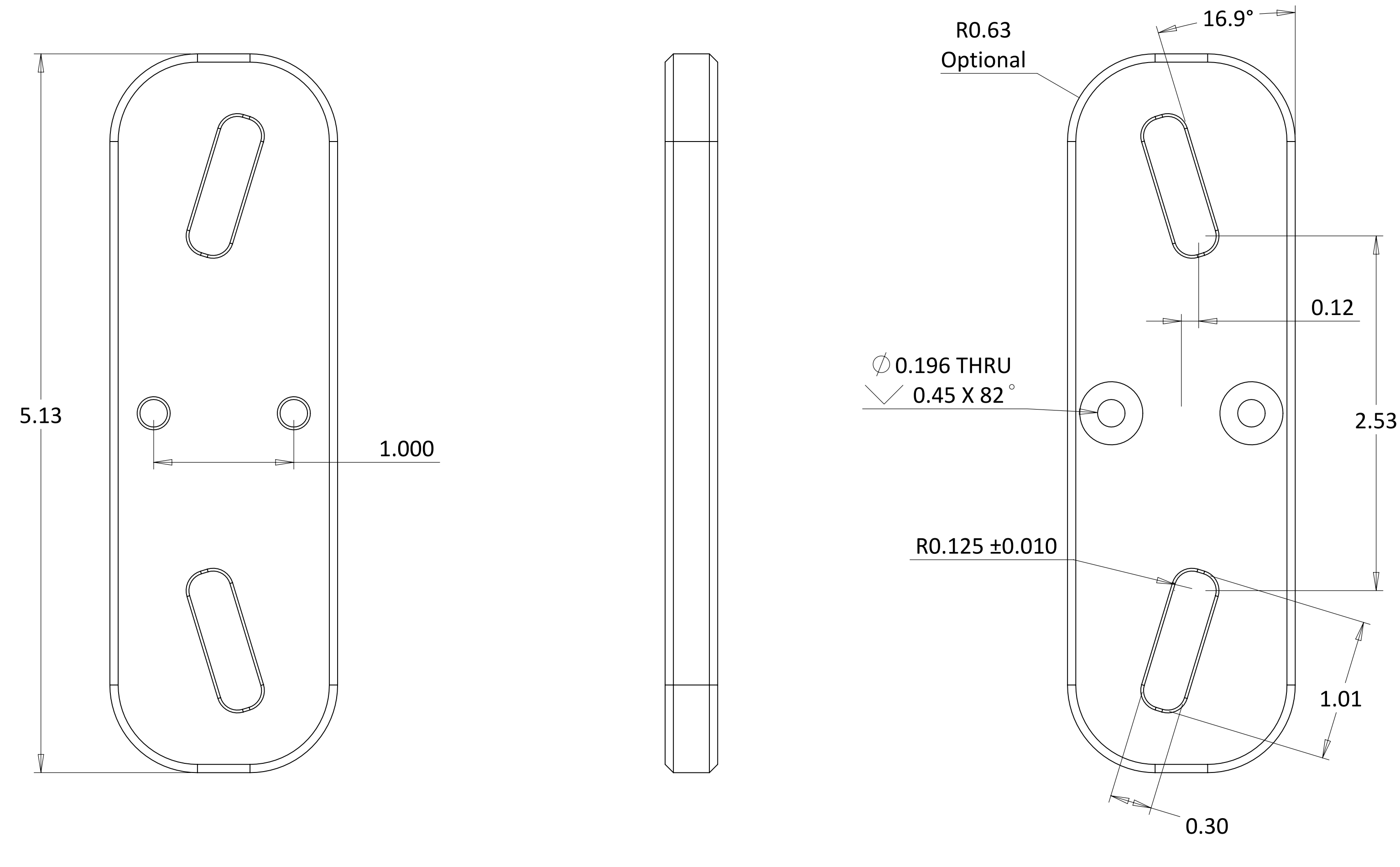
INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

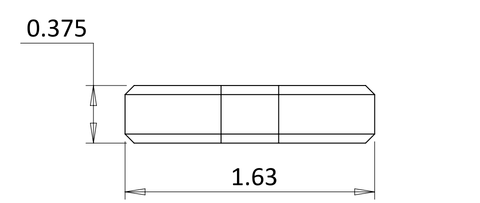
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

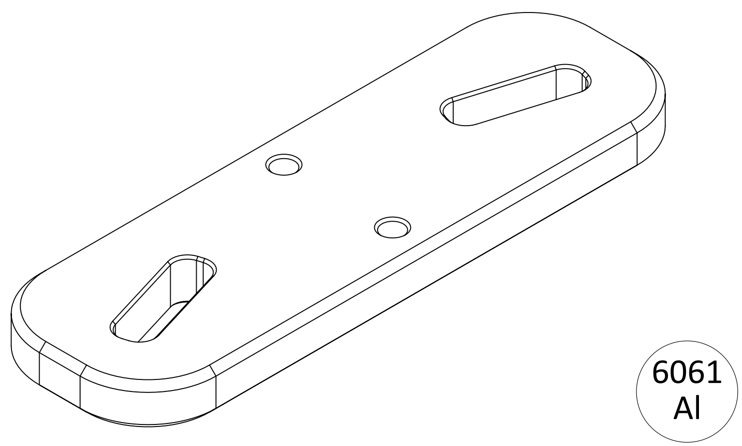
TITLE: Cosine and Beam Pins

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 2:1 | 2023-01-07 | REV







PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: Angle Beam Clamp
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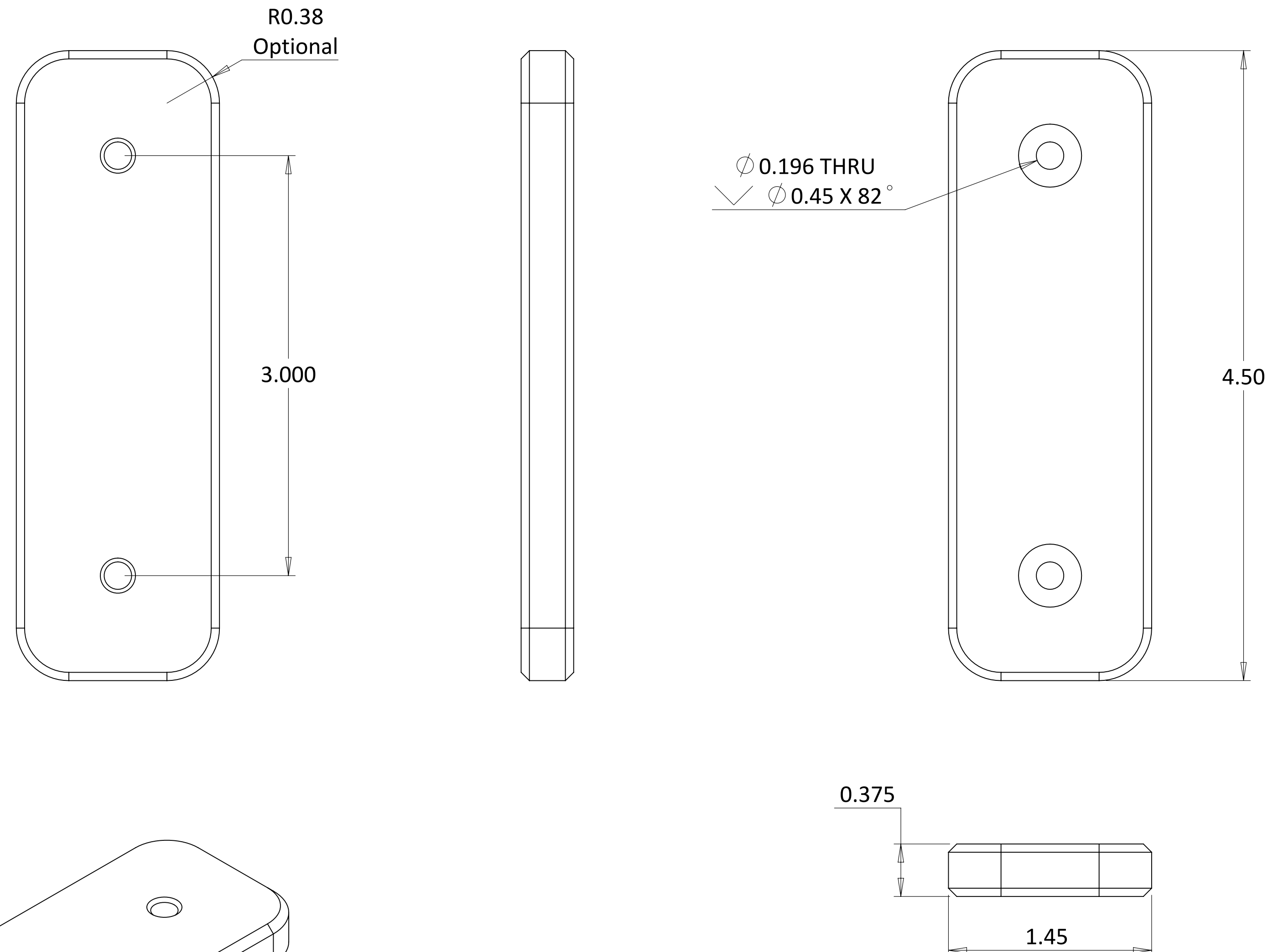
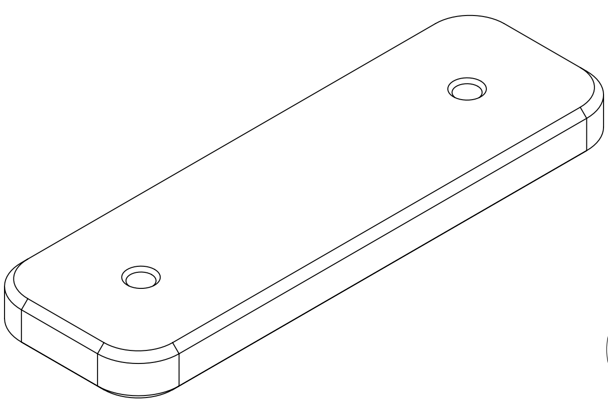
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 4:5 | 2023-01-07 | REV
COMMENTS:		





6061
Al

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

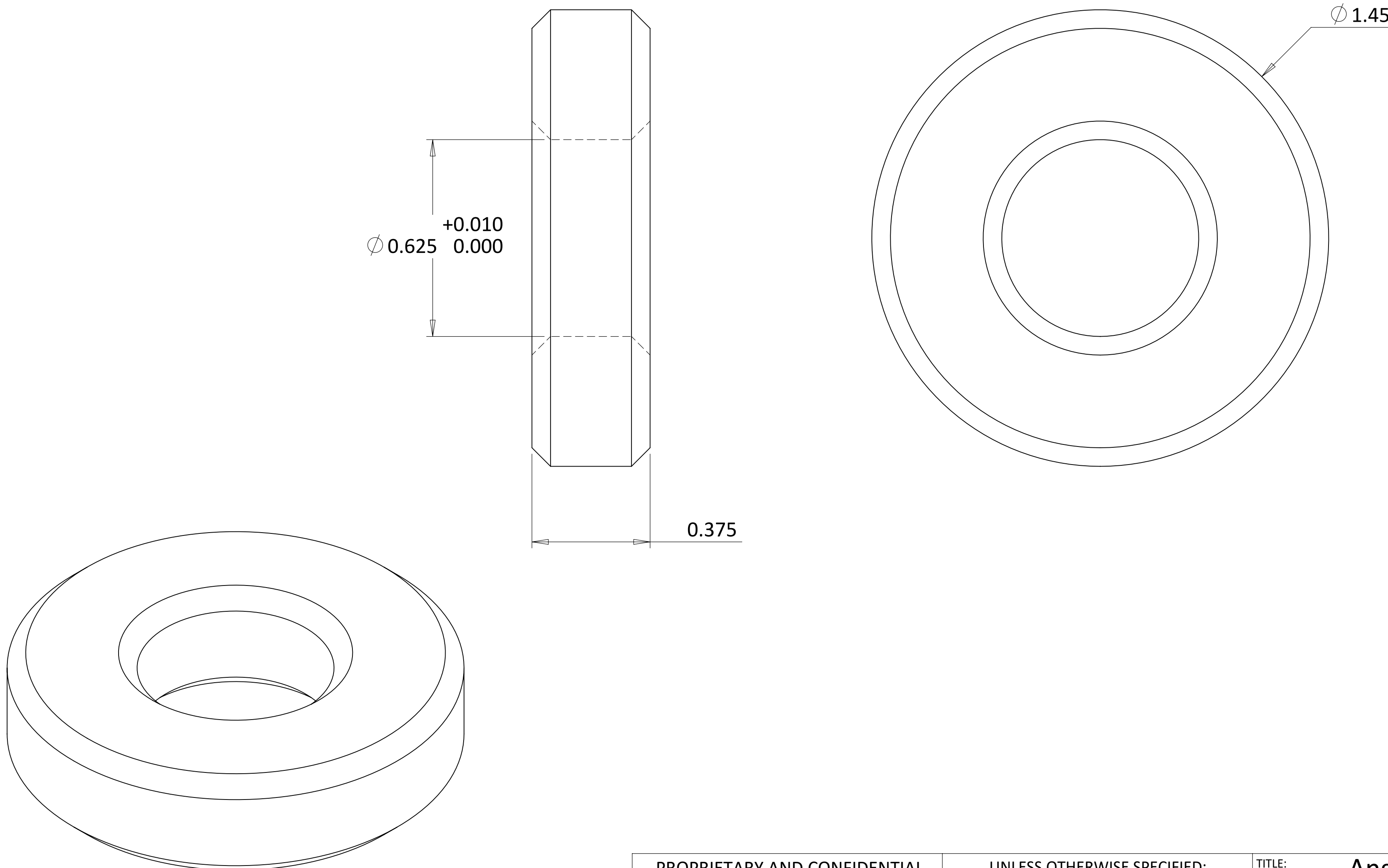
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Angle Beam Spacer

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 4:5 | 2023-01-07 | REV



6061
Al

PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X $\pm$.5	BEND X $\pm$1
ONE PLACE DECIMAL	X.X $\pm$.1
TWO PLACE DECIMAL	X.XX $\pm$.01
THREE PLACE DECIMAL	X.XXX $\pm$.005

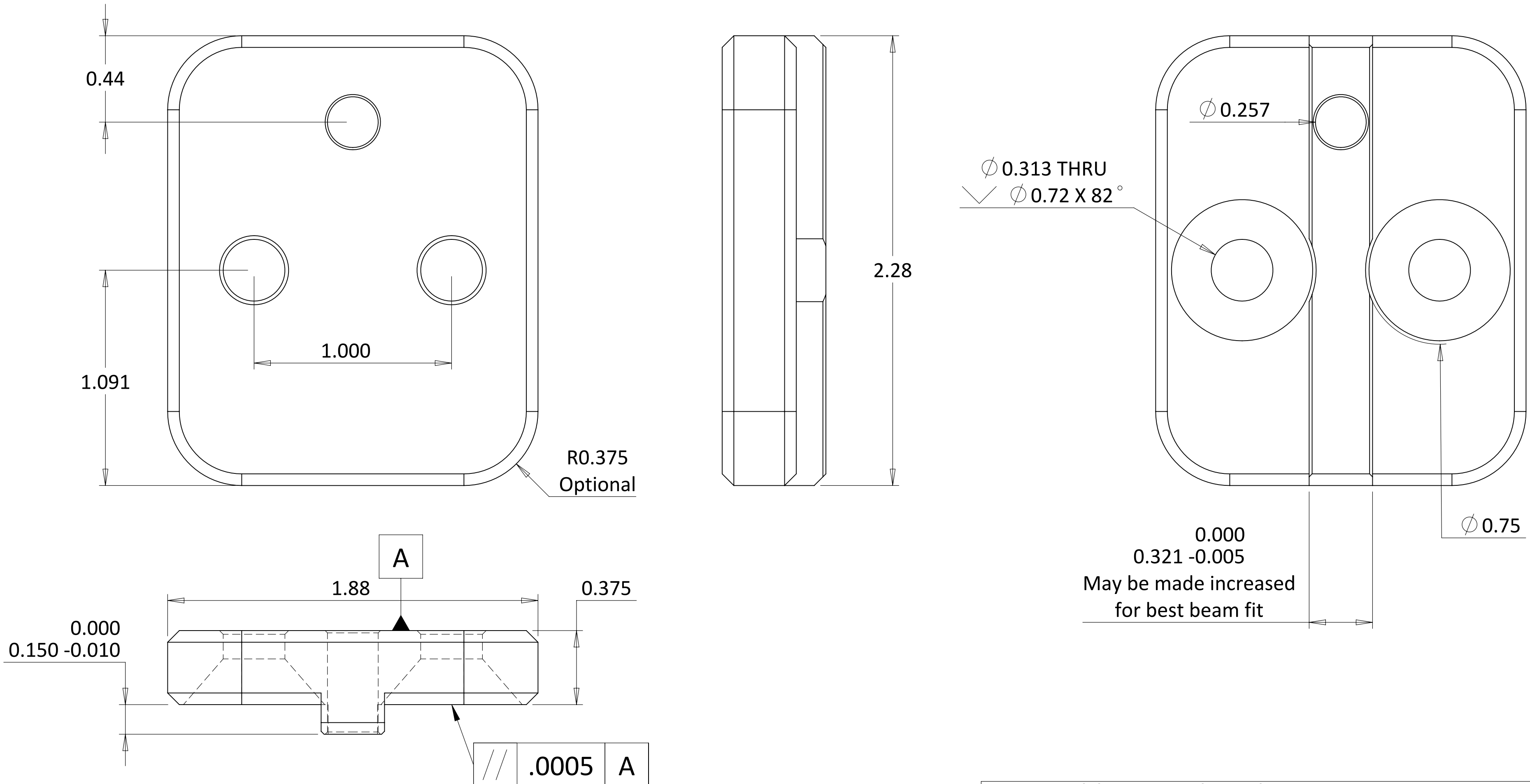
INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

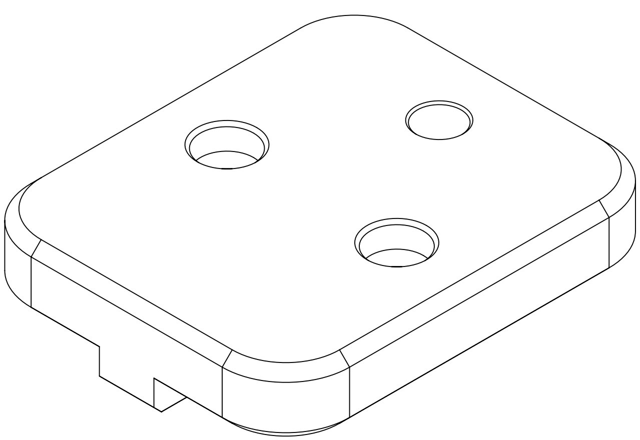
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
Angle Beam Pivot Spacer

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 2:1 | 2023-01-07 | REV





6061
Al

Possible Special Tool:
KEO
NC Spotting Drill, Hss, 82 deg., 3/4" x 1-7/8
#38342 (Zoro #: G8588151)

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

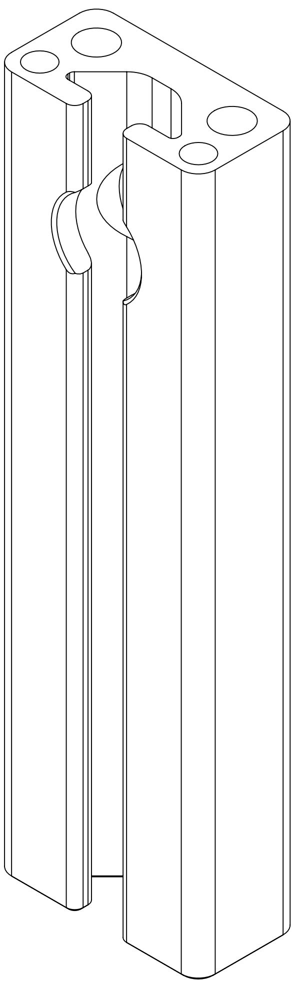
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

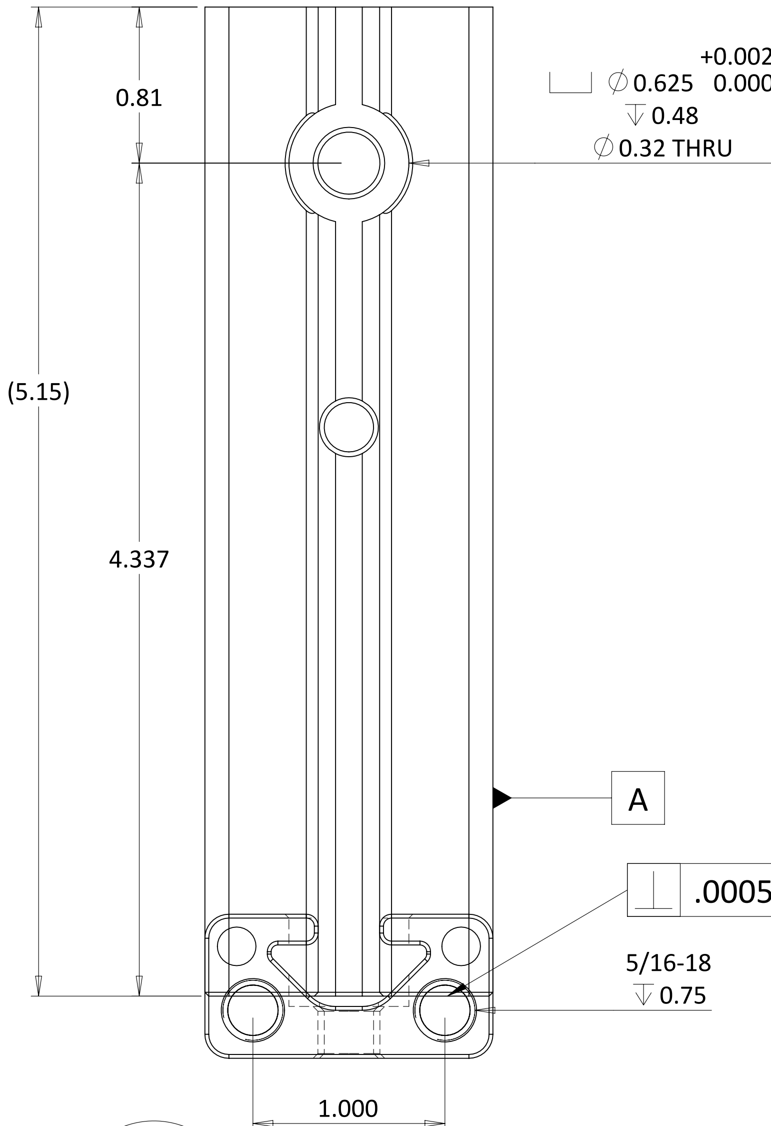
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

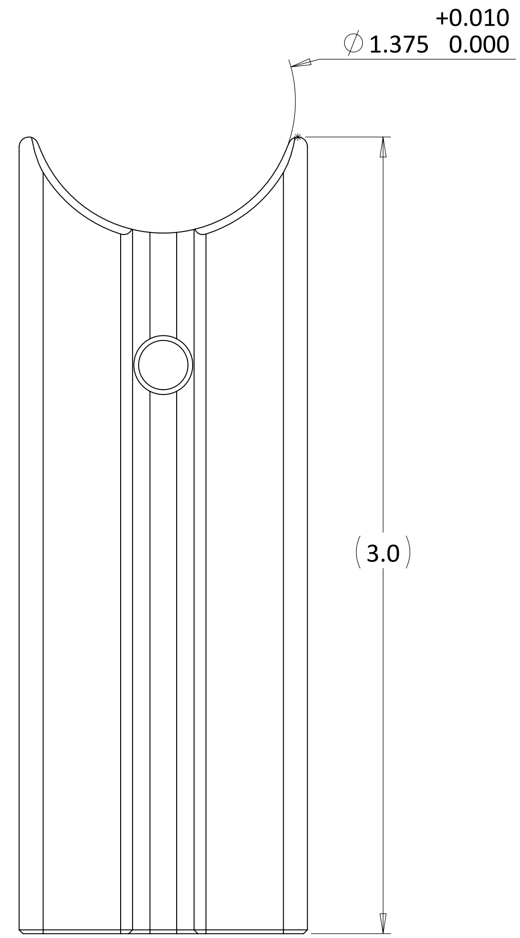
TITLE:
Angle Beam Slides

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 5:4 | 2023-01-07 | REV







8020
1575
-Black-FB

Note:
Calibrate centerline height based on tolerance stackup of any associated parts.

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ±.5 BEND X ±1
ONE PLACE DECIMAL X.X ±.1
TWO PLACE DECIMAL X.XX ±.01
THREE PLACE DECIMAL X.XXX ±.005

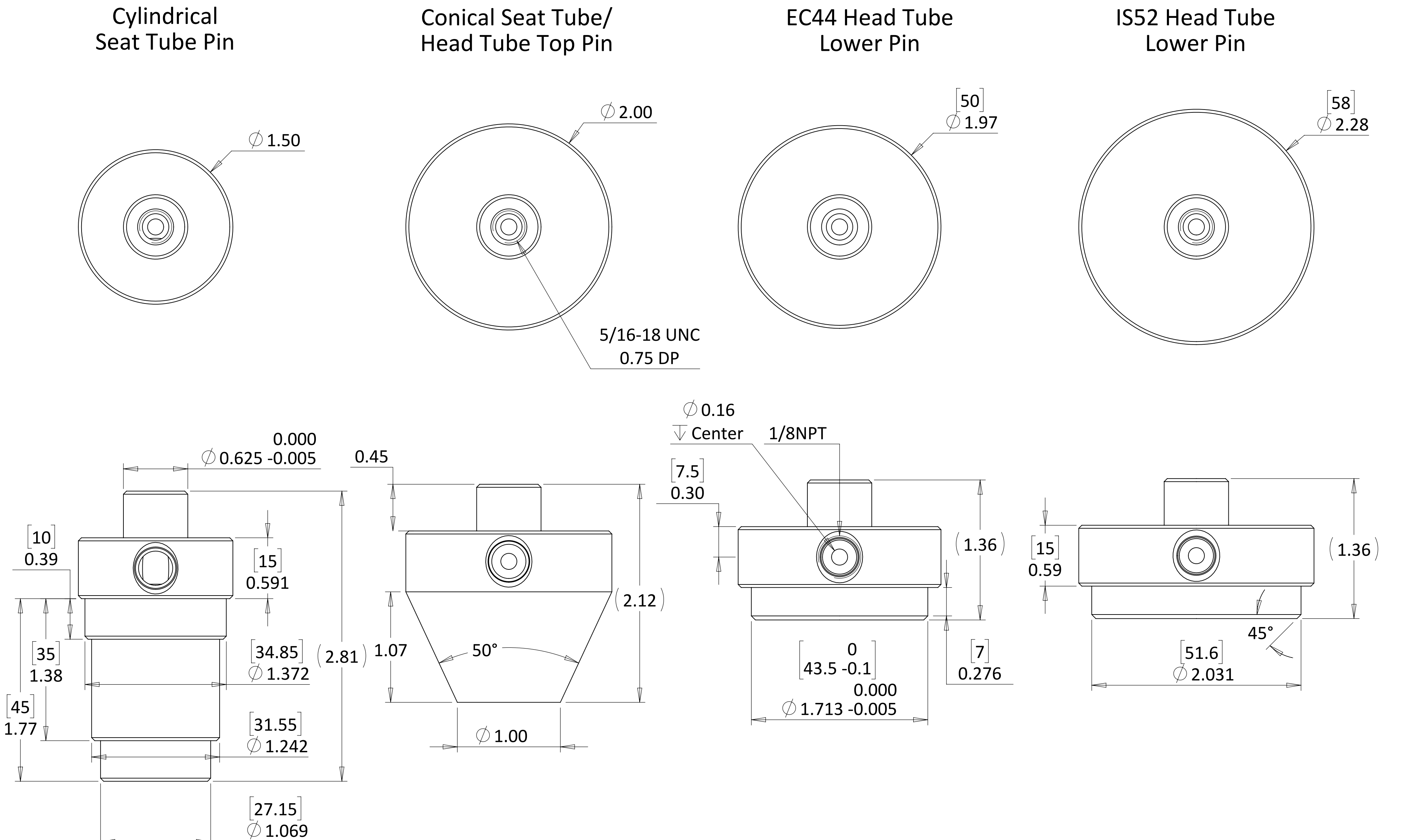
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
Angle Beam Slide Towers

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 1:1 | 2023-01-07 | REV



303
Stainless
Steel

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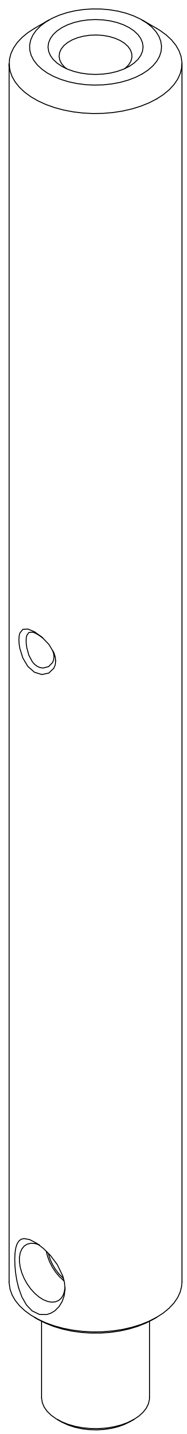
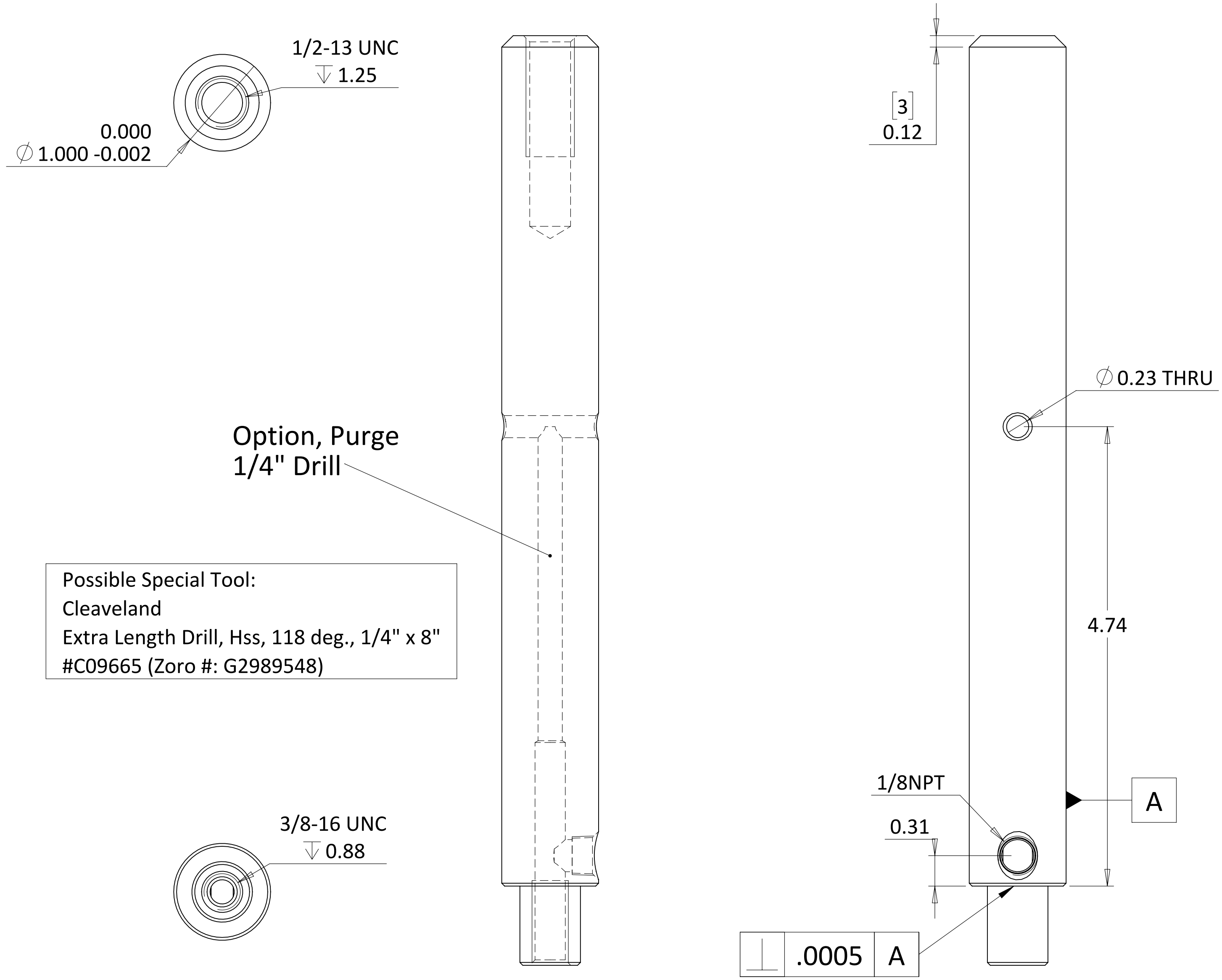
MATERIAL:	TOLERANCES: ANGULAR: MACH X ±.5 BEND X ±1 ONE PLACE DECIMAL X.X ±.1 TWO PLACE DECIMAL X.XX ±.01 THREE PLACE DECIMAL X.XXX ±.005	PETER VERDONE DESIGNS FAIRFAX, CA 94930 (415) 686-0257 PETERVERDONE@GMAIL.COM WWW.PETERVERDONE.COM
FINISH:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
COMMENTS:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 3:4 | 2023-01-07 | REV





Possible Special Tool:
Cleaveland
Extra Length Drill, Hss, 118 deg., 1/4" x 8"
#C09665 (Zoro #: G2989548)

303 Stainless Steel

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

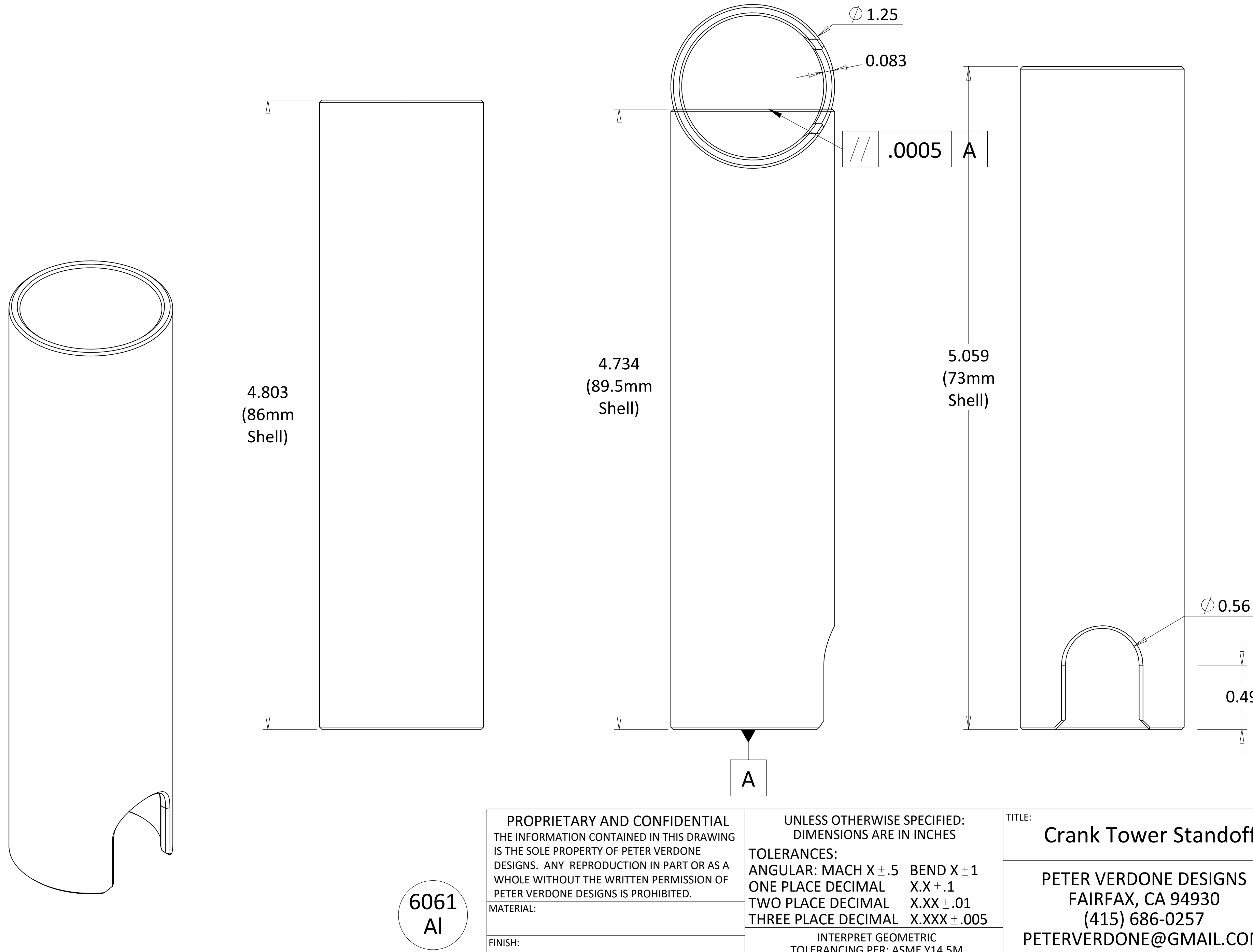
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Crank Shell Tower

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 12:20 | 2023-01-07 | REV



PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X $\pm$.5	BEND X $\pm$1
ONE PLACE DECIMAL	X.X $\pm$.1
TWO PLACE DECIMAL	X.XX $\pm$.01
THREE PLACE DECIMAL	X.XXX $\pm$.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

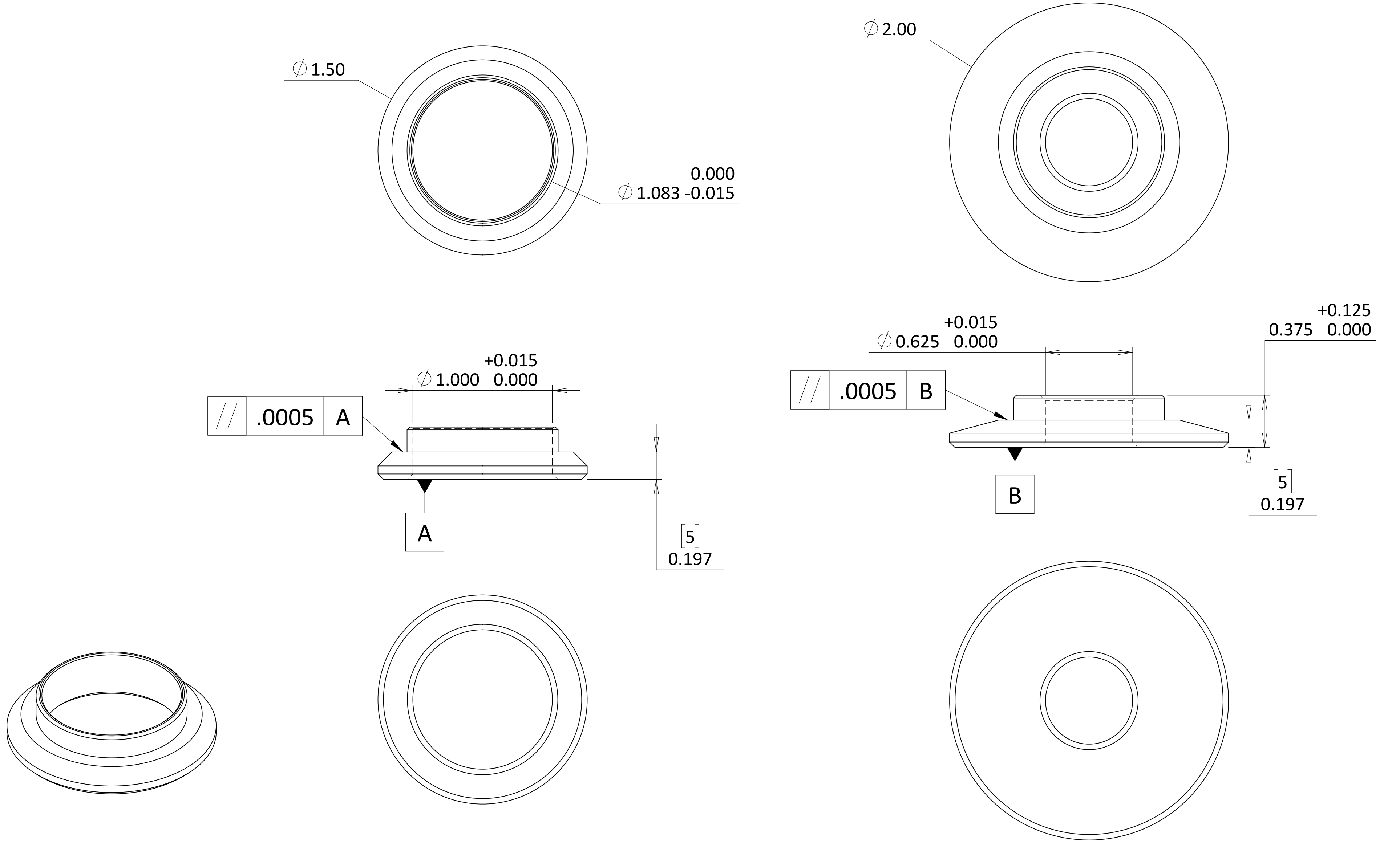
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

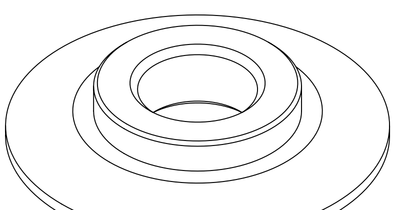
TITLE:

Crank Tower Standoff

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 1:1 | 2023-01-07 | REV





303
Stainless
Steel

PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1	
ONE PLACE DECIMAL	X.X ±.1	
TWO PLACE DECIMAL	X.XX ±.01	
THREE PLACE DECIMAL	X.XXX ±.005	

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

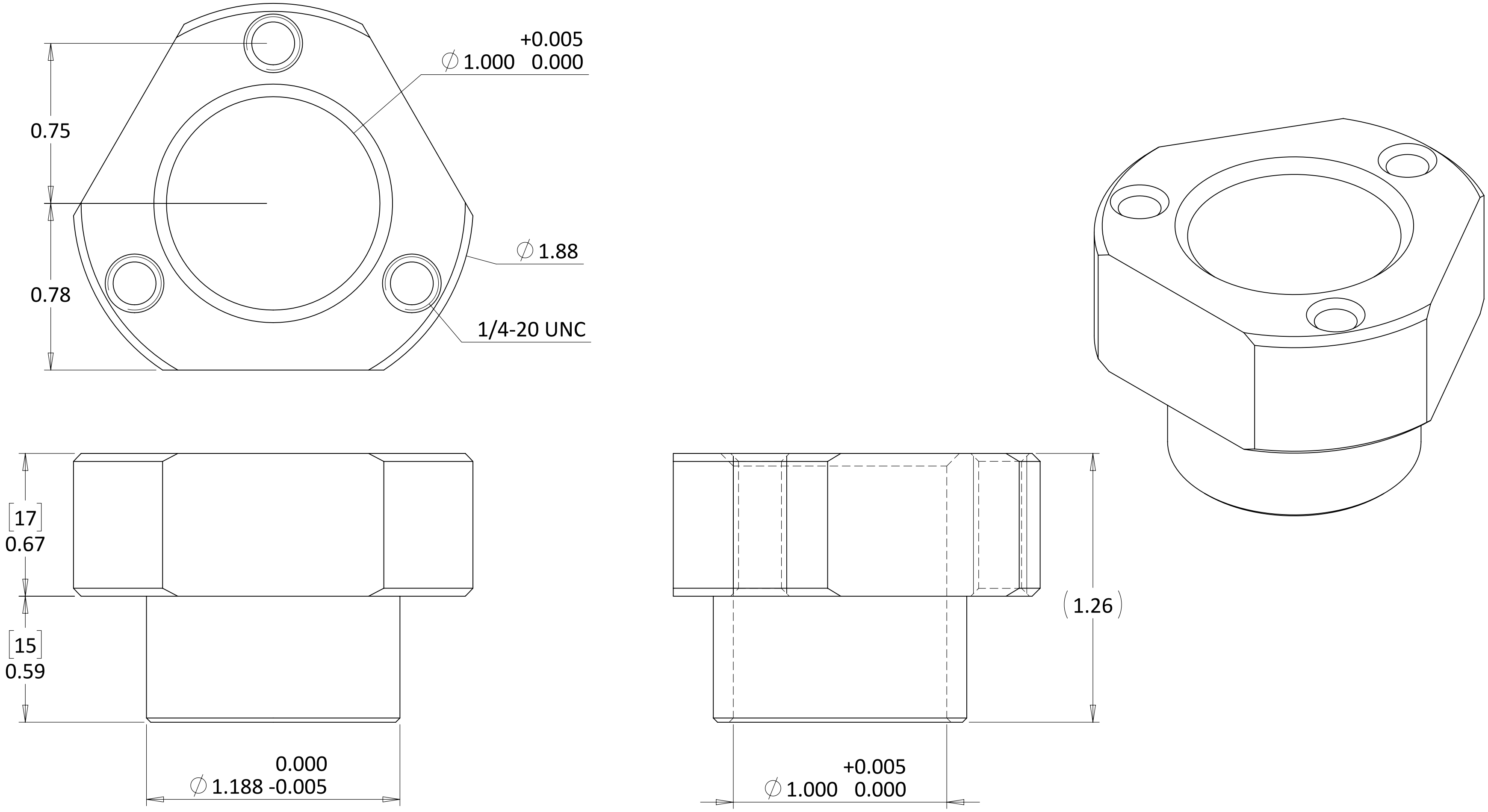
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

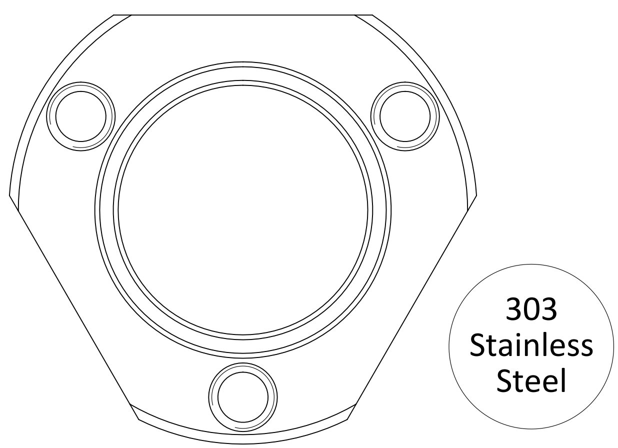
TITLE:

Crank Tower Standoff End

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 1:1 | 2023-01-07 | REV





PROPRIETARY AND CONFIDENTIAL

MATERIAL: 303 Stainless Steel

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

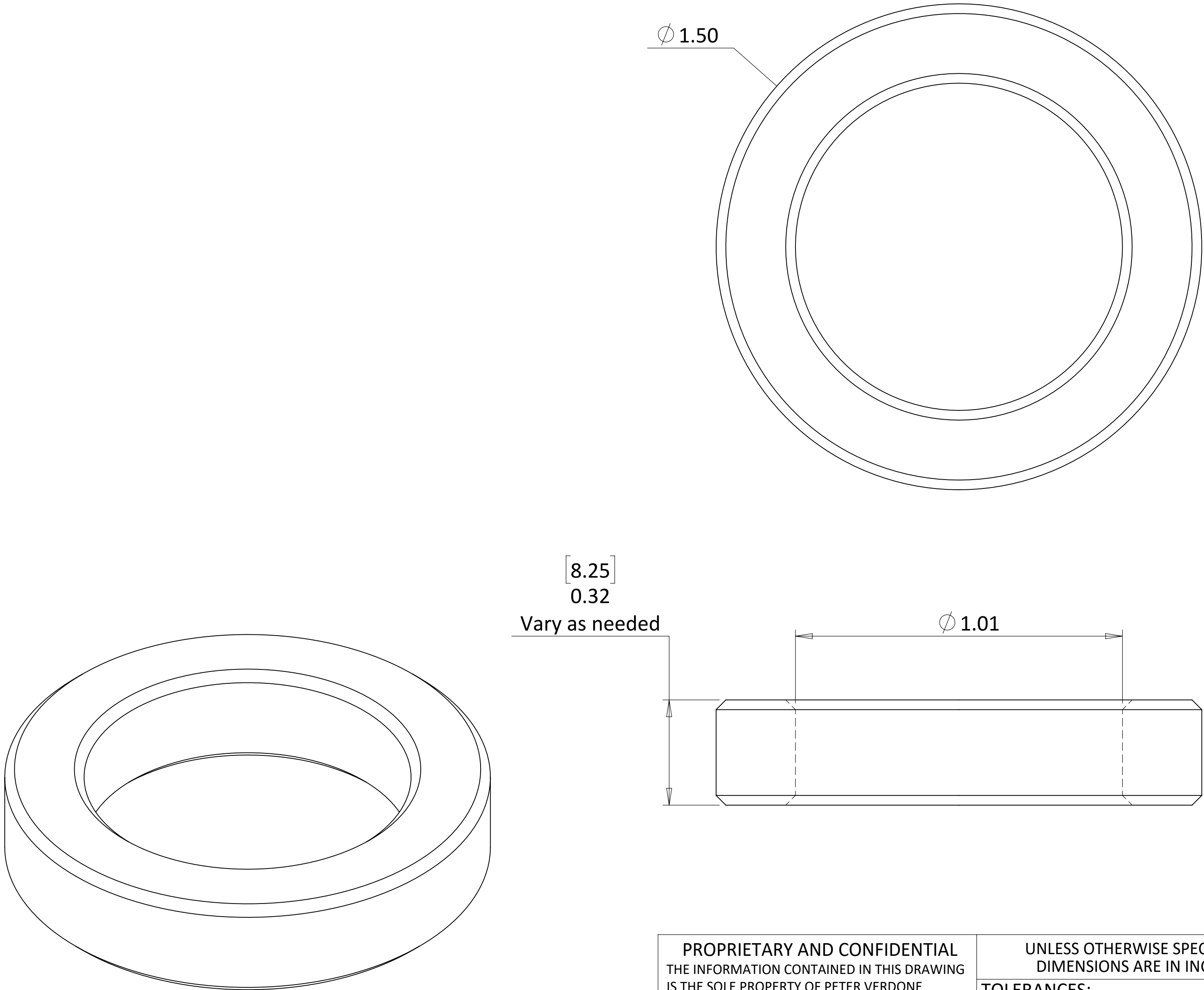
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE: Crank Tower Reducer Puller

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 13:10 | 2023-01-07 | REV



6061
Al

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MATERIAL: 303 Stainless Steel

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

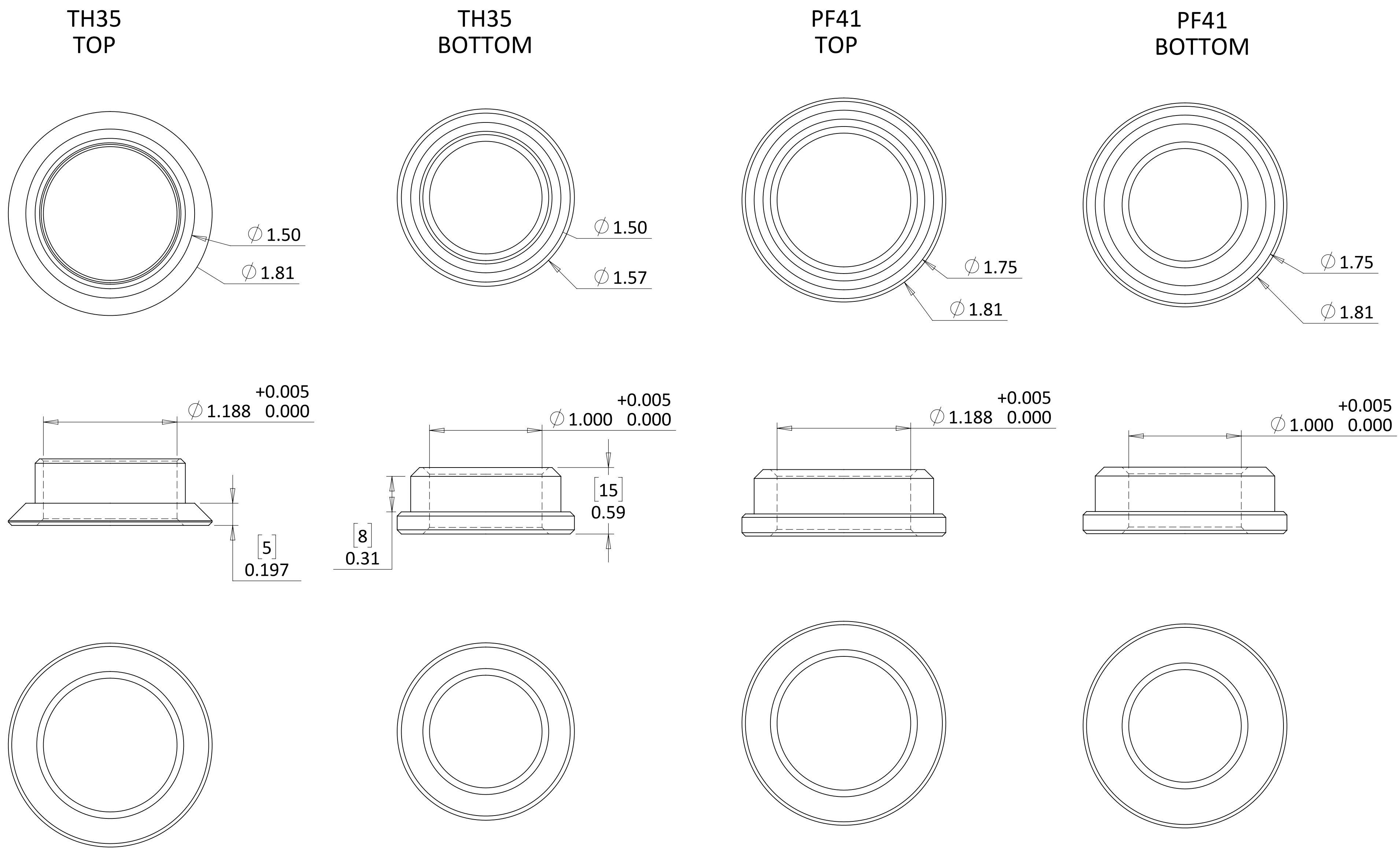
INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE: Crank Shell Tower Reducer Spacer

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 2:1 | 2023-01-07 | REV



303
Stainless
Steel

PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ± .5	BEND X ± 1
ONE PLACE DECIMAL	X.X ± .1
TWO PLACE DECIMAL	X.XX ± .01
THREE PLACE DECIMAL	X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

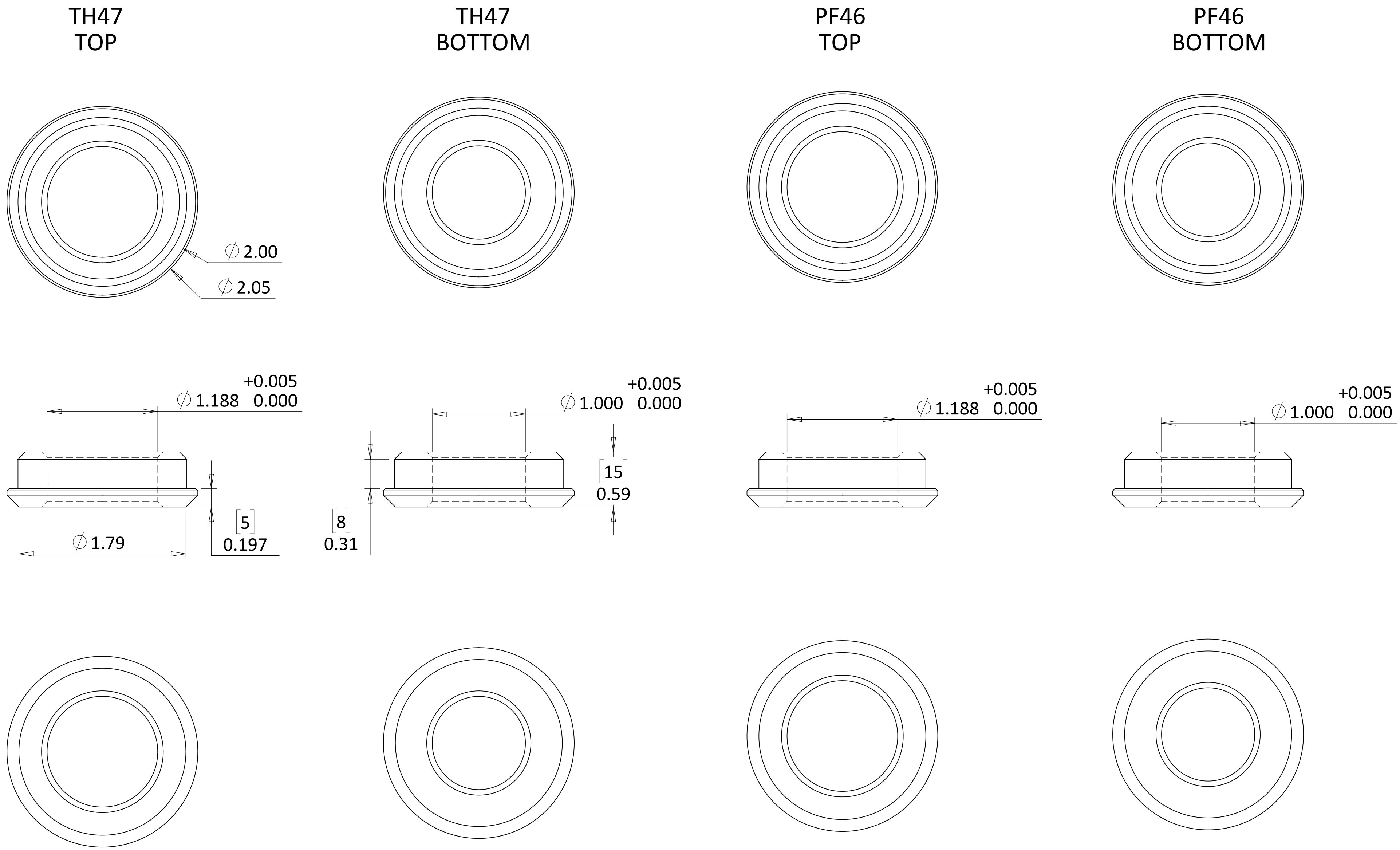
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

TH35 & PF41 Crank Shell Adapters

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 4:5 | 2023-01-07 | REV



303
Stainless
Steel

PROPRIETARY AND CONFIDENTIAL

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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

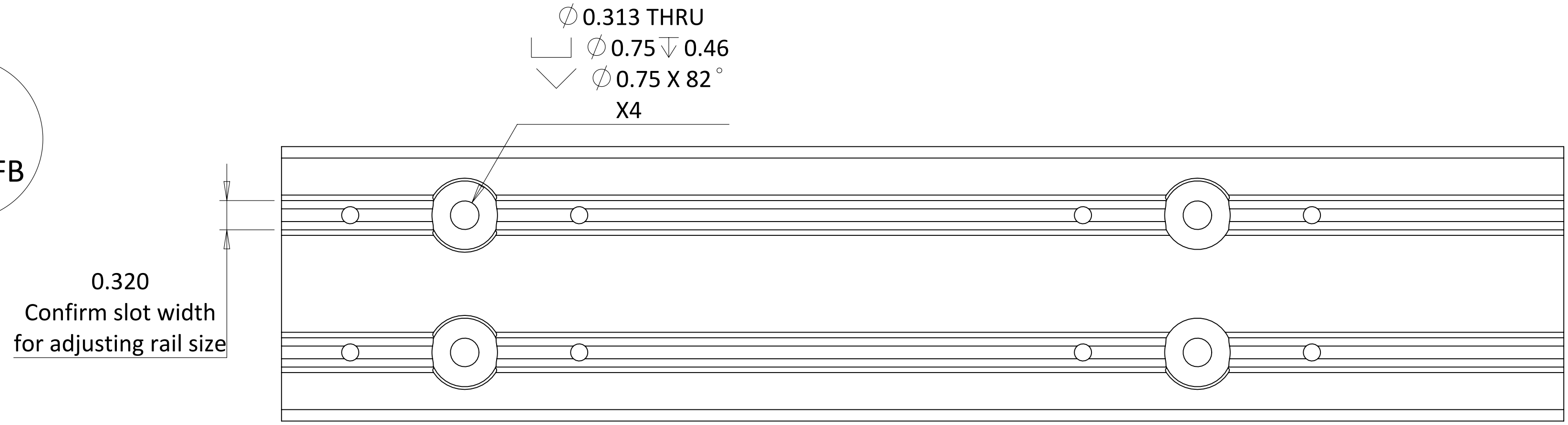
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

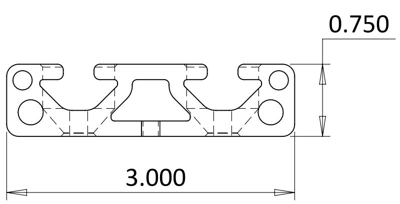
TITLE: TH47 & PF46
Crank Shell Adapters

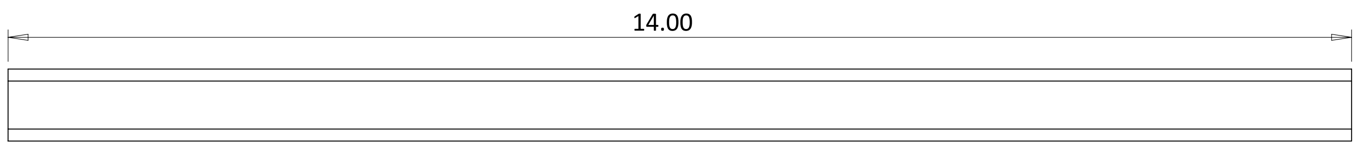
PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 2:3 | 2023-01-07 | REV

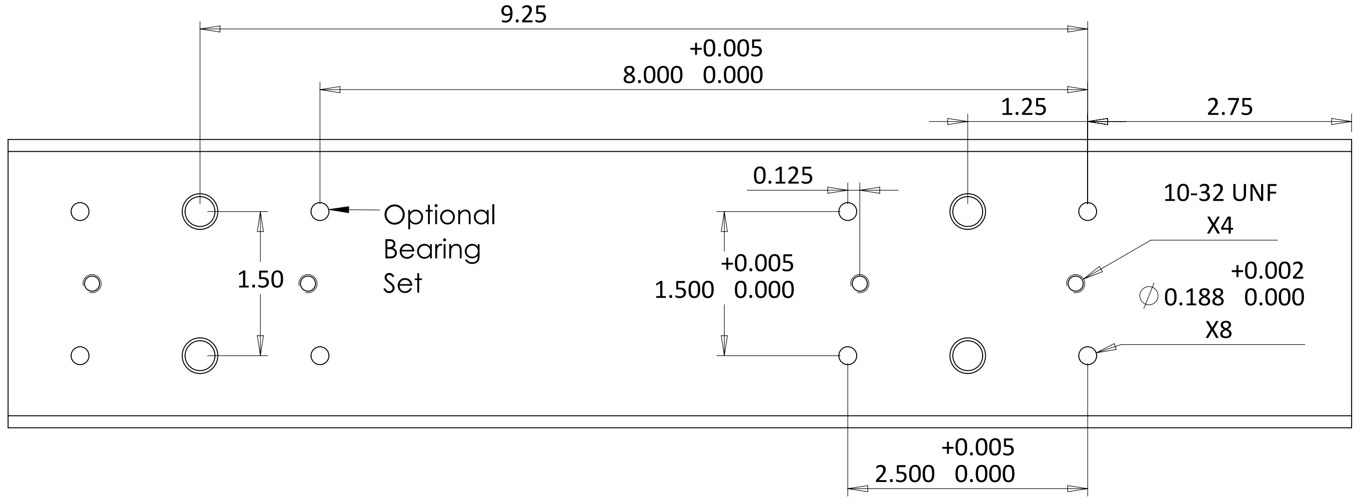
8020
3075
-Black-FB

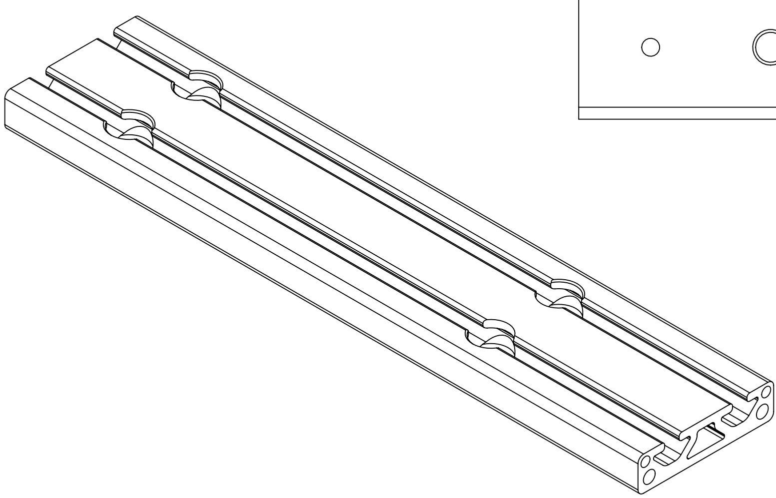






Possible Special Tool:
KEO
NC Spotting Drill, Hss, 82 deg.,
3/4" x 1-7/8
#38342 (Zoro #: G8588151)





PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: Rear Axle Y Rail
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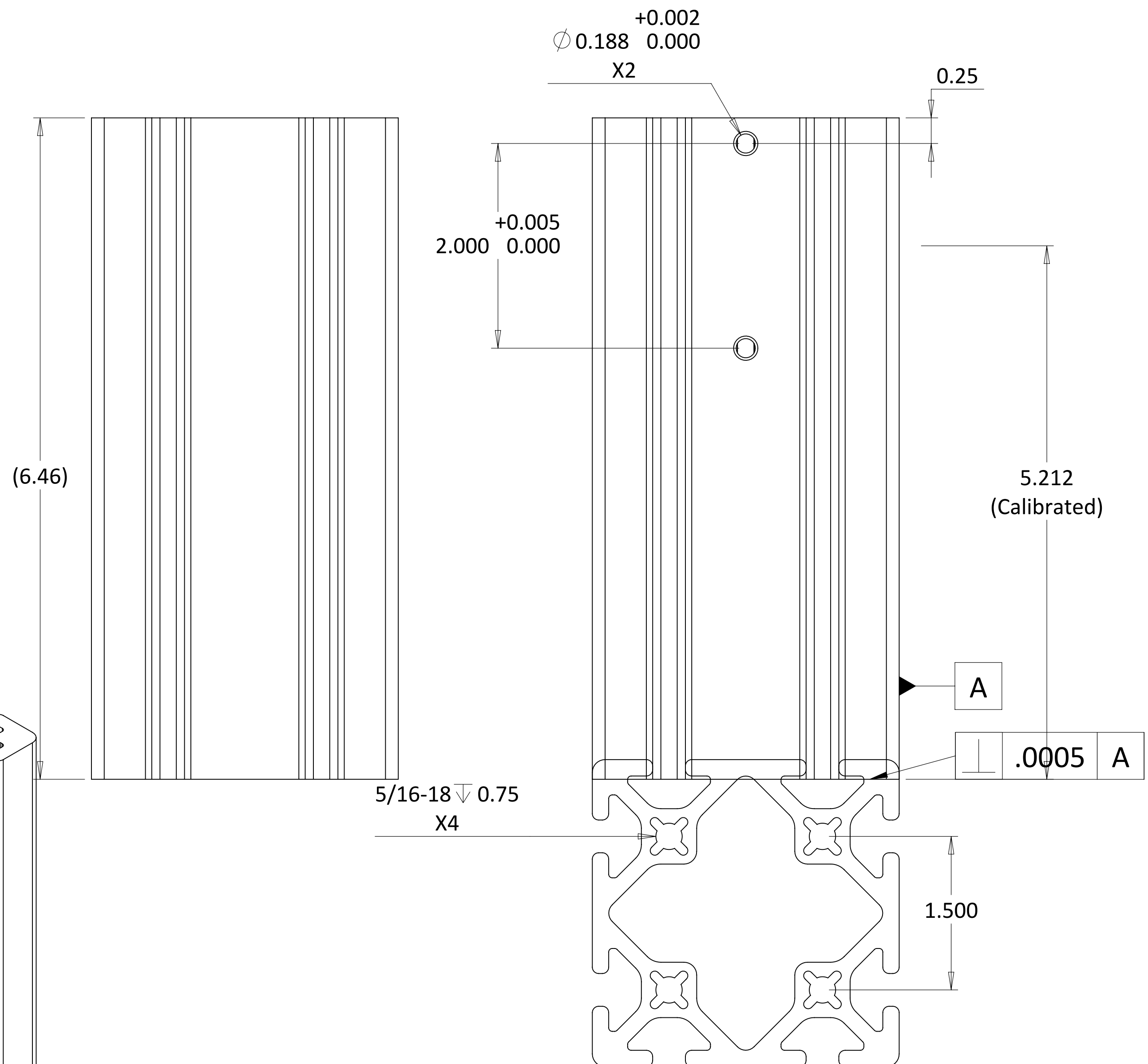
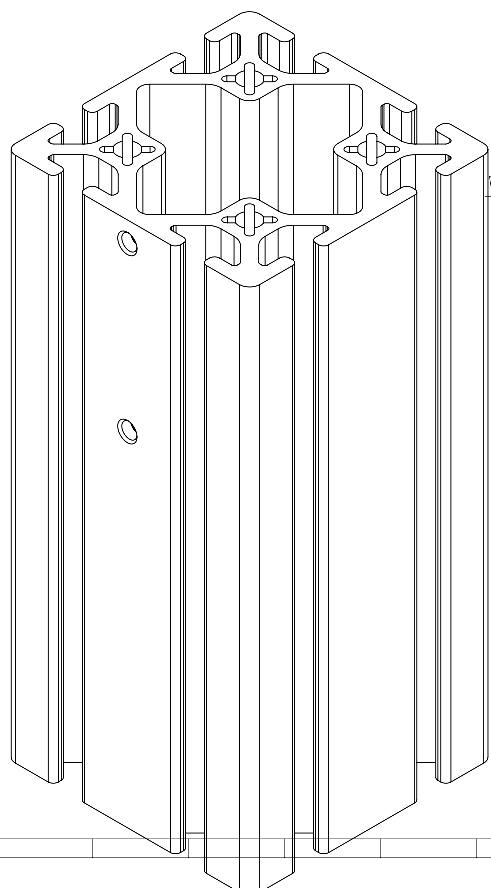
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 1:2
COMMENTS:		2023-01-07 REV





8020
3030
-S-Black

PROPRIETARY AND CONFIDENTIAL
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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ±.5 BEND X ±1
ONE PLACE DECIMAL X.X ±.1
TWO PLACE DECIMAL X.XX ±.01
THREE PLACE DECIMAL X.XXX ±.005

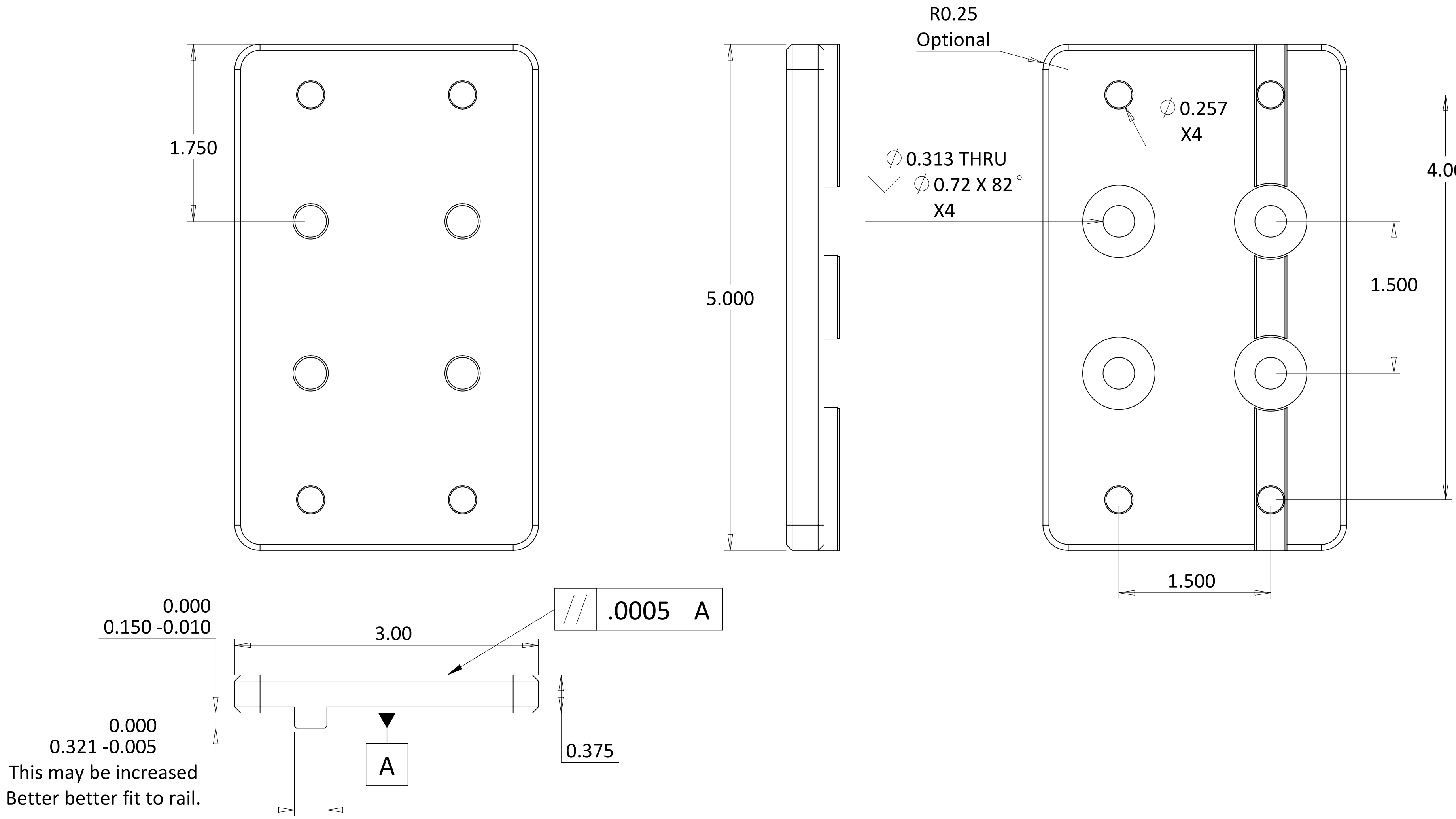
INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

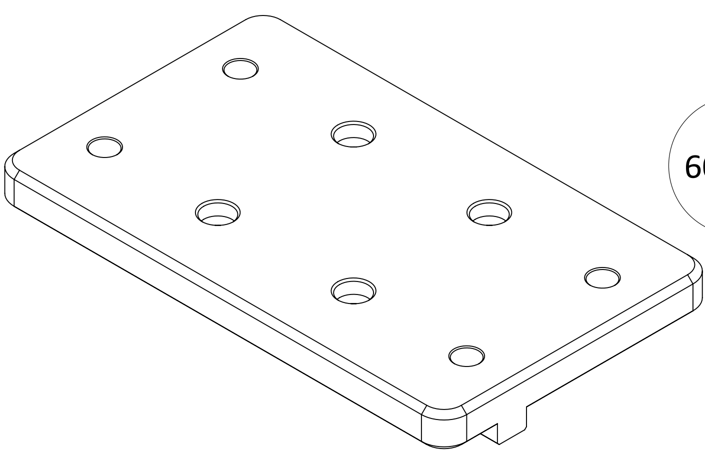
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
Axle Tower

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 3:5 | 2023-01-07 | REV





6061 Al

Possible Special Tool:
KEO
NC Spotting Drill, Hss, 82 deg., 3/4" x 1-7/8
#38342 (Zoro #: G8588151)

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ±.5 BEND X ±1
ONE PLACE DECIMAL X.X ±.1
TWO PLACE DECIMAL X.XX ±.01
THREE PLACE DECIMAL X.XXX ±.005

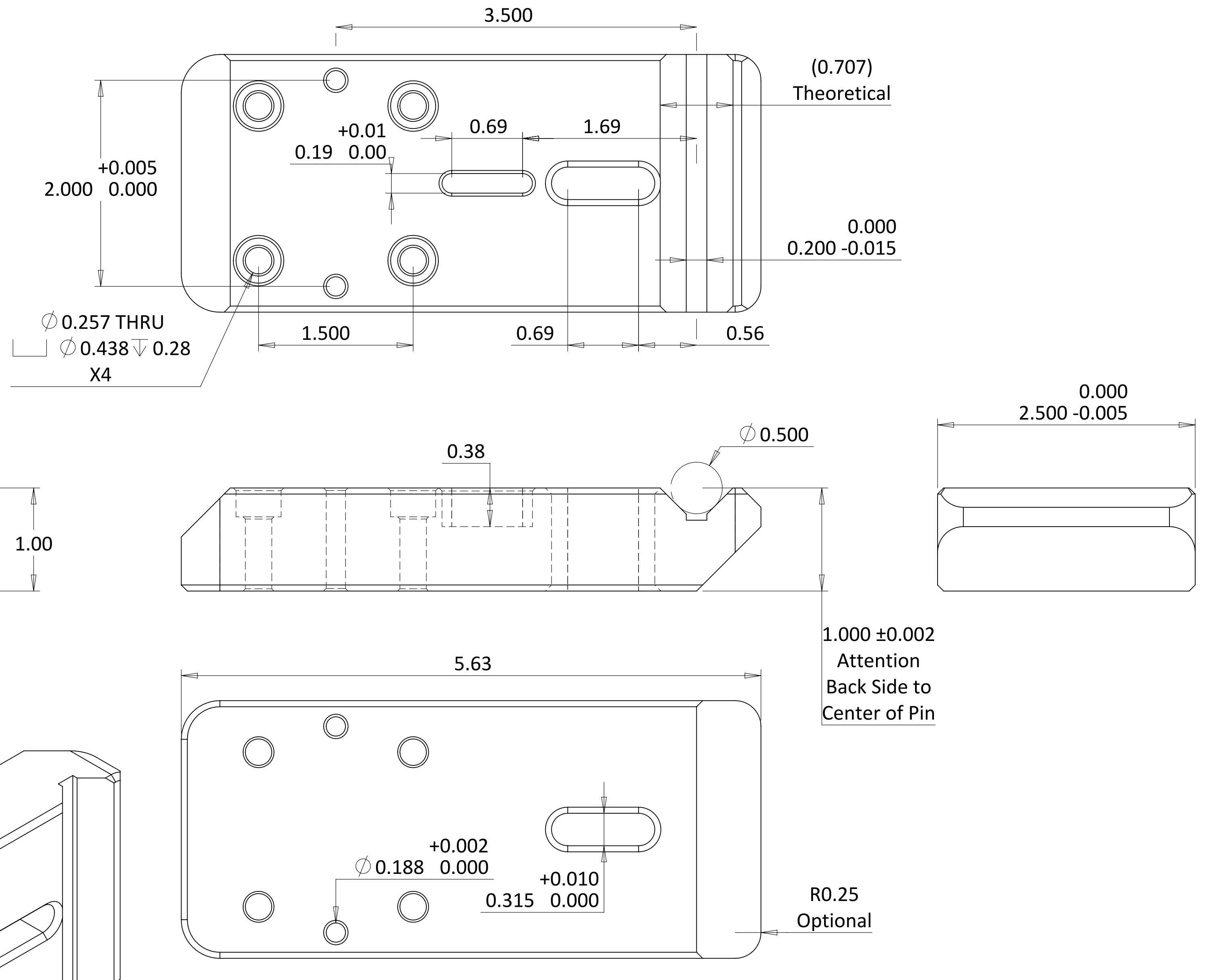
INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

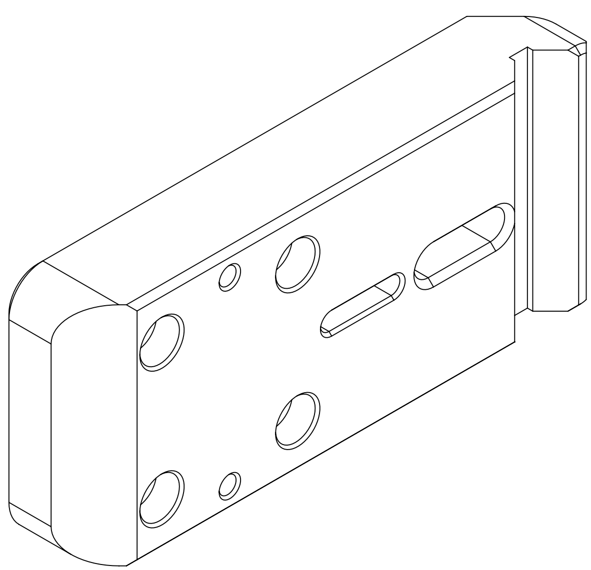
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
Axle Tower Slide

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 2:3 | 2023-01-07 | REV





6061
Al

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

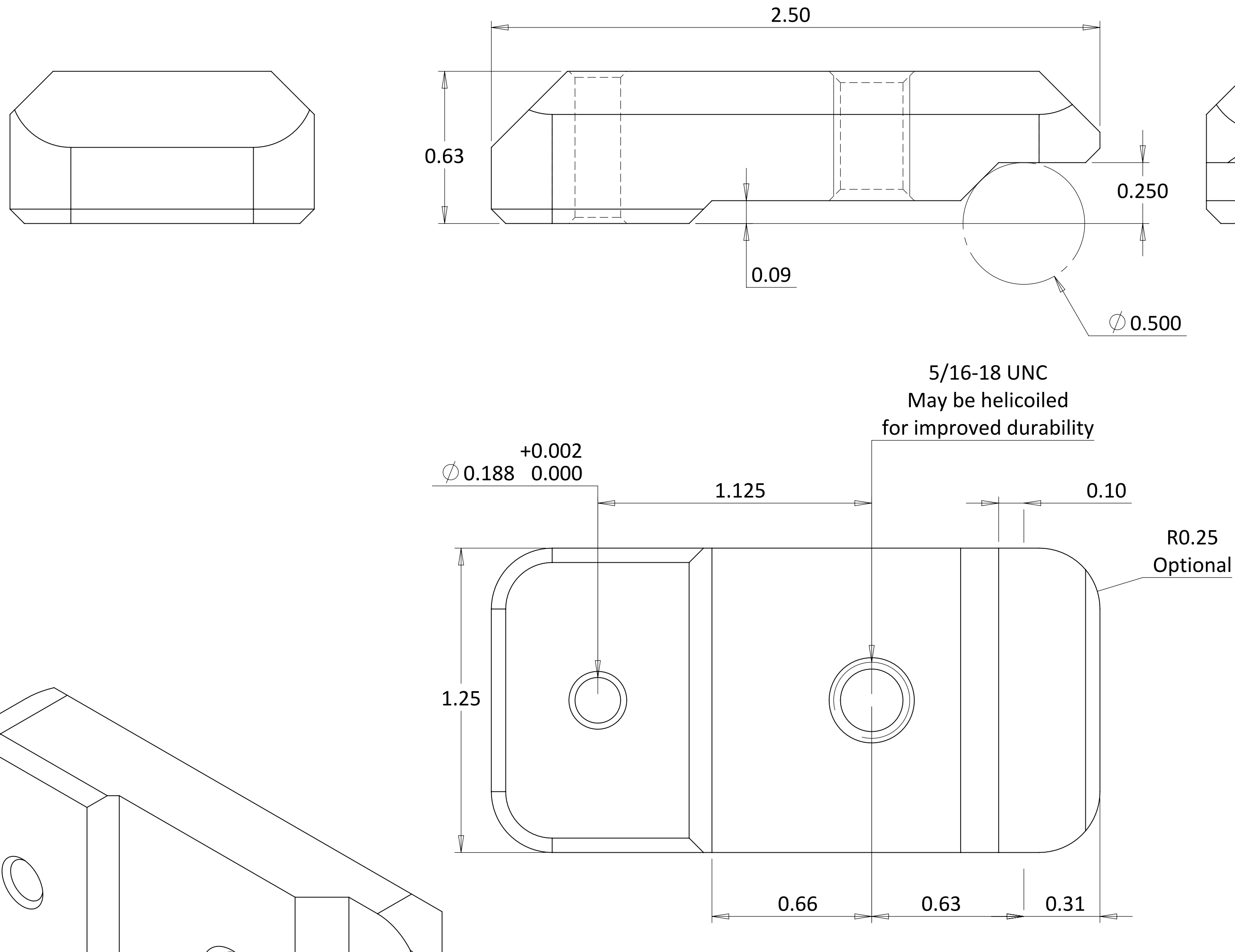
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

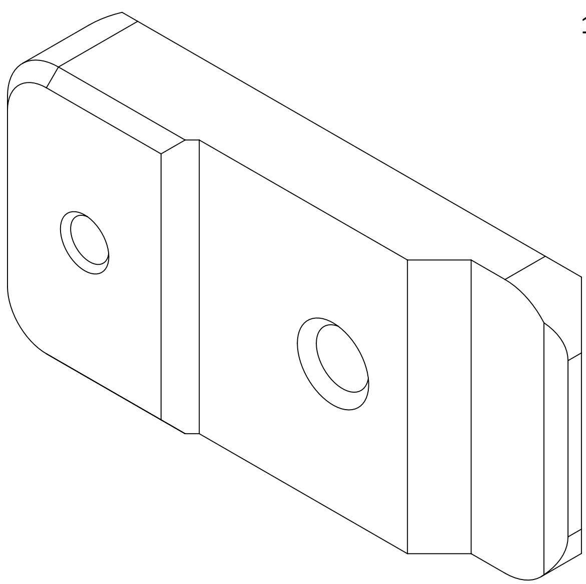
TITLE:

Axle Arm

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 2:3 | 2023-01-07 | REV





6061
Al

PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: Axle Clamp
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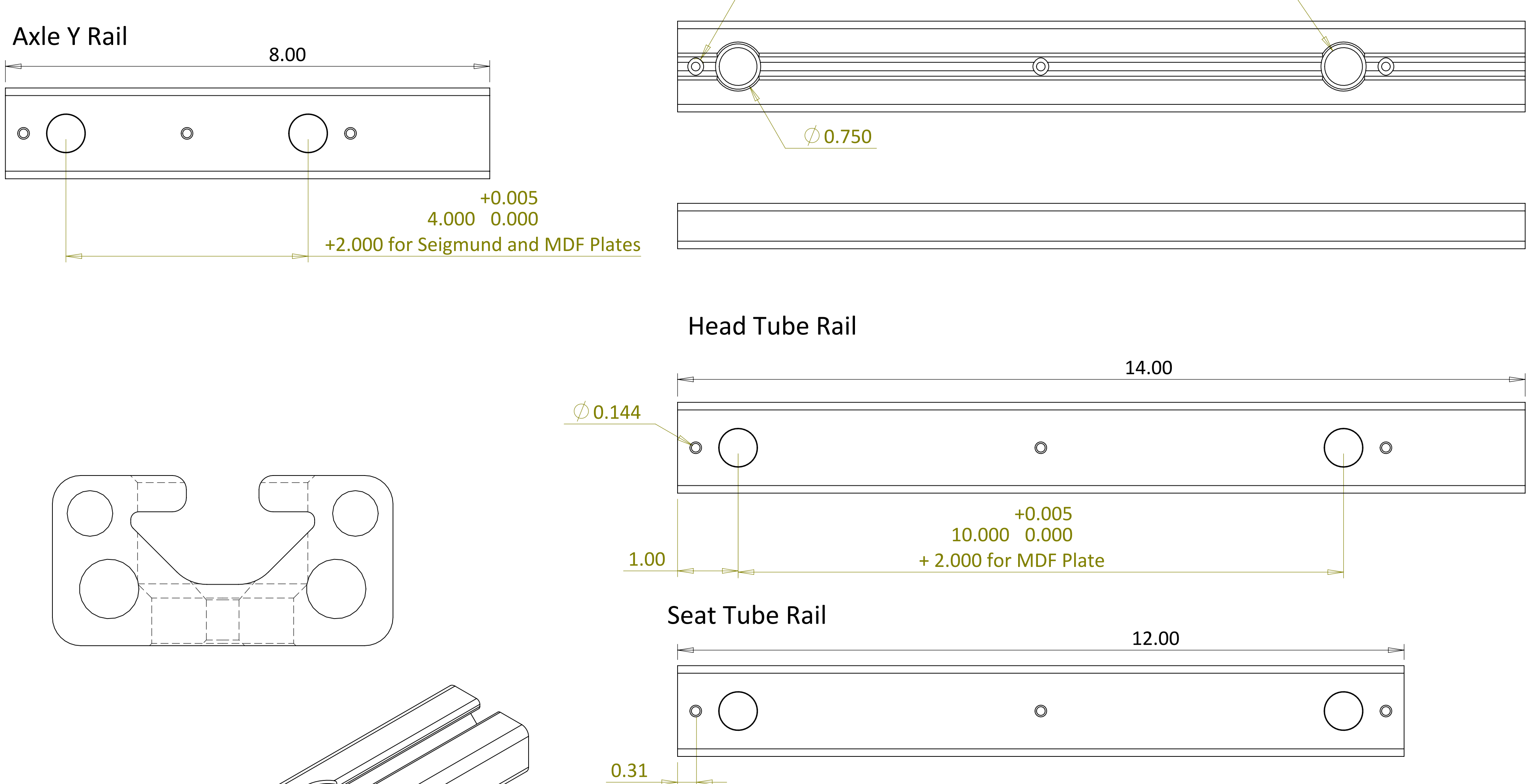
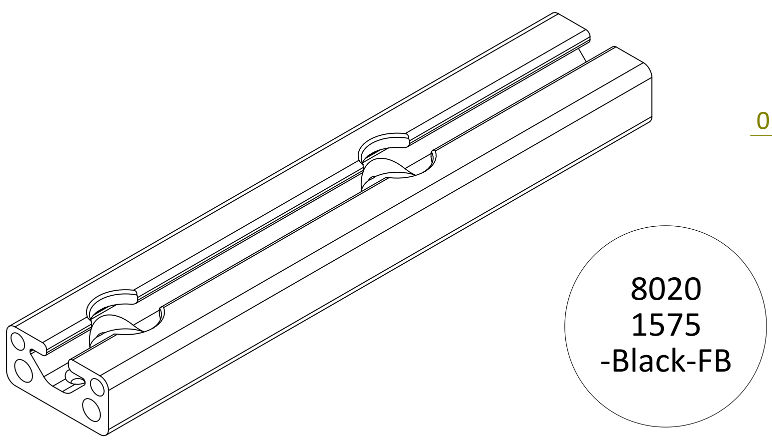
MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 3:2
COMMENTS:		2023-01-07 REV

Special Tool:
MELIN TOOL COMPANY
Drill Mill, Hss, 90 deg., 3/4" x 1-11/16
#A-2424-DP (Zoro #: G4991380)





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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

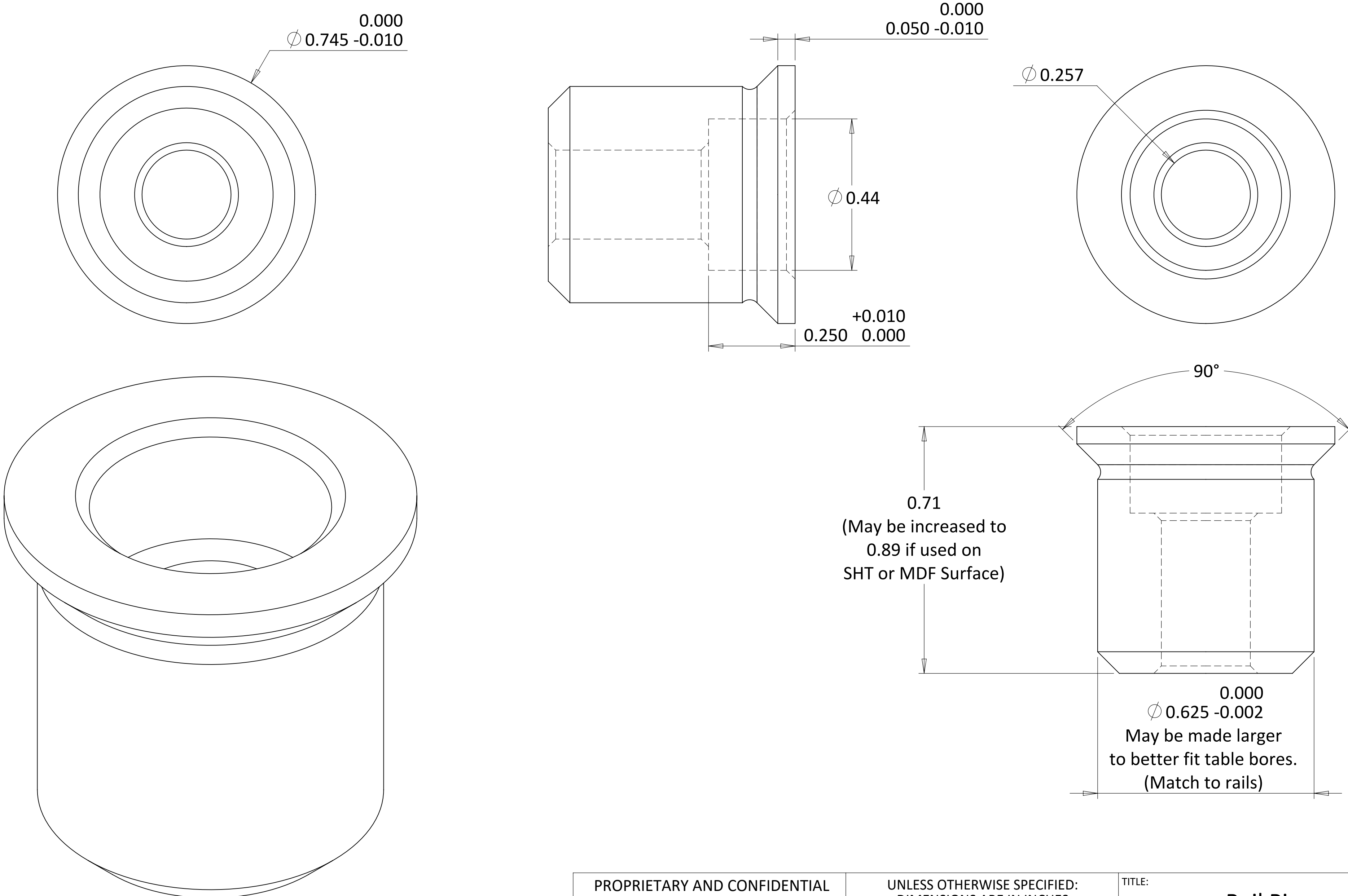
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
8020 Rails

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 2:5
2023-01-07
REV



303
Stainless
Steel

PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ± .5	BEND X ± 1
ONE PLACE DECIMAL	X.X ± .1
TWO PLACE DECIMAL	X.XX ± .01
THREE PLACE DECIMAL	X.XXX ± .005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

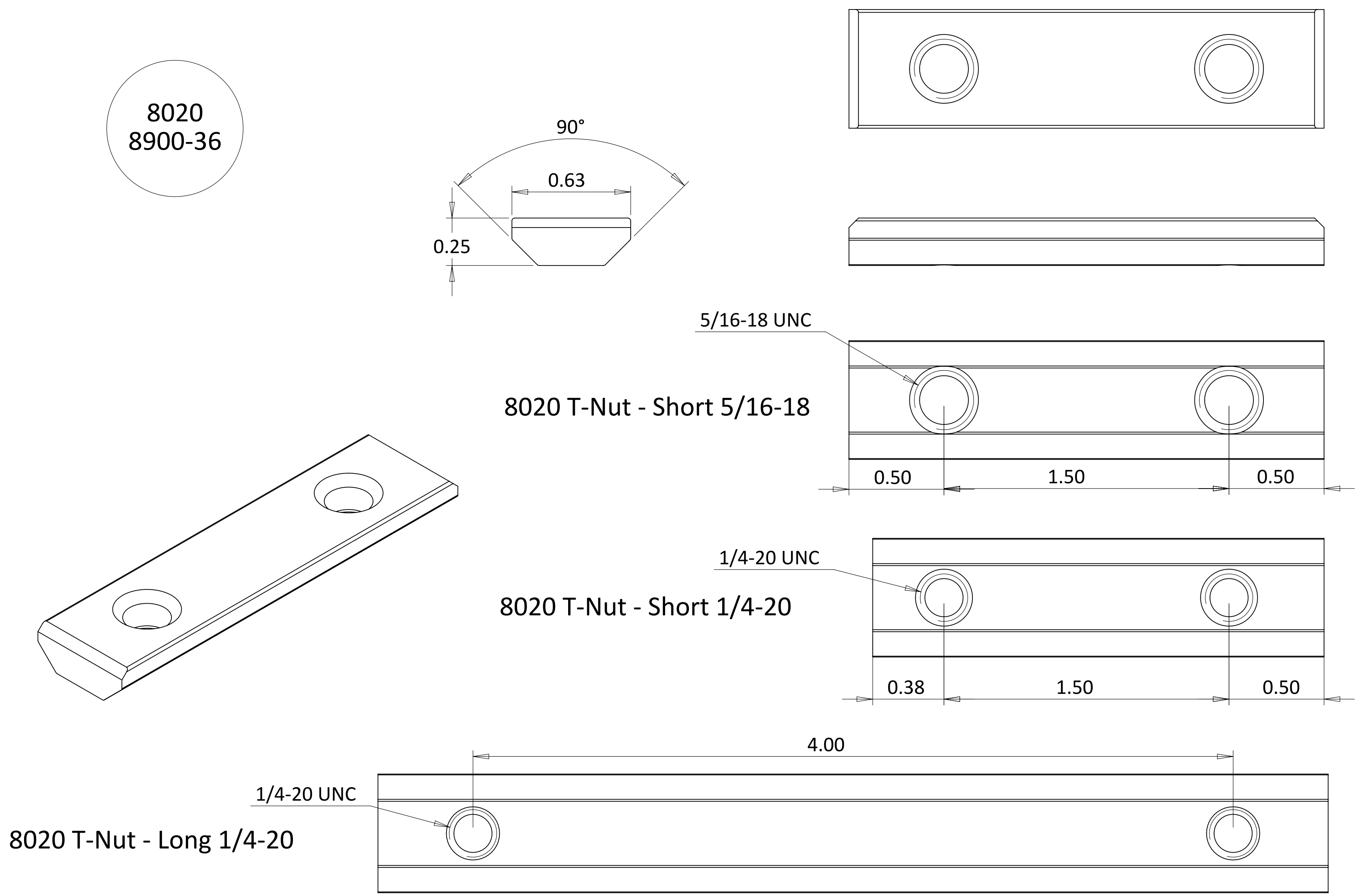
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Rail Pin

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 5:2 | 2023-01-07 | REV



PROPRIETARY AND CONFIDENTIAL

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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

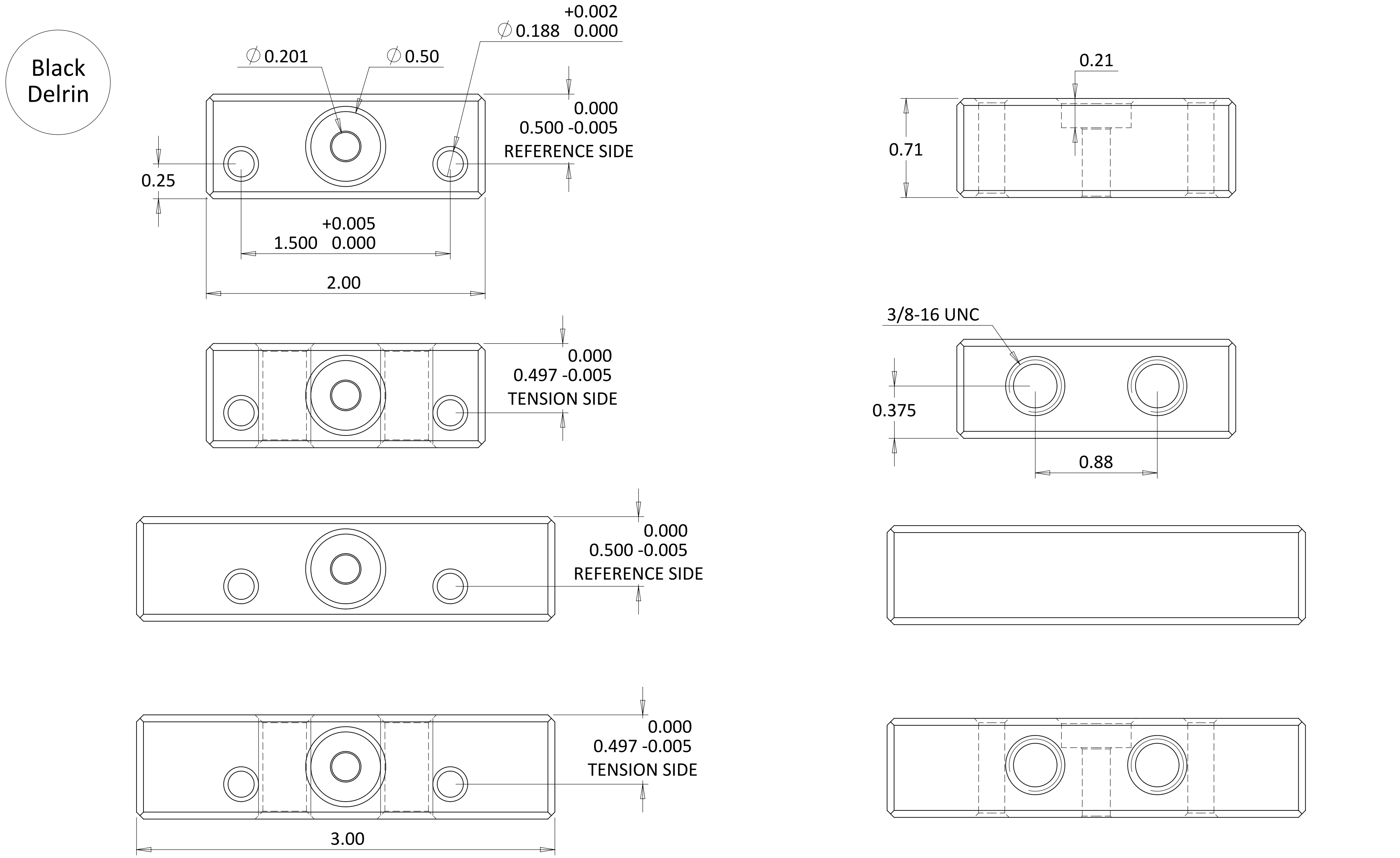
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

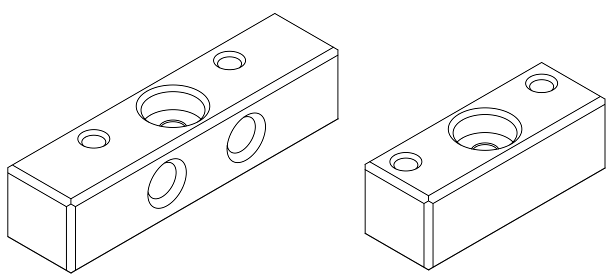
TITLE:

T-Nuts

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 5:4 | 2023-01-07 | REV





PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ± .5	BEND X ± 1
ONE PLACE DECIMAL	X.X ± .1
TWO PLACE DECIMAL	X.XX ± .01
THREE PLACE DECIMAL	X.XXX ± .005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Bearing Blocks

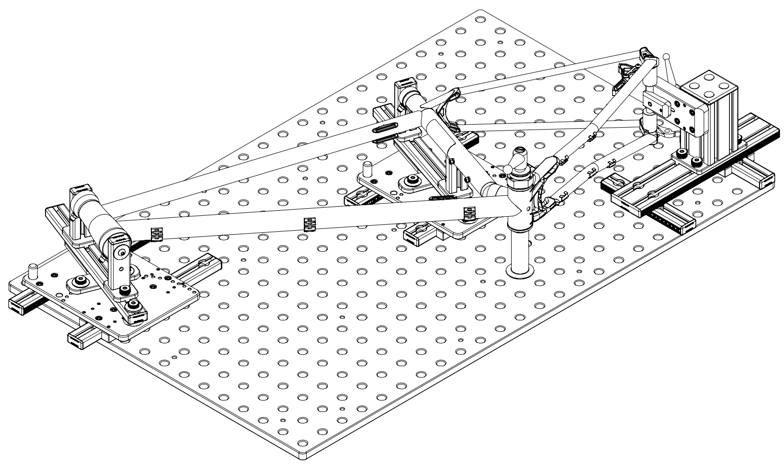
PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 1:1 | 2023-01-07 | REV

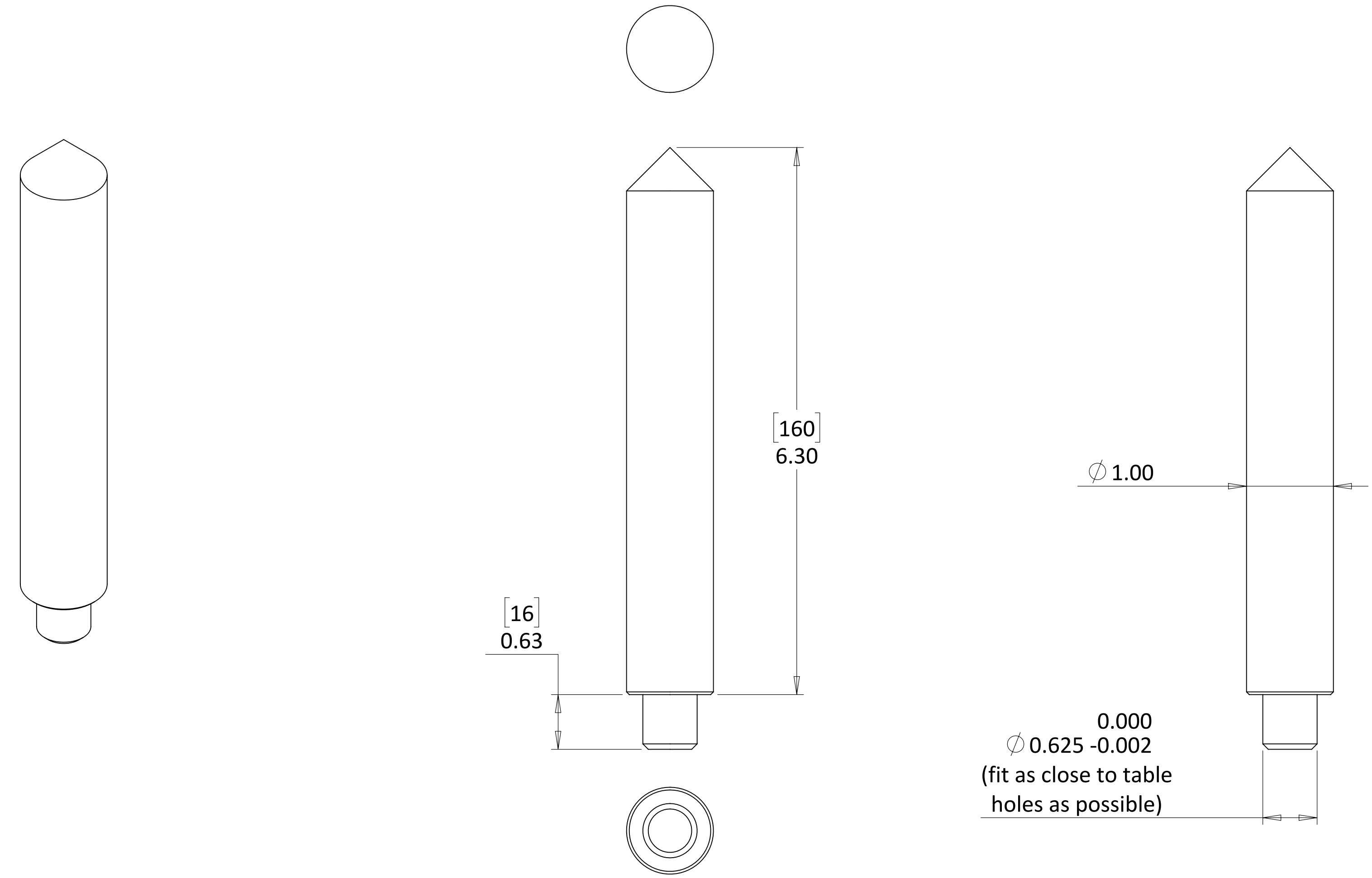
SKYNET

A BICYCLE CHASSIS FIXTURE

Accessories



PETER VERDONE DESIGNS, FAIRFAX, CA 94930
REV:2022-02-18-1



303
Stainless

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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ± .5 BEND X ± 1
ONE PLACE DECIMAL X.X ± .1
TWO PLACE DECIMAL X.XX ± .01
THREE PLACE DECIMAL X.XXX ± .005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

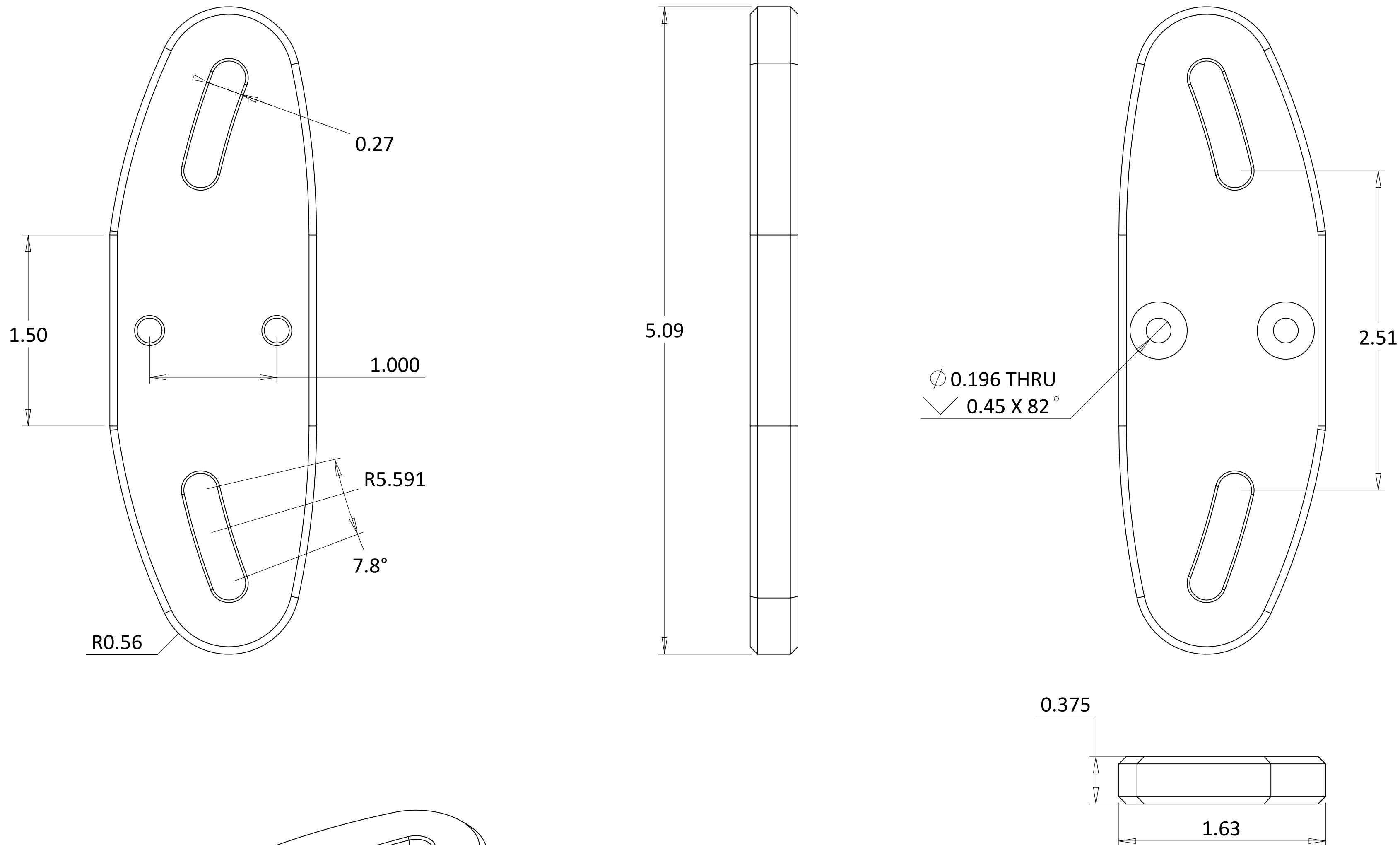
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

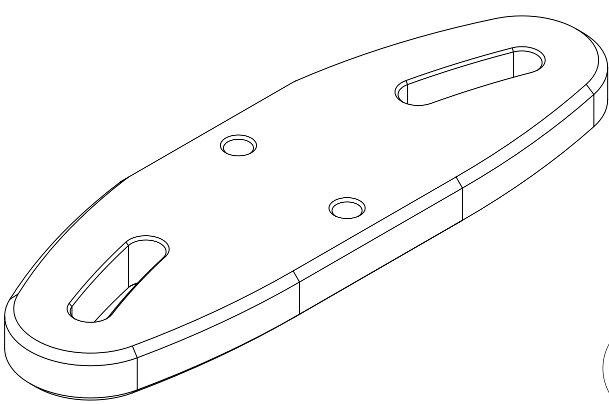
TITLE:

Reference Pin

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 10:20 | 2022-02-18 | REV





6061
Al

* This is an optional version that may require CNC to produce. It has been included as it would be really nice if it is used.

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

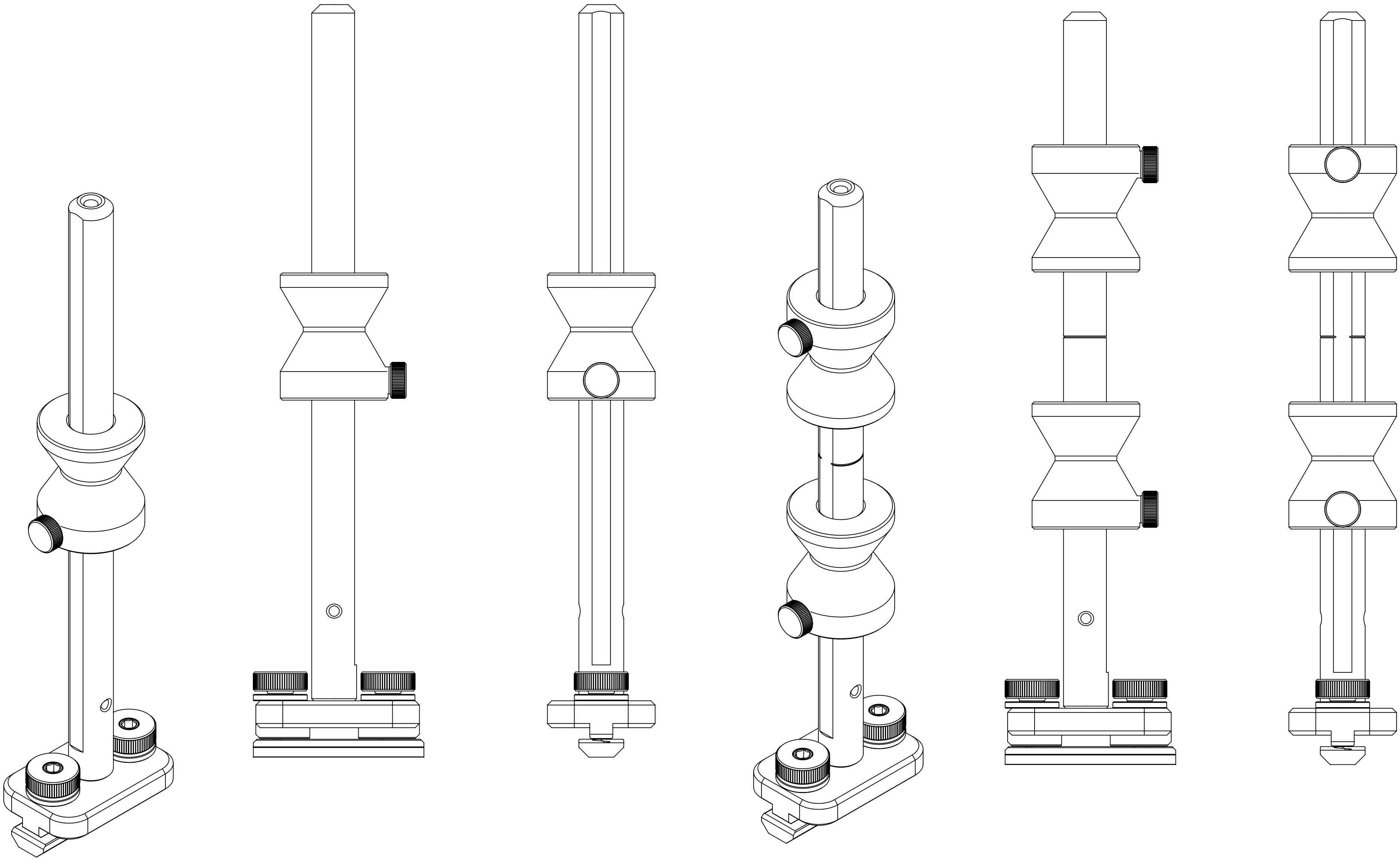
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

CNC Angle Beam Clamp

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 4:5 | 2022-02-18 | REV



PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X $\pm$.5	BEND X $\pm$1
ONE PLACE DECIMAL	X.X $\pm$.1
TWO PLACE DECIMAL	X.XX $\pm$.01
THREE PLACE DECIMAL	X.XXX $\pm$.005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

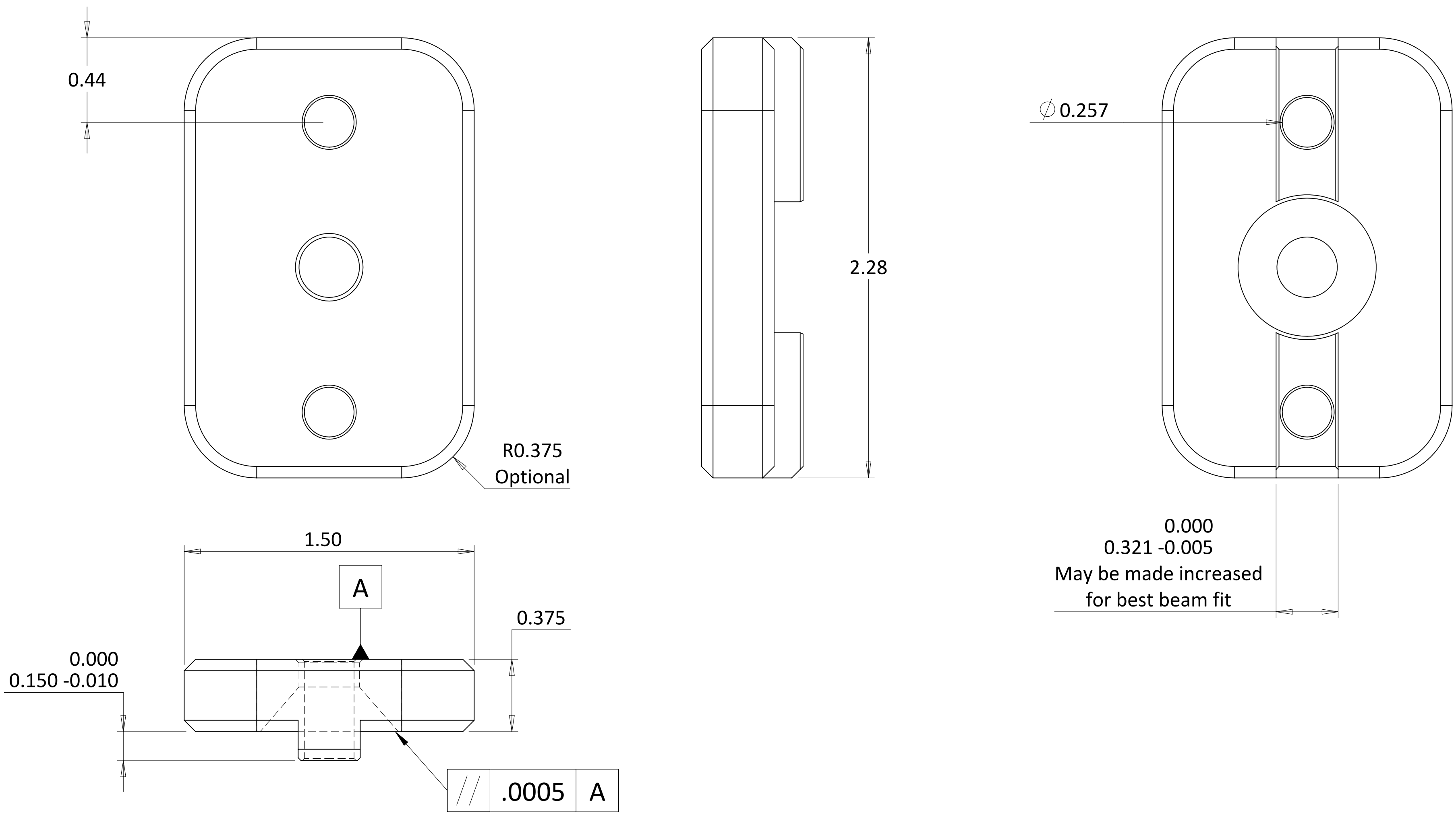
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

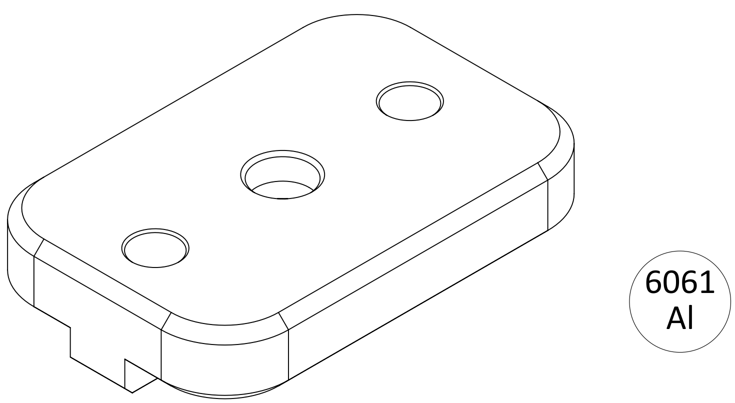
TITLE:

Centering Tower Assembly

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 1:2 | 2022-02-18 | REV





PROPRIETARY AND CONFIDENTIAL

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MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ±.5 BEND X ±1
ONE PLACE DECIMAL X.X ±.1
TWO PLACE DECIMAL X.XX ±.01
THREE PLACE DECIMAL X.XXX ±.005

INTERPRET GEOMETRIC
TOLERANCING PER: ASME Y14.5M

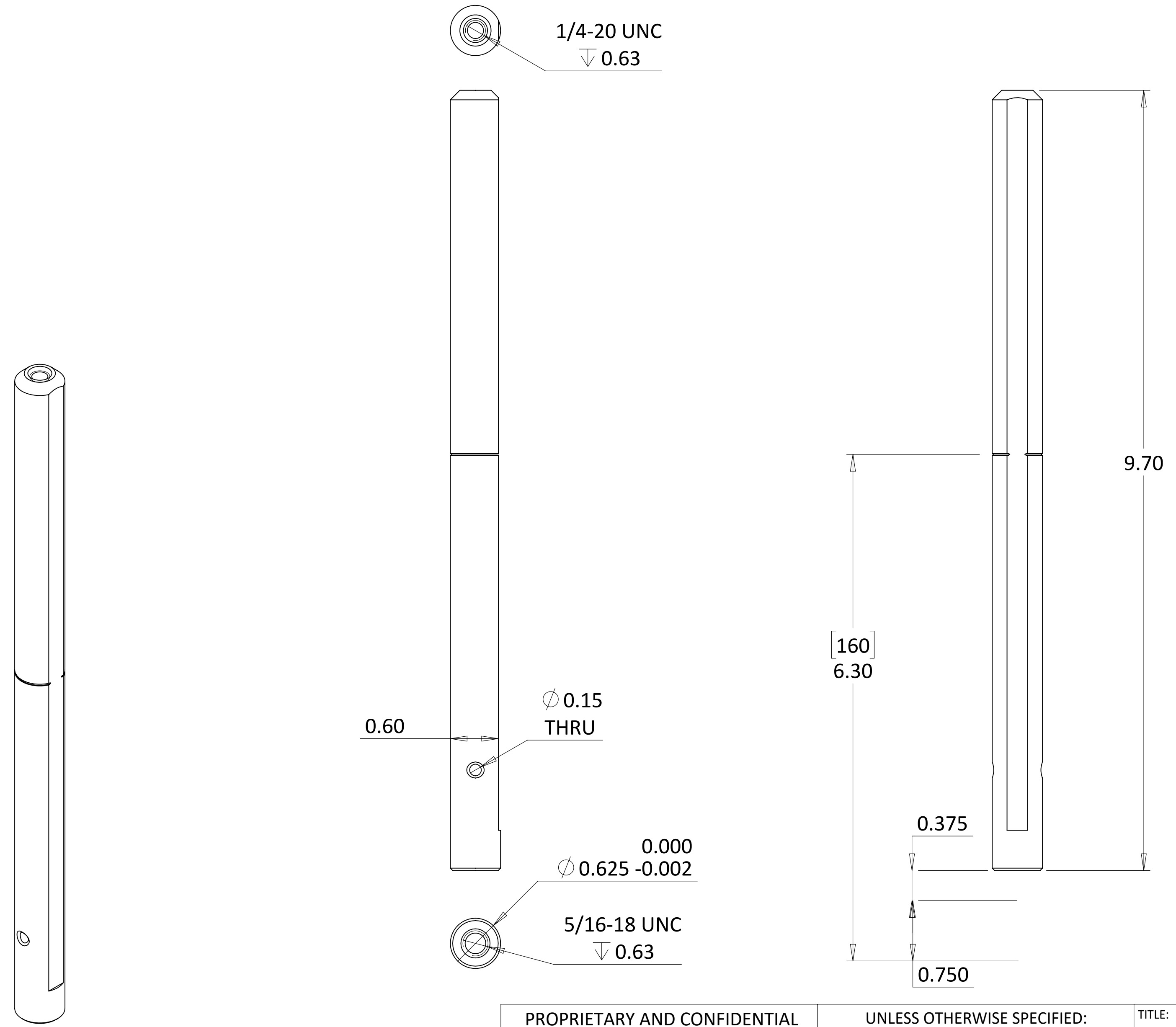
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:

Centering Tower Slide

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 5:4 | 2022-02-18 | REV



303 Stainless

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:
ANGULAR: MACH X ±.5 BEND X ±1
ONE PLACE DECIMAL X.X ±.1
TWO PLACE DECIMAL X.XX ±.01
THREE PLACE DECIMAL X.XXX ±.005

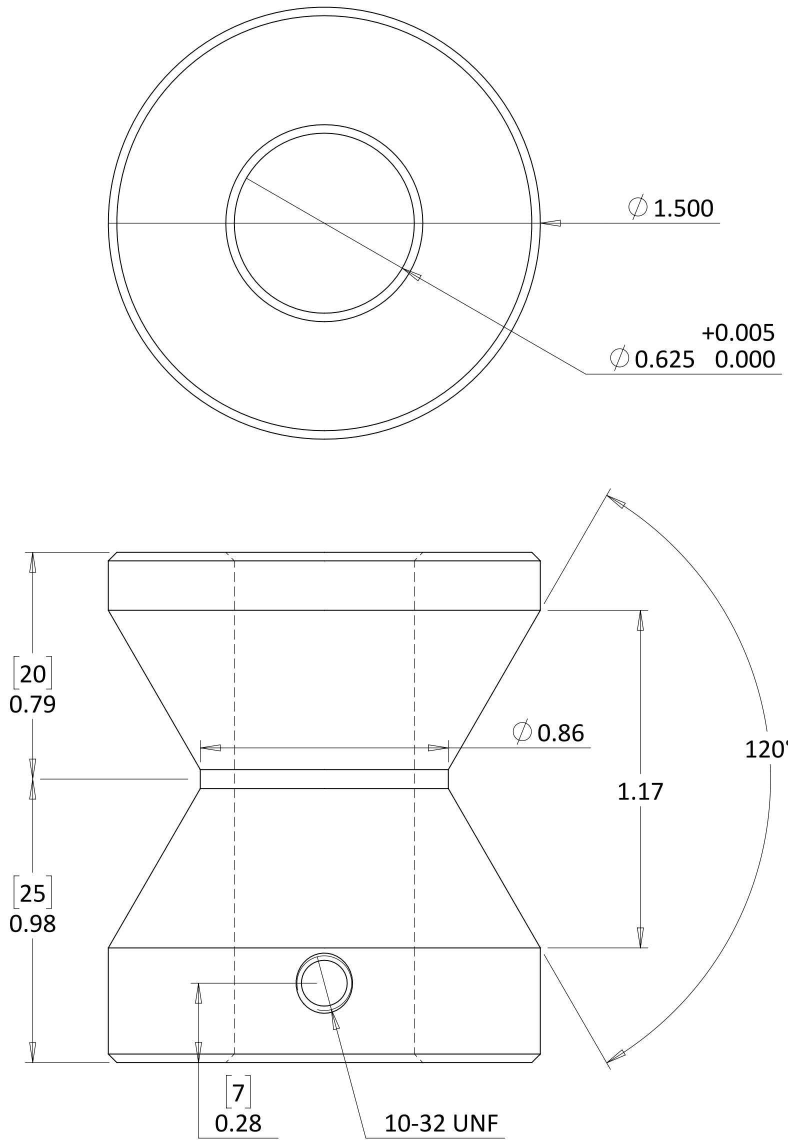
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

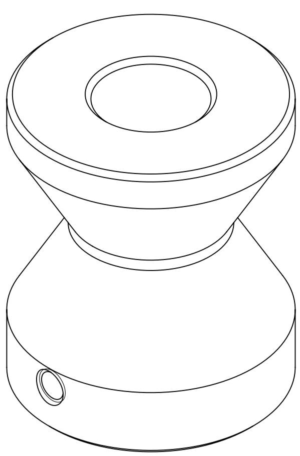
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

TITLE:
Centering Tower

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 1:2 | 2022-02-18 | REV





3/8" to 2 1/4" Tubes

303 Stainless

PROPRIETARY AND CONFIDENTIAL

MATERIAL:

FINISH:

COMMENTS:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES:

ANGULAR: MACH X ±.5	BEND X ±1
ONE PLACE DECIMAL	X.X ±.1
TWO PLACE DECIMAL	X.XX ±.01
THREE PLACE DECIMAL	X.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

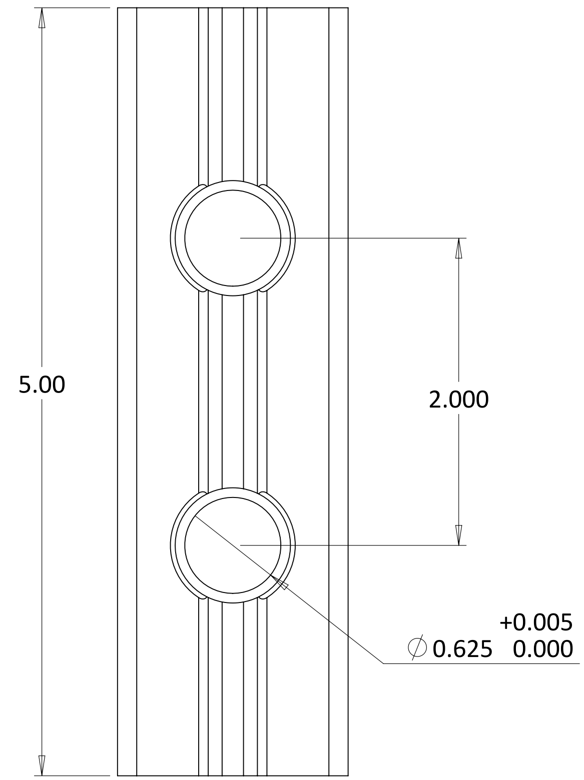
Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012

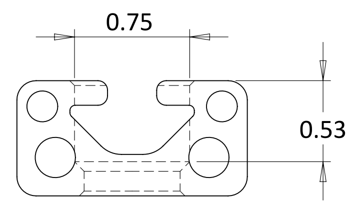
TITLE:

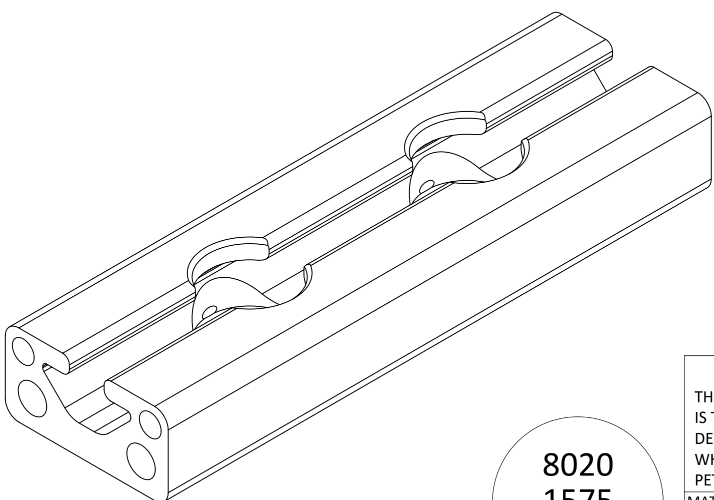
Centering Cones

PETER VERDONE DESIGNS
FAIRFAX, CA 94930
(415) 686-0257
PETERVERDONE@GMAIL.COM
WWW.PETERVERDONE.COM

SCALE: 3:2	2022-02-18	REV







8020
1575
-Black-FB

PROPRIETARY AND CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	TITLE: Centering Tower Rail
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MATERIAL:	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M	
FINISH:	Some parts may include a model-based definition to be interpreted per ASME Y14.41-2012	SCALE: 4:5
COMMENTS:		2022-02-18 REV