



The FirstLightWorks CoronaSector

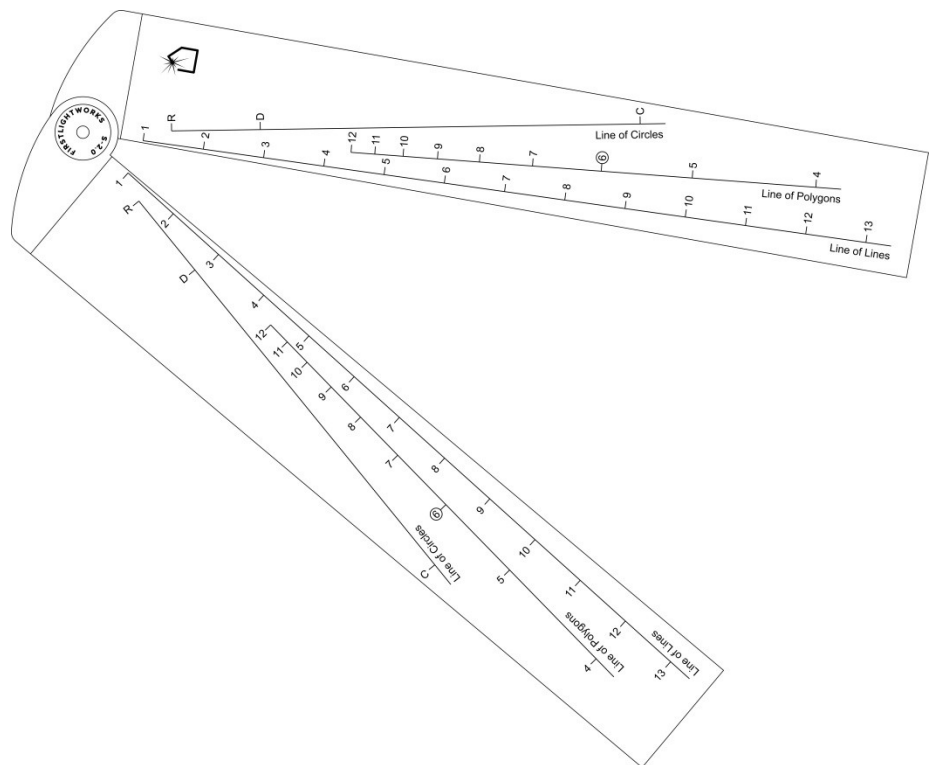
Thank you for downloading the FirstLightWorks CoronaSector, intended to help keep you occupied whilst staying at home. You have in your hands an ancient proportional layout device which applies some basic geometrical principles to create a tool that has many applications, even in today's modern workshop. At FirstLightWorks we didn't invent the sector, nor can we claim any credit for the recently raised awareness of it (for this, see the work of Jim Tolpin and George Walker); we're just making it accessible to people.

The sector is used in conjunction with a pair of dividers and allows the user to take a known dimension and convert this into an unknown (but proportional) dimension from the relevant scale on the sector. Dimensions are transferred to and from the sector through divider settings. The sector consists of two scales, joined together at a pivot point – this pivot point is the origin of each of the lines on the face of the scales.

We can use the sector to divide known dimensions into subdivisions; say we wanted to position a drawer pull $2/5$ of the way down a drawer front, or to equally space out fixings along a line of known length. We can also multiply known dimensions into larger values.

The sector allows us to take one known parameter of a circle (radius, diameter, and circumference) and derive the other two.

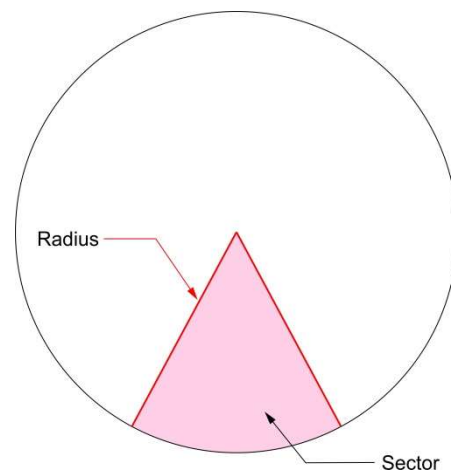
The sector also allows us to determine the side length of various regular polygons that fit within a circle of known radius.



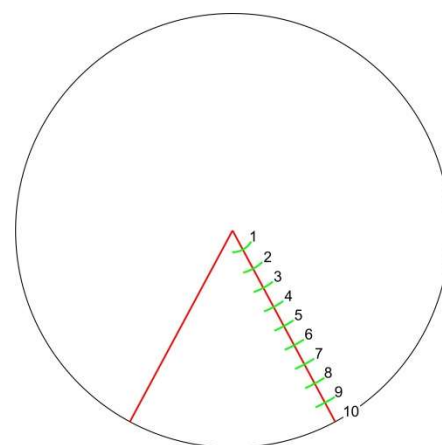
Once downloaded you can simply explore the function of this tool using two pieces of paper joined together with a pin. If you want something more durable you could glue the printout to some thin plywood, overlapping the material at the joint. If you're really keen, you could use the printout as a pattern to prick through the node points onto thicker wooden scales and join these with a half lap joint at the pivot, with a nut and bolt to join the two. Please note that the sector works at open angles of less than 90 degrees.

Underlying Geometry

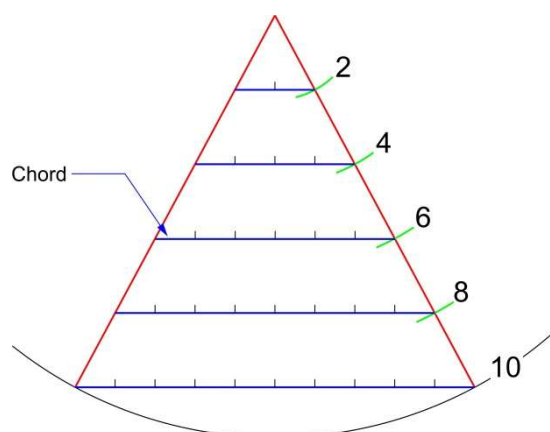
It's interesting to understand the geometrical principles at work here to enhance our understanding of the sector's use; the key thing to have in mind is that this tool is all about proportionality. The reason this tool is known as sector is that the pair of lines emanating from an origin point are effectively forming a sector of a circle, enclosed by the two red lines and a section of the circles circumference to the right.



If we step out one of those legs of the sector into equal parts as increasing radii (shown green), these effectively correspond to the markings provided on the 'line of lines' scale on the tool.



If we then strike some chords (shown blue) across from these lines of radii, we start to see the power of the sector (for clarity we've just used the even numbers here, but it could be any number). If we imagine the chord at the '2 radius' is 2 units long, when we step out that same module at the chord on the 8 radius we find that it is equal to 8 units. With this knowledge, we could therefore set our dividers to a dimension taken from real life, open the sector to allow us to set the '1 radius' to that dimension and we could then take off any multiple of that dimension we wanted along the scale. If we had a real-life dimension we wanted to divide into 5 equal parts we would set our dividers to the overall real-world dimension and use that to set the sector open to that dimension on the '5 radius' mark. If we re-set our dividers to the open width at the '1 radius' mark, this would be exactly one fifth of our original dimension, which we could then step out to divide the line into 5 equal parts.



There's no need to always use the '1' graduation when dividing and multiplying; sometimes it's easier to set a known number at 8 and we can then find half at 4, a quarter at 2 and so on – remember it's all about ratios.

If we take one key piece of information from this exercise, it is that there is a proportional relationship between the radius of a circle and the corresponding length of a chord of the sector; if we double the distance along the line of radius, we double the length of the chord of the sector drawn at that radius (and so on at any other radius). Knowing that, we can apply this logic to other proportional relationships, which is the very basis of the sector as a tool.

Using the sector

The face of the sector is marked with three key scales, which we use to take off our divider settings. Our sector is provided with a locking knob at the pivot, so once opened to a particular setting it is easily retained until you choose to change it.

Line of Lines

The line of lines is what I consider to be the core scale on the sector and the way it works is described in the section on underlying geometry.

- We can take a known dimension and increase it by a specified proportion, or in reverse we can also reduce it by a given proportion.
- We can use the line of lines to divide known dimensions into smaller parts.

Line of Circles

The line of circles allows us to take one known parameter of a circle and derive the other two, from radius, diameter and circumference. If we had a cylindrical box that was to be edge banded, by knowing the radius we could easily derive the circumference, telling us the length of edge banding needed.

Line of Polygons

The line of polygons gives us a side length for regular polygons of various numbers of sides that fit within the radius of any given circle, or vice versa. This particular line on the scale is using the same principles outlined in the 'underlying geometry' section, but also uses a very specific further piece of knowledge. This is that the sector of a circle we draw within a hexagon (a 6-sided shape) is an equilateral triangle. In an equilateral triangle all internal angles are 60 degrees and crucially the radius and the chord are of equal length.

Taking that knowledge, we know that at the '6 sides' graduation on our sectors scale, we have a point where radius equals chord length, so we can set the open width at this point to the radius of the circle we are interested in and know that this also equals chord length. The '6 sides' graduation is marked with a circle to remind us that is the key location. The line of polygons is set out proportionally for the numbers of sides for various polygons from 4 to 12-sided, so once the radius is set at the '6 sides' point, we can read off the length of side (chord length) for any of the other polygons that would fit within the same circle.

We can also reverse this logic, in that if we have a regular polygon where we know a side length, but wish to know the radius of a circle it would fit within, we can set the open width of the sector at the relevant number of sides on the scale then read the radius off at the '6 sides' graduation. If we want to facet the leg of a chair or table, simply by knowing the radius and the desired number of facets we can set our dividers to the relevant side length to set out the shape.

